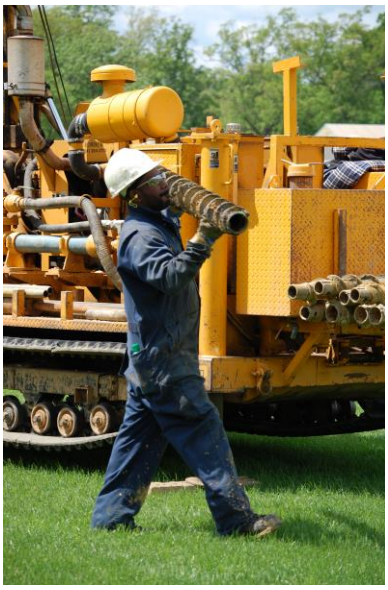
FROEHLING & ROBERTSON, INC.



SUBSURFACE INVESTIGATION AND BRIDGE FOUNDATION DESIGN RECOMMENDATIONS

WBS Element No. 45360.1.23 TIP No. BD-5114W
Structure No. 370011 – Bridge on NC 143B over Long Creek
Graham County, North Carolina
F&R PROJECT NO. 63P-0310-0011

Prepared for:

Vaughn & Melton Consulting Engineers
1318-F Patton Avenue
Asheville, North Carolina 28806

July 30, 2013

2505 Hutchison-McDonald Road Charlotte, North Carolina 28269 704.596.2889

SINCE 1881

FROEHLING & ROBERTSON, INC.

Engineering Stability Since 1881

2505 Hutchison-McDonald Road
Charlotte, North Carolina 28269
T 704.596.2889 | F 704.596.3784
NC License #F-0266

July 30, 2013

Mr. Hardy Willis, P.E.
Vaughn & Melton Consulting Engineers
1318-F Patton Avenue
Asheville, North Carolina 28806

Re: **Subsurface Investigation and Bridge Foundation Design Recommendations**
Bridge Structure No. 370011 on NC 143B over Long Creek
WBS Element No.: 45360.1.23
TIP No.: BD-5114W
County: Graham
F&R Project No.: 63P-0310-0011

Dear Mr. Willis,

Froehling & Robertson, Inc. (F&R) has completed the subsurface investigation and bridge foundation design recommendations for the new structure proposed on NC 143B over Long Creek. Our design is based on NCDOT standard loads and information provided to us by Vaughn & Melton. This work was performed in general accordance with F&R's Proposal No. 1363-164G, dated August 9, 2012. This report contains the foundation recommendations, NCDOT Legend Sheet, Site Location Plan, Boring Location Plan, Borelog Reports, Core Boring Reports, and supporting calculations.

Please do not hesitate to contact us if you have any questions regarding this report or if you need additional services.

Sincerely,

FROEHLING & ROBERTSON, INC.

NORTH CAROLINA PROFESSIONAL SEAL 026917 ENGINEER MICHAEL J. WALKO

7/30/13

Michael J. Walko, P.E.
Senior Engineer
N.C. Registration No. 26917

W. Patrick Alton, P.E.
Geotechnical Engineer

APPENDIX A

FOUNDATION RECOMMENDATIONS

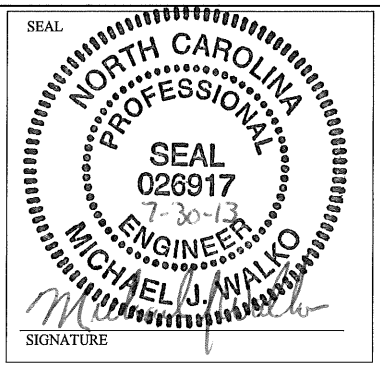
FOUNDATION RECOMMENDATIONS

WBS # 45360.1.23 DESCRIPTION Bridge 011 - NC 143B over Long Creek

T.I.P. NO. BD-5114W

COUNTY Graham

STATION 13+93.50 -L-



	INITIALS	DATE
DESIGN	MJW	Jul-13
CHECK	WPA	Jul-13
REVISED		

BENT	STATION	FOUNDATION TYPE	FACTORED RESISTANCE	MISCELLANEOUS DETAILS
END BENT 1	13+74.84	Cap on HP 12X53 Steel Piles	60 Tons/Pile	BOC Elevation = 2,085.6 ft Avg. Pile Length = 15 ft 7 vertical piles @ 6'-6" spacing Point of Fixity Elevation = 2,074 ft Minimum Tip Elevation = 2,072 ft
END BENT 2	14+12.21	Cap on HP 12X53 Steel Piles	60 Tons/Pile	BOC Elevation = 2,085.5 ft Avg. Pile Length = 15 ft 7 vertical piles @ 6'-6" spacing Point of Fixity Elevation = 2,077 ft Minimum Tip Elevation = 2,074 ft

NOTES ON PLANS & COMMENTS (See following page)

WBS # 45360.1.23 **County** Graham

FOUNDATION RECOMMENDATION NOTES ON PLANS

1) For Piles, see Section 450 of the Standard Specifications.

2) Piles at End Bent No. 1 and End Bent No. 2 are designed for a factored resistance of 60 tons per pile.

3) Drive piles at End Bent No. 1 and End Bent No. 2 to a required driving resistance of 100 tons per pile.

4) It has been estimated that a hammer with an equivalent rated energy in the range of 20 to 45 ft-kips per blow will be required to drive piles at End Bent No. 1 and End Bent No. 2. The estimated energy range does not release the contractor from providing driving equipment in accordance with Subarticle 450-3(D)(2) of the Standard Specifications.

5) Pile excavation is required to install piles at End Bent No. 1. Excavate holes at pile locations to elevation 2,072 ft. For pile excavation, see Section 450 of the Standard Specifications.

6) Install piles at End Bent No. 1 to a tip elevation no higher than 2,072 ft.

7) Pile excavation is required to install piles at End Bent No. 2. Excavate holes at pile locations to elevation 2,074 ft. For pile excavation, see Section 450 of the Standard Specifications.

8) Install piles at End Bent No. 2 to a tip elevation no higher than 2,074 ft.

9) Concrete is required to fill holes for pile excavation at End Bent No. 1 and End Bent No. 2.

