



**CAROLINAS  
GEOTECHNICAL  
GROUP**

## **Structure Foundation Recommendations**

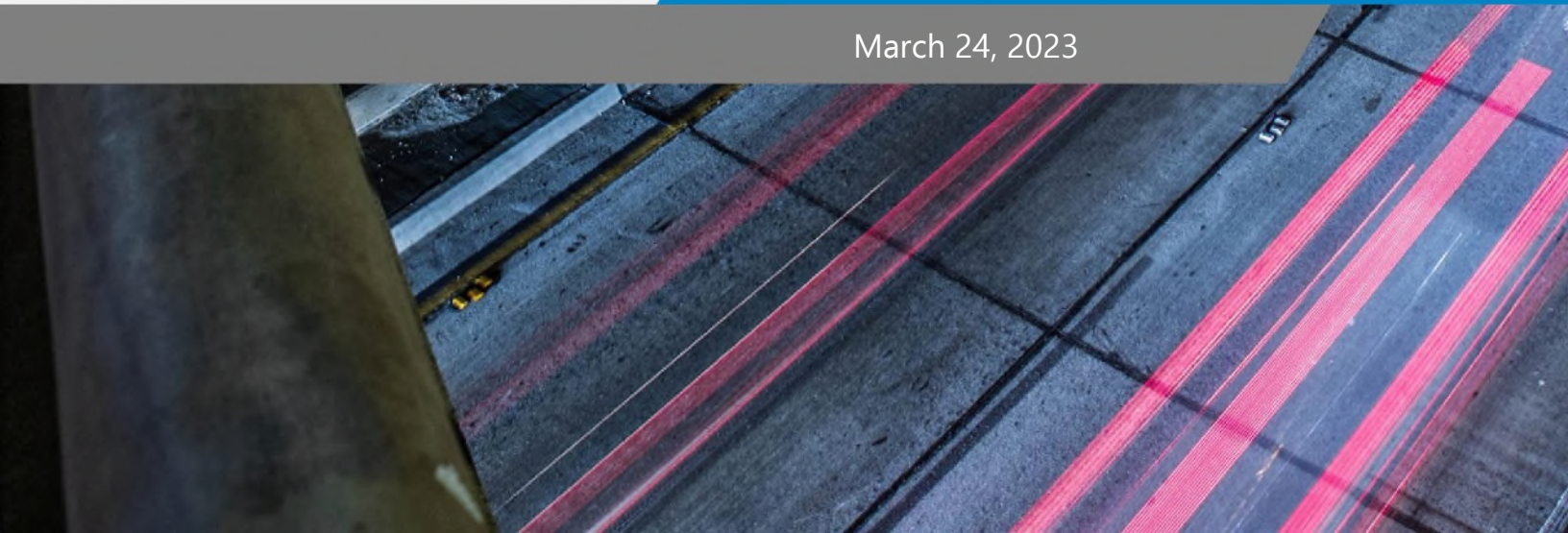
### **Prepared for:**

TGS Engineers, Inc.

201 West Marion Street, Suite 200

Shelby, North Carolina 28150

March 24, 2023





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Suite 800  
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March 24, 2023

Mr. Jimmy L. Terry, P.E.  
TGS Engineers, Inc.  
201 West Marion Street, Suite 200  
Shelby, North Carolina 28150

WBS ELEMENT: 00579838  
T.I.P. NO.: HS-2006Q  
I.D. NO.: SF-420015  
COUNTY: Harnett  
DESCRIPTION: Bridge No. 015 on SR 1532 (Langdon Road) over Black River

SUBJECT: Structure Foundation Recommendations

Dear Mr. Terry:

Carolinas Geotechnical Group, PLLC (CG2) has completed the Structure Foundation Recommendations for the proposed replacement of Bridge No. 420015 on SR 1532 (Langdon Road) over Black River in Harnett County, North Carolina. The Structure Foundation Recommendations are attached. The supporting calculations will be submitted under separate cover.

CG2 is pleased to have the opportunity to provide these services to you and looks forward to working with you on your project. If you have questions concerning the content of this letter, or if CG2 can be of further service, please contact CG2 at (980) 339-8684.