10) The scour critical elevation for End Bent No. 1 is 2,081 ft. and 2,079 ft. for End Bent No. 2. Scour critical elevations are used to monitor possible scour problems during the life of the structure.

FOUNDATION RECOMMENDATION COMMENTS

1) PDA will not be used to monitor driving stresses

2) Rip rap slope protection is recommended on the bridge end slopes.

3) The sub-regional approach fill detail should be used at both end bents.

4) No waiting period is required at either end bent prior to construction.

PILE PAY ITEMS

(Revised 8/15/12)

WBS ELEMENT: 45360.1.23 — DATE: Jul-13

TIP NO.: BD-5114W — DESIGNED BY: MJW

COUNTY: Graham — CHECKED BY: WPA

STATION: 13+93.53 -L-

DESCRIPTION: Bridge No. 011 - NC 143B over Long Creek

NUMBER OF BENTS WITH PILES:

NUMBER OF PILES PER BENT:

NUMBER OF END BENTS WITH PILES: 2

NUMBER OF PILES PER END BENT: 7

Only required for "Predrilling for Piles" & "Pile Excavation" pay items

	PILE PAY ITEM QUANTITIES						
					Pile Excavation (per linear ft)		
Bent # or End Bent #	Steel Pile Points (yes/no)	Pipe Pile Plates (yes/no/maybe)	Predrilling For Piles (per linear ft)	Pile Redrives (per each)	In Soil	Not In Soil	PDA Testing (per each)
End Bent No. 1	No	No	0	0	59	37	
End Bent No. 2	No	No	0	0	44	38	
TOTALS			0	0	103	75	0

Notes:

Blanks or "no" represent quantity of zero.

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

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

Show quantity of "PDA Testing" on the plans as total only.

If quantity of "PDA Testing" is 3 or less, reference "Pile Driving Criteria" provision in PDA notes on plans and include "Pile Driving Criteria" provision in the contract.

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS HIGHWAY BUILDING 1589 MAIL SERVICE CENTER RALEIGH, NORTH CAROLINA 27699-1589	SUBJECT: Bridge 011 - NC 143B over Long Creek		WBS Element No. 45360.1.23
	PREPARED BY:	MJW	COUNTY: Graham
	DATE:	Jul-13	TIP No. BD-5114W
	CHECKED BY:	WPA	**Bridge Structure No. 370011**
	DATE:	Jul-13	

END BENTS SUMMARY

END BENT 1

Pile Type: HP 12X53 Steel Piles	
Bottom of Cap Elevation: 2,085.6 ft	Provided to us by Vaughn & Melton
Approx. Top of CR Elevation: 2,074.0 ft (Lt), 2,075.0 ft (Rt)	By inspection of EB1-A and EB1-B
Minimum Pile Tip Elevation: 2,072.0 ft.	L-Pile Analysis
Anticipated Pile Length: 15 ft ±	BOC Elev - Pile Tip Elevation + 1' Embed into Cap
Average Pile Length: 15 ft ±	Anticipated pile length rounded up to the nearest 5 feet
Pile Excavation In Soil: 59 ft.	
Pile Excavation Not In Soil: 37 ft.	Includes CR + 1/2 of WR depth, if encountered
Max Factored Load: 60 Tons/Pile	Standard NCDOT loads
Required Ultimate Resistance: 135 Tons/Pile	AASHTO Resistance Factor = 0.45
Required Driving Resistance: 100 Tons/Pile	Driving Resistance Factor = 0.6 for WEAP Analysis without PDA's.

END BENT 2

Pile Type: HP 12X53 Steel Piles	
Bottom of Cap Elevation: 2,085.5 ft	Provided to us by Vaughn & Melton
Approx. Top of CR Elevation: 2,079.5 ft (Lt), 2,078.0 ft (Rt)	By inspection of EB2-A and EB2-B
Minimum Pile Tip Elevation: 2,074.0 ft.	L-Pile Analysis
Anticipated Pile Length: 13 ft ±	BOC Elev - Pile Tip Elevation + 1' Embed into Cap
Average Pile Length: 15 ft ±	Anticipated pile length rounded up to the nearest 5 feet
Pile Excavation In Soil: 44 ft.	
Pile Excavation Not In Soil: 38 ft.	Includes CR + 1/2 of WR depth, if encountered
Max Factored Load: 60 Tons/Pile	Standard NCDOT loads
Required Ultimate Resistance: 135 Tons/Pile	AASHTO Resistance Factor = 0.45
Required Driving Resistance: 100 Tons/Pile	Driving Resistance Factor = 0.6 for WEAP Analysis without PDA's.

NOTES

1) See Notes on Sheet 2

COMMENTS

1) PDA will not be used to monitor driving stresses

2) Rip rap slope protection is recommended on the bridge end slopes.

3) The sub-regional approach fill detail should be used at both end bents.

4) No waiting period is required at either end bent prior to construction.

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS HIGHWAY BUILDING PO BOX 25201 RALEIGH, NORTH CAROLINA 27611	SUBJECT: Bridge 011 - NC 143B over Long Creek		WBS Element No. 45360.1.23
	PREPARED BY:	MJW	COUNTY: Graham
	DATE:	Jul-13	TIP # BD-5114W
	CHECKED BY:	WPA	**Bridge Structure No. 370011**
	DATE:	Jul-13	

SCOUR DETERMINATION

HYDRAULICS SCOUR ELEVATIONS

(Scour elevations provided by Vaughn & Melton from the Bridge Survey & Hydraulic Design Report dated 6/11/13)

END BENT #1	**2083.0**	ft
END BENT #2	**2081.6**	ft

DESIGN SCOUR ELEVATIONS

(Used the Hydraulic Scour elevation)

END BENT #1	**2083.0**	ft
END BENT #2	**2081.6**	ft

SCOUR CRITICAL ELEVATIONS

(Used 2 - 3 feet below the Hydraulic Scour elevation)

END BENT #1	**2081.0**	ft
END BENT #2	**2079.0**	ft

APPENDIX B

STRUCTURE SUBSURFACE INVESTIGATION REPORT

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	43560.1.23	1	13

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

STRUCTURE SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. *45360.1.23* F.A. PROJ. *N/A*

COUNTY *Graham*

PROJECT DESCRIPTION *Bridge No. 370011 on SR 1127 (NC HWY 143 BUS) over Long Creek*

CONTENTS

PERSONNEL

C. Boyce

S. Joyner

M. Hosseini

R. Kral, E.I.

INVESTIGATED BY *F&R, Inc.*

CHECKED BY *M. Walko, P.E.*

SUBMITTED BY *F&R, Inc.*

DATE *July 2013*

CAUTION NOTICE

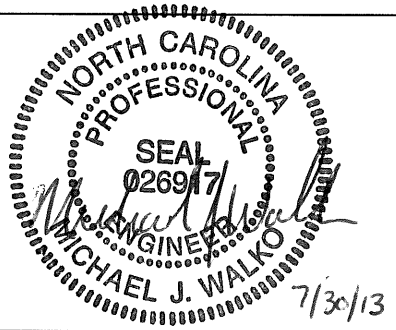
THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

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

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

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IT IS CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.



DRAWN BY: *M. Brewer, E.I.*

PROJECT REFERENCE NO.	SHEET NO.
45360.1.23-Structure 370011	2

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

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6			
SYMBOL														
% PASSING #10	50 MX											GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
#40	30 MX	50 MX	51 MN											
#200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN			
LIQUID LIMIT	6 MX		NP	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PLASTIC INDEX				10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

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

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.50
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	>30	>4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

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

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

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL - LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL - PLASTIC LIMIT		
OM - OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL - SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

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

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%
MODERATELY ORGANIC	5 - 10%	12 - 20%
HIGHLY ORGANIC	>10%	>20%

OTHER MATERIAL	
TRACE	1 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW - PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

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

SAMPLE DESIGNATIONS

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

ABBREVIATIONS

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

EQUIPMENT USED ON SUBJECT PROJECT

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

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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

REVISED 02/23/06

PROJECT REFERENCE NO.	SHEET NO.
45360.1.23-Structure 370011	2A

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

ROCK DESCRIPTION

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

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

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FEET
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	> 4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

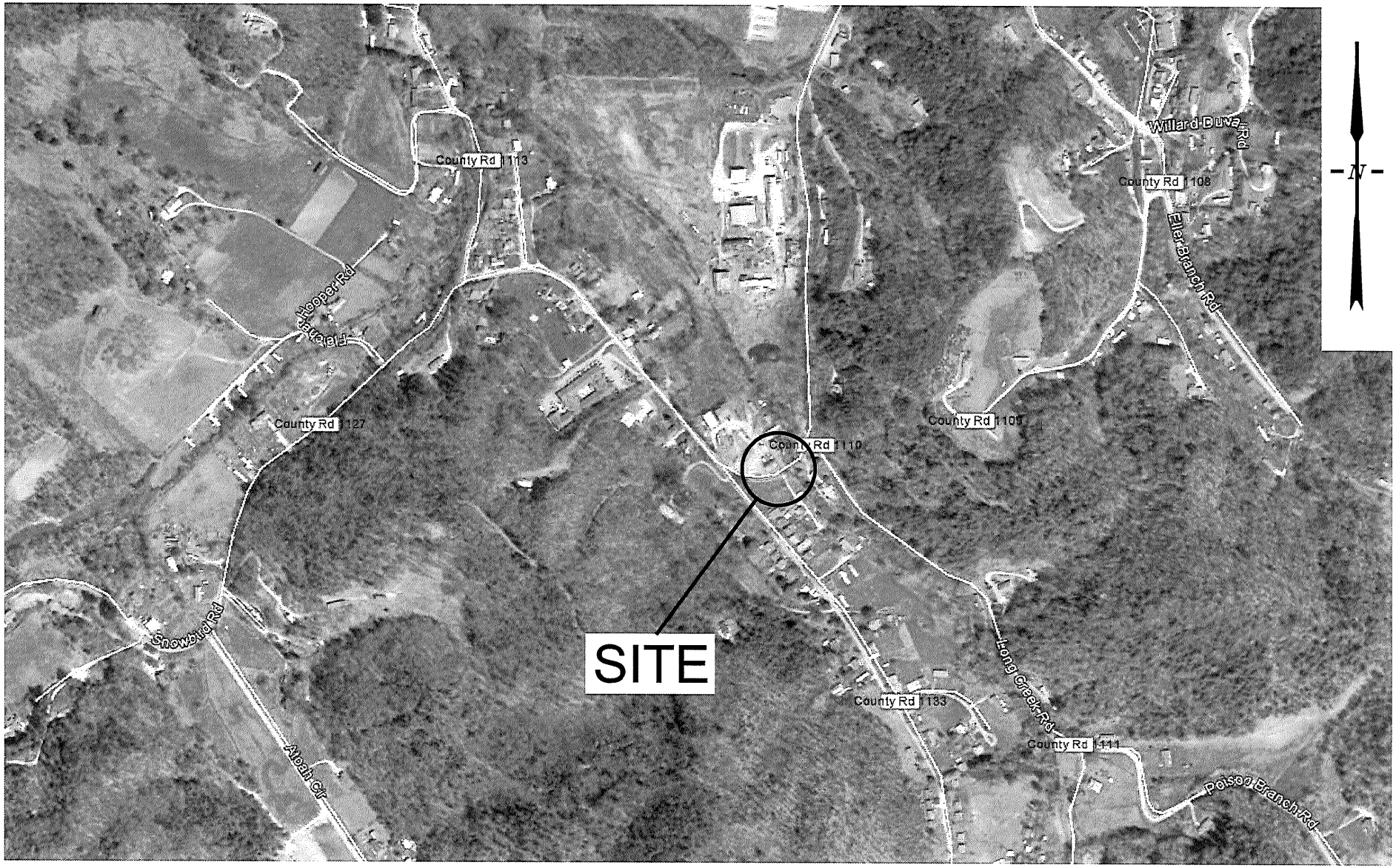
TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: SURVEY INFORMATION OBTAINED BY F&R, INC.

ELEVATION: - FT.