Sincerely,  
**Carolinas Geotechnical Group, PLLC**

DocuSigned by:  
*D. Matthew Brewer*  
386129C0A4C1462...  
D. Matthew Brewer, P.E.  
Senior Project Engineer

DocuSigned by:  
*Robert E. Kral*  
8AD703B2A8484F4...  
Robert E. Kral, P.E.  
Senior Project Engineer



**Structure Foundation Recommendations**

Bridge No. 015 on SR 1532 (Langdon Road) over Black River  
Harnett County, North Carolina

**ATTACHMENTS:**

- Foundation Recommendation Sheet(s)
  - Foundation Recommendations Notes on Plans Sheet(s)
  - Foundation Recommendations Comments Sheet(s)
  - Geotechnical Foundation Tables
-



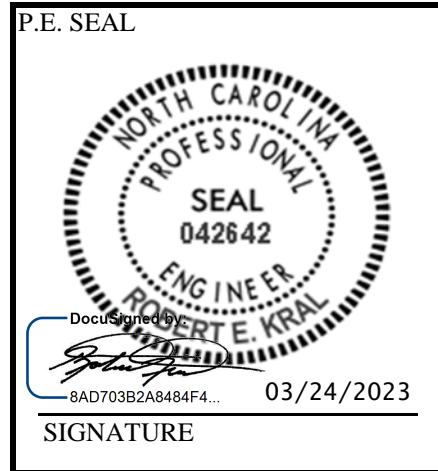
# FOUNDATION RECOMMENDATIONS

Prepared for NCDOT by: Carolinas Geotechnical Group, PLLC (CG2)

PROJECT 00579838  
 TIP NO. HS-2006Q  
 COUNTY Harnett  
 STATION 15+78.00 -L-

DESCRIPTION Bridge No. 015 on SR 1532  
(Langdon Road) over Black River

	INITIALS	DATE
DESIGN	REK	3/24/23
CHECK	DMB	3/24/23



	BENT STATION	FOUNDATION TYPE	FACTORED RESISTANCE	ADDITIONAL INFORMATION
END BENT 1	15+21.81 -L-	2'-6" Cap on HP 12 x 53 Steel H-Piles	71 Tons/Pile	Bottom of Cap Elev. = 217.40 ft Average Estimated Pile Length = 35 ft Number of Plumb Piles/Cap = 7 Pile Spacing = 6'-0"
BENT 1	15+78.00 -L-	Cap on 36 in. Diameter Drilled Pier	360 Tons/Pier	Bottom of Cap Elev. = 217.10 ft Point of Fixity Elev. = 186.00 ft Tip Elevation No Higher Than = 154.00 ft Number of Drilled Piers = 3 Drilled Pier Spacing = 13'-0"
END BENT 2	16+34.19 -L-	2'-6" Cap on HP 12 x 53 Steel H-Piles	71 Tons/Pile	Bottom of Cap Elev. = 217.40 ft Average Estimated Pile Length = 35 ft (LT) 40 ft (RT) Number of Piles/Cap = 7 Pile Spacing = 6'-0"

**(SEE NOTES ON PLANS AND COMMENTS ON FOLLOWING PAGES.)**

**FOUNDATION RECOMMENDATIONS NOTES ON PLANS**

1. FOR DRILED PIERS, SEE SECTION 411 OF THE STANDARD SPECIFICATIONS.
2. INSTALL PERMANENT STEEL CASINGS AT BENT NO. 1 BY VIBRATING, SCREWING OR DRIVING PERMANENT CASINGS BEFORE EXCAVATING OR DISTURBING ANY MATERIAL BELOW ELEVATION 203.0 FT.
3. FOR PILES, SEE PILES PROVISION AND SECTION 450 OF THE STANDARD SPECIFICATIONS.
4. IT HAS BEEN ESTIMATED THAT A HAMMER WITH AN EQUIVALENT RATED ENERGY IN THE RANGE OF 25,000 TO 35,000 FT-LBS PER BLOW WILL BE REQUIRED TO DRIVE PILES AT END BENT NO. 1 AND END BENT NO. 2. THIS ESTIMATED ENERGY RANGE DOES NOT RELEASE THE CONTRACTOR FROM PROVIDING DRIVING EQUIPMENT IN ACCORDANCE WITH SUBARTICLE 450-3(D)(2) OF THE STANDARD SPECIFICATIONS.

**FOUNDATION RECOMMENDATIONS COMMENTS**

1. USE TYPE II MODIFIED BRIDGE APPROACH FILL (STANDARD DRAWING 422.02) AT END BENT NO. 1 AND END BENT NO. 2.
2. 1.5:1 (H:V) OR FLATTER SLOPE AT BOTH END BENTS IS OK WITH RIP RAP SLOPE PROTECTION.
3. NO WAITING PERIOD IS REQUIRED AT EITHER END BENT PRIOR TO CONSTRUCTION.
4. PDA MAY BE REQUIRED TO MONITOR DRIVING STRESSES.
5. AVERAGE PILE LENGTHS ARE BASED ON PLUMB PILES FROM THE PILE CUTOFF ELEVATION TO THE ANTICIPATED TIP ELEVATION, ROUNDED UP TO THE NEAREST 5 FEET.
6. THE DESIGN SCOUR ELEVATION IS 203.0 FT AT BENT NO. 1.