NOTES:

REVISED 02/23/06



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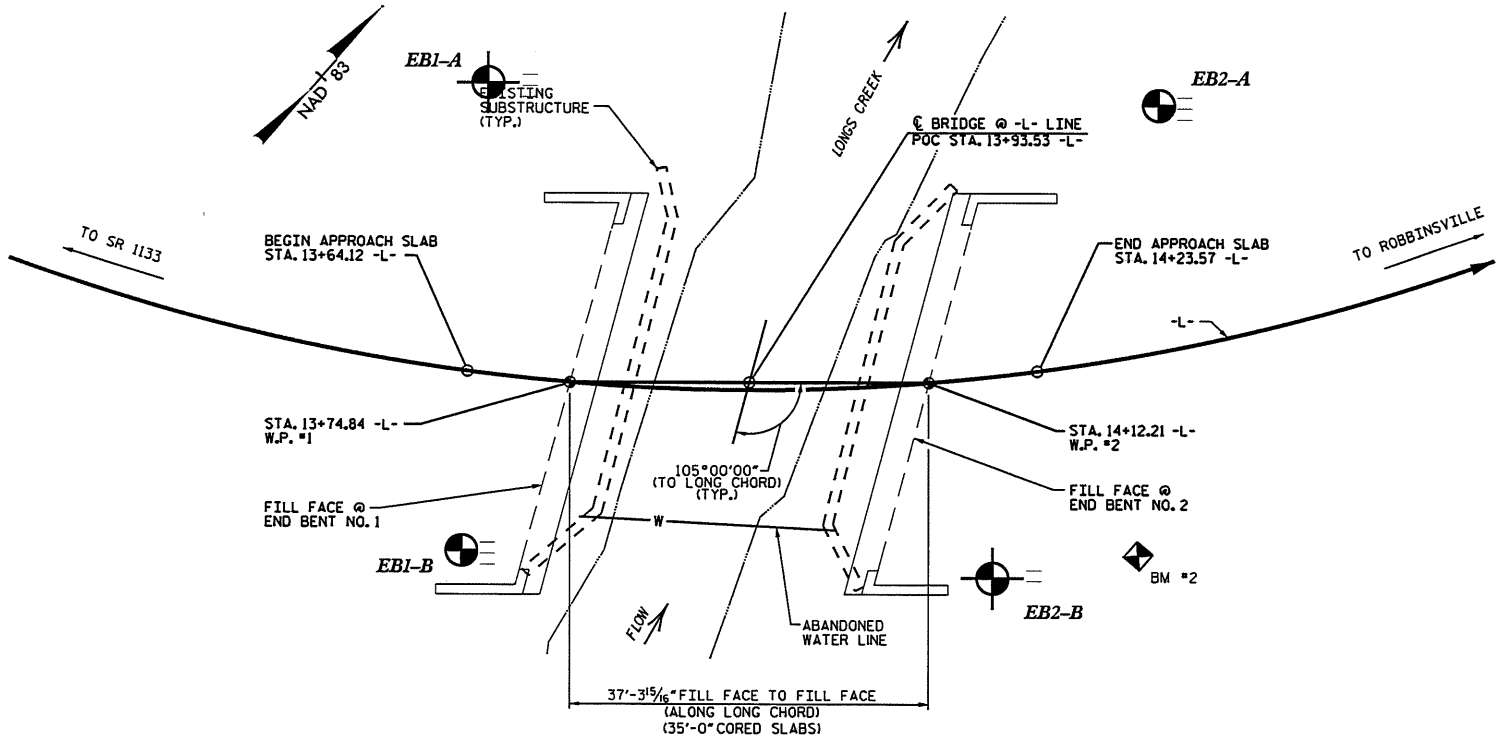
SITE LOCATION PLAN

PROJECT REFERENCE NO.: BD-5114W		F&R PROJECT NO.: 63P-0310-0011
I.D. NO.: N/A	F.A. PROJECT NO.: N/A	COUNTY: Graham
PROJECT DESCRIPTION: Bridge #011 on NC 143B over Longs Creek		
SITE DESCRIPTION: Bridge #011 on NC 143B over Longs Creek		SHEET No. 3
DRAWN BY: R. Kral	CHECKED BY: M. Walko, P.E.	
DATE: June 2013		

END BENT 1 END BENT 2

SECTION ALONG C/L SURVEY -L-

SECTIONS AT END BENTS ARE AT RIGHT ANGLES.



END BENTS ARE PARALLEL.
PILES NOT SHOWN IN PLAN VIEW FOR CLARITY.
CORED SLABS PARALLEL TO LONG CHORD.

PLAN ALONG C/L SURVEY -L-

SCALE (FEET)
0 10' 20'
1"=20'

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BORING LOCATION PLAN

PROJECT REFERENCE NO.: BD-5114W		F&R PROJECT NO.: 63P-0310
I.D. NO.: N/A	F.A. PROJECT NO.: N/A	COUNTY: Graham
PROJECT DESCRIPTION: Bridge #011 on NC 143B over Longs Creek		
SITE DESCRIPTION: Bridge #011 on NC 143B over Longs Creek		SHEET No. 4
DRAWN BY: R. Kral	CHECKED BY: M. Walko, P.E.	
DATE: June 2013	SCALE: 1" = 20'	

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral / J. Harris
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+62	**OFFSET** 30 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 27.0 ft	**NORTHING** 602,727	**EASTING** 564,329	**24 HR.** 6.0
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 04/22/13	**COMP. DATE** 04/22/13	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2095										
	2,091.0	0.0								2,091.0 GROUND SURFACE 0.0
2090			2	3	2	5		M		2,089.5 **ROADWAY EMBANKMENT** 1.5 Brown, silty fine to coarse SAND (A-2-4), with trace gravel.
	2,087.5	3.5	1	7	48	55		M		**COLLUVIAL** Orange and brown, fine to coarse sandy GRAVEL (A-1-a) with some cobbles.
2085										
	2,082.5	8.5	100/0.2			100/0.2				2,082.5 8.5 **WEATHERED ROCK** Tan and gray, (BIOTITE SCHIST).
2080										
	2,077.5	13.5	100/0.4			100/0.4				
2075										
	2,074.0	17.0	60/0.0			60/0.0				2,074.0 17.0 **CRYSTALLINE ROCK** Gray and Brown, (BIOTITE SCHIST).
2070										2,070.5 20.5 **CRYSTALLINE ROCK** Gray and brown, (METAGRAYWACKE).
2065										2,064.0 27.0 Boring Terminated at Elevation 2,064.0 ft In CRYSTALLINE ROCK (METAGRAYWACKE)

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral / J. Harris
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+62	**OFFSET** 30 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 27.0 ft	**NORTHING** 602,727	**EASTING** 564,329	**24 HR.** 6.0
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic	
DRILLER C. Boyce	**START DATE** 04/22/13	**COMP. DATE** 04/22/13	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ-2	**TOTAL RUN** 10.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
2074											Begin Coring @ 17.0 ft
	2,074.0	17.0	5.0	N=60/0.0 1:58/1.0 3:06/1.0 3:18/1.0 3:27/1.0	(4.4) 88%	(1.4) 28%		(2.9) 83%	(0.0) 0%		**CRYSTALLINE ROCK** 17.0 Gray and brown, slightly to moderately weathered, moderately hard to hard, (BIOTITE SCHIST), with very close to closely fracture spacing.
2070	2,070.5	20.5									
	2,069.0	22.0		3:21/1.0				(6.5) 100%	(5.7) 88%		**CRYSTALLINE ROCK** Gray and brown, very slightly to slightly weathered, moderately hard to hard, (METAGRAYWACKE), with very close to close fracture spacing.
			5.0	4:25/1.0 4:24/1.0 4:03/1.0 4:06/1.0	(5.0) 100%	(4.3) 86%					
2065	2,064.0	27.0		2:27/1.0							Boring Terminated at Elevation 2,064.0 ft In CRYSTALLINE ROCK (METAGRAYWACKE)

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 13+66	**OFFSET** 19 ft RT	**ALIGNMENT** -L-	**0 HR.** 6.0
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 602,688	**EASTING** 564,358	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 04/23/13	**COMP. DATE** 04/23/13	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2095										
	2,091.0	0.0								2,091.0 GROUND SURFACE 0.0
2090			3	3	3	6		M		2,089.5 **ROADWAY EMBANKMENT** 1.5 Tan and brown, silty fine to coarse SAND (A-2-4), with trace gravel.
	2,087.5	3.5	18	14	26	40		M		**COLLUVIAL** Tan and gray, fine to coarse sandy GRAVEL (A-1-a), with some cobbles.
2085								▽		
	2,082.5	8.5	4	4	16	20		W		
2080										
	2,077.5	13.5	100/0.8			100/0.8				2,077.5 13.5
2075	2,075.0	16.0	60/0.0			60/0.0				2,075.0 **WEATHERED ROCK** 16.0 Tan and gray, (BIOTITE SCHIST). Boring Terminated with Standard Penetration Test Refusal at Elevation 2,075.0 ft On CRYSTALLINE ROCK (BIOTITE SCHIST)

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral	
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 14+42	**OFFSET** 25 ft LT	**ALIGNMENT** -L-	**0 HR.** 6.0
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 11.5 ft	**NORTHING** 602,771	**EASTING** 564,383	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 04/15/13	**COMP. DATE** 04/15/13	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2095										
	2,091.0	0.0								2,091.0 GROUND SURFACE 0.0
2090			5	5	5	10		M		**ROADWAY EMBANKMENT** Brown, silty fine to coarse SAND (A-2-4), with little to some gravel.
	2,087.5	3.5	6	6	12	18		M		
2085								▽		
	2,082.5	8.5	22	41	59/0.2	100/0.7				2,082.0 9.0
2080	2,079.5	11.5	60/0.0			60/0.0				**WEATHERED ROCK** Orange and brown, (BIOTITE SCHIST). 2,079.5 11.5
										Boring Terminated with Standard Penetration Test Refusal at Elevation 2,079.5 ft On CRYSTALLINE ROCK (BIOTITE SCHIST)

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral / J. Harris
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 14+17	**OFFSET** 21 ft RT	**ALIGNMENT** -L-	**0 HR.** 6.0
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 23.0 ft	**NORTHING** 602,722	**EASTING** 564,402	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 04/23/13	**COMP. DATE** 04/23/13	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
2095										
	2,091.0	0.0								2,091.0 GROUND SURFACE 0.0
2090			2	3	3	6		M		**ROADWAY EMBANKMENT** Dark brown, silty fine to coarse SAND (A-2-4).
	2,087.5	3.5								2,087.5 3.5
			7	12	25	37		M		**RESIDUAL** Tan and brown, silty fine to coarse SAND (A-2-4), with some gravel-sized rock fragments.
2085										
	2,082.5	8.5								2,082.5 8.5
			15	16	13	29		M		Tan, brown and black, silty GRAVEL (A-1-a).
2080										
	2,078.0	13.0								2,078.0 13.0
			60/0.0			60/0.0				**CRYSTALLINE ROCK** Tan and gray, (METAGRAYWACKE).
2075										
2070										
										2,068.0 23.0
										Boring Terminated at Elevation 2,068.0 ft In CRYSTALLINE ROCK (METAGRAYWACKE)

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral / J. Harris	
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 14+17	**OFFSET** 21 ft RT	**ALIGNMENT** -L-	**0 HR.** 6.0
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 23.0 ft	**NORTHING** 602,722	**EASTING** 564,402	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic	
DRILLER C. Boyce	**START DATE** 04/23/13	**COMP. DATE** 04/23/13	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ-2	**TOTAL RUN** 10.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
2078											Begin Coring @ 13.0 ft
	2,078.0	13.0	5.0	*N=60/0.0* 3:40/1.0 3:18/1.0 2:14/1.0 1:37/1.0 2:19/1.0	(4.6) 92%	(1.8) 36%		(9.4) 94%	(6.4) 64%		2,078.0 **CRYSTALLINE ROCK** 13.0 Tan and gray, very slightly to moderately weathered, moderately hard to very hard, (METAGRAYWACKE), with very close to moderately close fracture spacing.
2075											
	2,073.0	18.0									
			5.0	3:28/1.0 3:44/1.0 3:38/1.0 3:02/1.0 3:09/1.0	(4.8) 96%	(4.6) 92%					
2070											
	2,068.0	23.0									2,068.0 23.0 Boring Terminated at Elevation 2,068.0 ft In CRYSTALLINE ROCK (METAGRAYWACKE)