**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 Length 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 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 1, Piles 1-7	71	218.40	35			120							
End Bent 2, Piles 1-3	71	218.40	35			120	7						
End Bent 2, Piles 4-7	71	218.40	40			120							

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

**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 1, Piles 1-7	71			0.60			1.00
End Bent 2, Piles 1-7	71			0.60			1.00

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

**SUMMARY OF DRILLED PIER INFORMATION/INSTALLATION**

(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No, Pier(s) #-# (e.g., "Bent 1, Piers 1-3")	Factored Resistance per Pier TONS	Minimum Pier Tip (Tip No Higher Than) Elevation FT	Required Tip Resistance per Pier TSF	Scour Critical Elevation FT	Minimum Drilled Pier Penetration Into Rock per Pier Lin FT	Drilled Pier Length per Pier Lin FT	Drilled Pier Length Not In Soil per Pier Lin FT	Drilled Pier Length In Soil per Pier Lin FT	Permanent Steel Casing Required? YES or MAYBE	Permanent Steel Casing Tip Elevation (Elev Not To Extend Casing Below) FT	Permanent Steel Casing Length* per Pier Lin FT
Bent 1, Piers 1-3	360	154.0	5	200.0		63.1			YES	195.0	22.1

\*Permanent Steel Casing Length equals the difference between the ground line or top of drilled pier elevation, whichever is higher, and the permanent casing tip elevation.

**SUMMARY OF PDA/PILE ORDER LENGTHS**

(Blank entries indicate item is not applicable to structure)

Pile Driving Analyzer (PDA)				Pile Order Lengths	
End Bent/ Bent No	PDA Testing Required? YES or MAYBE	PDA Test Pile Length FT	Total PDA Testing Quantity EACH	End Bent/ Bent No(s)	Pile Order Length Basis* EST or PDA
End Bent 1, Piles 1-7	MAYBE	40	1		
End Bent 2, Piles 1-3	MAYBE	40			
End Bent 2, Piles 4-7	MAYBE	45			

\*EST = Pile order lengths from estimated pile lengths; PDA = Pile order lengths based on PDA testing. For groups of end bents/bents with pile order lengths based on PDA testing, the first end bent/bent no. listed for each group is the representative end bent/bent with the PDA.

**SUMMARY OF DRILLED PIER TESTING**

(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No, Pier(s) #-# (e.g., "Bent 1, Piers 1-3")	Standard Penetration Test (SPT) Required? YES or MAYBE	Crosshole Sonic Logging (CSL) Required?*	Total CSL Tube Length (For All Tubes) per Pier Lin FT	Shaft Inspection Device (SID) Required? YES or MAYBE	Pile Integrity Test (PIT) Required? MAYBE
Bent 1, Piers 1-3	MAYBE	MAYBE	258	MAYBE	
<b>TOTAL QTY:</b>	1	1	775	1	

\*CSL Tubes are required if CSL Testing is or may be required. The number of CSL Tubes per drilled pier is equal to one tube per foot of design pier diameter with at least 4 tubes per pier. The length of each CSL Tube is equal to the drilled pier length plus 1.5 ft.


PROJECT NO. HS-2006Q

Harnett COUNTY

STATION: 15+78.00 -L-

**NOTES:**

- The Pile and Drilled Pier Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Robert E. Kral, P.E. No. 042642) on 3/24/2023.
- 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.
- The Engineer will determine the need for PDA Testing, SPTs, CSL Testing, and SID Inspections when these items may be required.
- For Drilled Piers, See Section 411 of the Standard Specifications.
- Install Permanent Steel Casing at Bent No. 1 by vibrating, screwing, or driving permanent casings before excavating or disturbing any material below elevation 203.0 ft.
- For Piles, See Piles Provision and Section 450 of the Standard Specifications.
- It has been estimated that a hammer with an equivalent rated energy in the range of 25,000 to 35,000 ft-lbs per blow will be required to drive piles at End Bent No. 1 and End Bent No. 2. This estimated energy range does not release the contractor from providing driving equipment in accordance with Subarticle 450-3(d)(2) of the Standard Specifications.

	STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RALEIGH			
	<b>PILE AND DRILLED PIER FOUNDATION TABLES</b>			
SIGNATURE _____	DATE _____	REVISIONS		SHEET NO.
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	NO. <u>1</u>	BY: _____	DATE: _____	NO. <u>3</u>
	NO. <u>2</u>	BY: _____	DATE: _____	NO. <u>4</u>
				TOTAL SHEETS