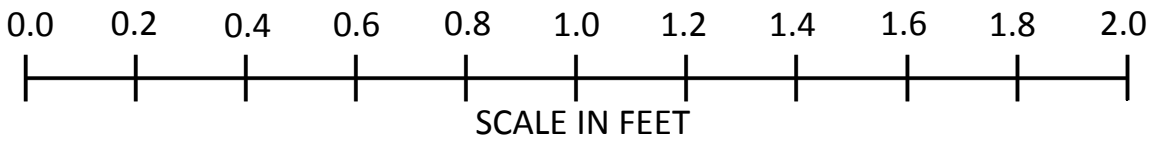
Bridge No. 3700011 on NC 143 B over Long Creek

CORE PHOTOGRAPHS: EB1-A: Station 13+62

Begin Run 1
17.0 feet

Begin Run 2
22.0 feet

End Run 2
27.0 feet



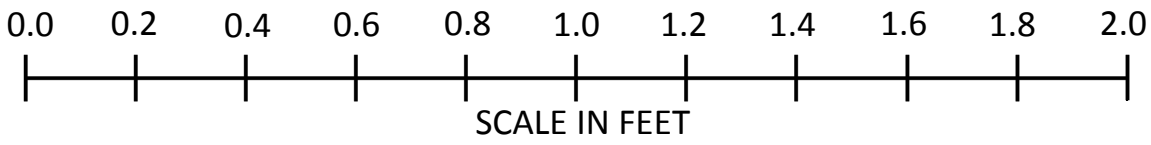
Bridge No. 3700011 on NC 143 B over Long Creek

CORE PHOTOGRAPHS: EB2-B: Station 14+17

Begin Run 1
13.0 feet

Begin Run 2
18.0 feet

End Run 2
23.0 feet



APPENDIX C

SUPPORTING CALCULATIONS

End Bent Geometry and Loads

Bridge Width	CS Unit Length	Factored Pile Reaction (kips)	Factored Pile Reaction (tons)
27'	25'-0"	106	53
	30'-0"	118	59
	35'-0"	126	63
	40'-0"	132	66
	45'-0"	140	70
	50'-0"	154	77
	55'-0"	162	81
	60'-0"	170	85
	65'-0"	178	89
	70'-0"	184	92
30'	25'-0"	110	55
	30'-0"	122	61
	35'-0"	132	66
	40'-0"	140	70
	45'-0"	148	74
	50'-0"	162	81
	55'-0"	170	85
	60'-0"	180	90
	65'-0"	188	94
	70'-0"	194	97
33'	25'-0"	92	46
	30'-0"	102	51
	35'-0"	110	55
	40'-0"	118	59
	45'-0"	122	61
	50'-0"	134	67
	55'-0"	142	71
	60'-0"	148	74
	65'-0"	156	78
	70'-0"	162	81
36' →	25'-0"	96	48
	30'-0"	108	54
	35'-0"	116	58
	40'-0"	122	61
	45'-0"	130	65
	50'-0"	142	71
	55'-0"	148	74
	60'-0"	156	78
	65'-0"	164	82
	70'-0"	170	85
39'	25'-0"	100	50
	30'-0"	112	56
	35'-0"	120	60
	40'-0"	126	63
	45'-0"	136	68
	50'-0"	146	73
	55'-0"	154	77
	60'-0"	162	81
	65'-0"	170	85
	70'-0"	176	88

Bridge 011
Per BSR, 1@35',
36' out to out, 105° Skew

Factored Load =
58 ton/pile. Round up to
nearest 5 ton = 60 ton/pile
for End Bent Analysis

Bridge Width	Skew	Cap Length	No. of Vertical Piles	Pile Spacing
27'	60/120	38'-2"	5	8'-6"
	75/105	34'-3"	5	7'-6"
	90	33'-0"	5	7'-6"
30'	60/120	41'-8"	5	9'-6"
	75/105	37'-4"	5	8'-3"
	90	36'-0"	5	8'-3"
33'	60/120	45'-2"	7	7'-0"
	75/105	40'-6"	7	6'-0"
	90	39'-0"	7	6'-0"
36' →	60/120	48'-7"	7	7'-6"
	75/105	43'-7"	7	6'-6"
	90	42'-0"	7	6'-6"
39'	60/120	52'-0"	7	8'-0"
	75/105	46'-8"	7	7'-0"
	90	45'-0"	7	7'-0"

7 piles at
6'-6" Spacing

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral / J. Harris
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 13+62	**OFFSET** 30 ft LT	**ALIGNMENT** -L- — **0 HR.** N/A
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 27.0 ft	**NORTHING** 602,727	**EASTING** 564,329 — **24 HR.** 6.0
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 04/22/13	**COMP. DATE** 04/22/13	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
						BOC = 2085.6' Scour = 2083.0'				ELEV. (ft) DEPTH (ft)
2095										
	2,091.0	0.0								2,091.0 GROUND SURFACE 0.0
2090			2	3	2	5		M		2,089.5 **ROADWAY EMBANKMENT** 1.5 Brown, silty fine to coarse SAND (A-2-4), with trace gravel.
	2,087.5	3.5						M		**COLLUVIAL** Orange and brown, fine to coarse sandy GRAVEL (A-1-a) with some cobbles.
2085			1	7	48	55 BOC				
	2,082.5	8.5				Scour				2,082.5 8.5
2080			100/0.2			100/0.2				**WEATHERED ROCK** Tan and gray, (BIOTITE SCHIST).
	2,077.5	13.5	100/0.4			100/0.4				
2075	2,074.0	17.0								2,074.0 17.0
			60/0.0			60/0.0				**CRYSTALLINE ROCK** Gray and Brown, (BIOTITE SCHIST).
2070										2,070.5 20.5
										CRYSTALLINE ROCK Gray and brown, (METAGRAYWACKE).
2065										2,064.0 27.0
										Boring Terminated at Elevation 2,064.0 ft In CRYSTALLINE ROCK (METAGRAYWACKE)

BOC = 2085.6'. Per L-Pile Set Min Tip @ Elev 2072 ft to Account for Scour. Pile Excavation is Required

L = BOC - Tip EL + 1.0 Embed

= 2085.6 - 2072.0 + 1.0

= 14.6 ft

Anticipated Pile Length = 15'

Ave Pile Length = 15'

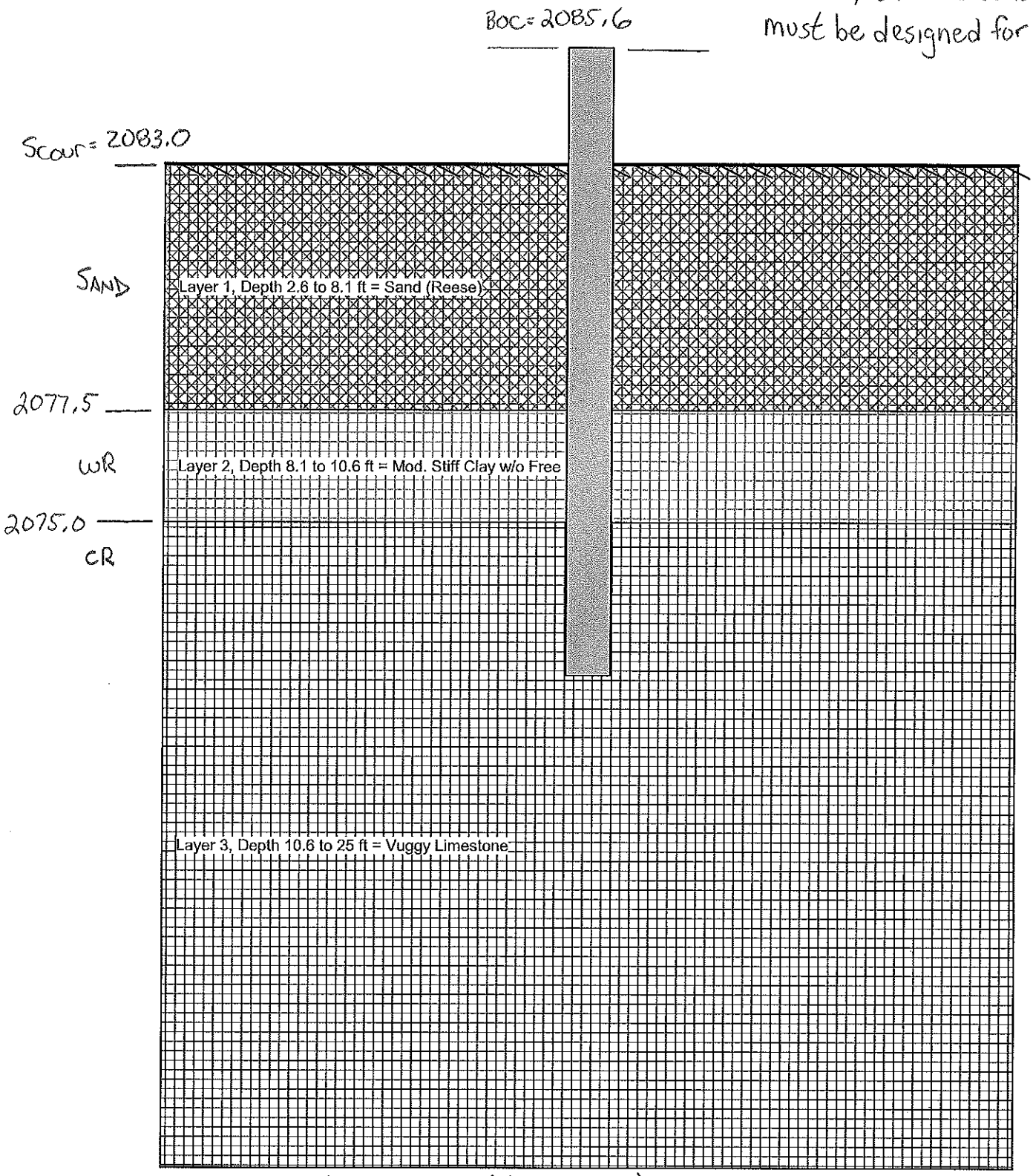
NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	**TIP** BD-5114W	**COUNTY** Graham	**GEOLOGIST** R. Kral
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 13+66	**OFFSET** 19 ft RT	**ALIGNMENT** -L-	**0 HR.** 6.0
COLLAR ELEV. 2,091.0 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 602,688	**EASTING** 564,358	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 04/23/13	**COMP. DATE** 04/23/13	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2095						BOC = 2085.6'				
	2,091.0	0.0	3	3	3	6		M		2,091.0 GROUND SURFACE 0.0
2090										2,089.5 **ROADWAY EMBANKMENT** 1.5 Tan and brown, silty fine to coarse SAND (A-2-4), with trace gravel.
	2,087.5	3.5	18	14	26	40		M		**COLLUVIAL** Tan and gray, fine to coarse sandy GRAVEL (A-1-a), with some cobbles.
2085						BOC				
	2,082.5	8.5	4	4	16	Scour 20		W		
2080										
	2,077.5	13.5	100/0.8			100/0.8				2,077.5 13.5 **WEATHERED ROCK** Tan and gray, (BIOTITE SCHIST).
2075	2,075.0	16.0	60/0.0			60/0.0				2,075.0 16.0 Boring Terminated with Standard Penetration Test Refusal at Elevation 2,075.0 ft On CRYSTALLINE ROCK (BIOTITE SCHIST)

END Bent 1

Per BSR, the end bent piles must be designed for scour

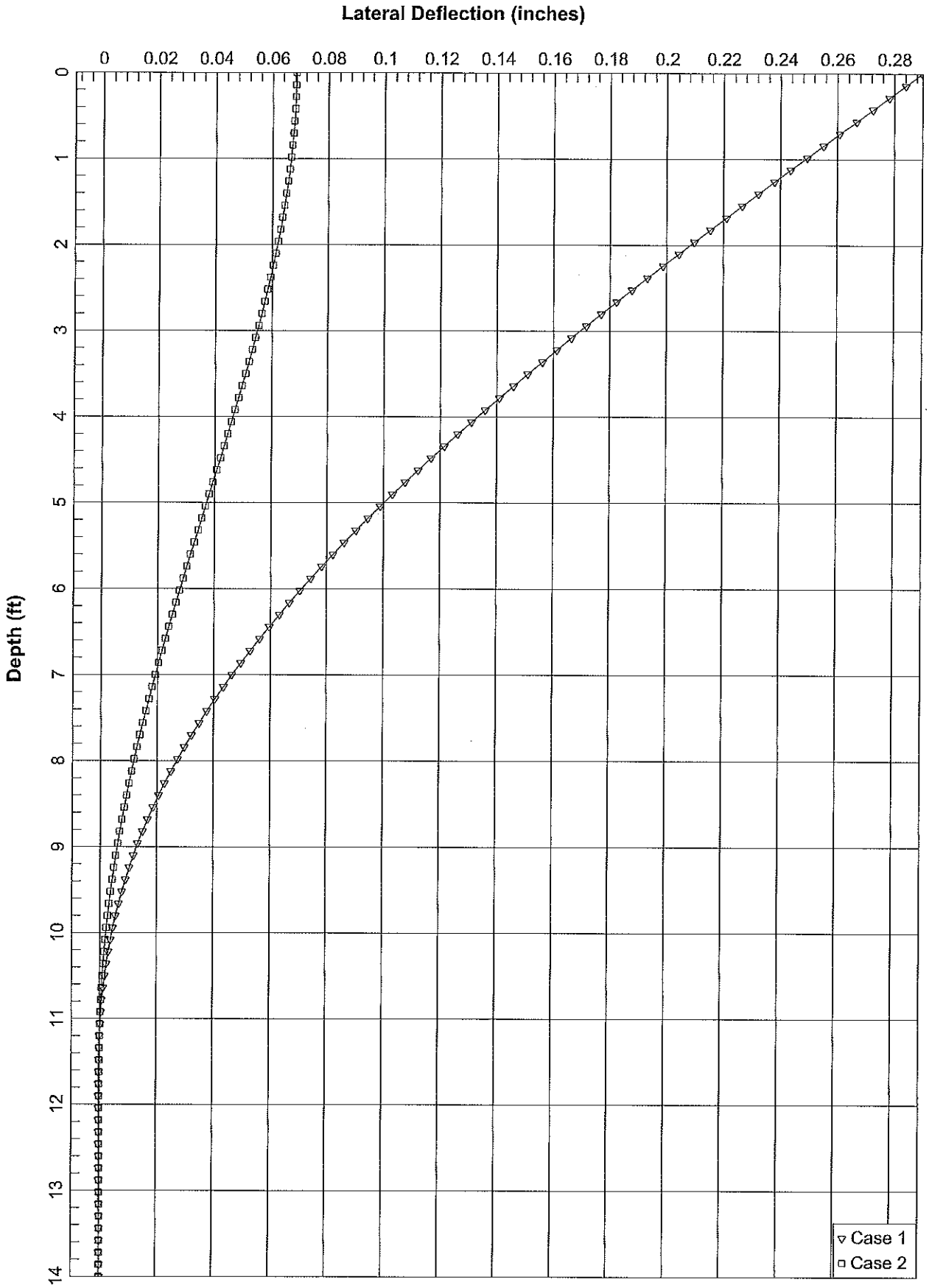


① $\delta = 0.29''$ 1ST Neg = 11.2' (EL = 2074.4) POF = 2074 ft
MAX Neg = 11.9' (EL = 2073.7)

② $\delta = 0.07''$ 1ST Neg = 11.3' (EL = 2074.3) POF = 2074 ft
MAX Neg = 11.9' (EL = 2073.7)

Set MIN Tip Elevation to a depth below where curve crosses back to zero.

SAY MIN TIP ELEV. = 2072 ft


Lateral Deflection (inches)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Case 1
Case 2

LPile Plus for Windows, Version 2012-06.034

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

This copy of LPile is licensed to:

testt
test

Serial Number of Security Device: 293783516
Company Name Stored in Security Device: Froehling & Robertson, Inc.

Files Used for Analysis

Path to file locations: E:\Lpile 2012\Branch63\Division 14 Vaughn and Melton\
Name of input data file: Graham 011 EB-1.lp6d
Name of output report file: Graham 011 EB-1.lp6o
Name of plot output file: Graham 011 EB-1.lp6p
Name of runtime messeage file: Graham 011 EB-1.lp6r

Date and Time of Analysis

Date: July 18, 2013 Time: 15:18:28

Problem Title

Project Name: Division 14 - Bridge 011

Job Number: 63P-0310-0011

Client: Vaughn & Melton Engineers

Engineer: F&R

Description: Bridge 011 - End Bent 1 Lateral Analysis

Program Options

Engineering units are US Customary Units: pounds, inches, feet

Basic Program Options:

This analysis computes pile response to lateral loading and will compute nonlinear moment-curvature and nominal moment capacity for section types with nonlinear properties.

Computation Options:
- Analysis does not use p-y multipliers (individual pile or shaft only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix values
- Report pile response for full length of pile
- Analysis assumes no loading by soil movements acting on pile
- No p-y curves to be computed and reported for user-specified depths

Solution Control Parameters:

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

Pile Response Output Options:
- 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

Pile Structural Properties and Geometry

Total number of pile sections = 1

Total length of pile = 14.00 ft

Depth of ground surface below top of pile = 2.60 ft

Pile diameter values 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.

Point	Depth X ft	Pile Diameter in
1	0.00000	12.0450000
2	14.000000	12.0450000

Input Structural Properties:

Pile Section No. 1:

Section Type	=	Elastic Pile	
Cross-sectional Shape	=	Strong H-Pile	
Section Length	=	14.00000000	ft
Flange Width	=	12.04500000	in
Section Depth	=	11.78000000	in
Flange Thickness	=	0.43500000	in
Web Thickness	=	0.43500000	in
Section Area	=	15.50000000	Sq. in
Moment of Inertia	=	393.00000000	in^4
Elastic Modulus	=	29000000.	lbs/in^2

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	=	2.60000 ft
Distance from top of pile to bottom of layer	=	8.10000 ft
Effective unit weight at top of layer	=	57.60000 pcf
Effective unit weight at bottom of layer	=	57.60000 pcf
Friction angle at top of layer	=	30.00000 deg.
Friction angle at bottom of layer	=	30.00000 deg.
Subgrade k at top of layer	=	60.00000 pci
Subgrade k at bottom of layer	=	60.00000 pci

Layer 2 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	8.10000 ft
Distance from top of pile to bottom of layer	=	10.60000 ft
Effective unit weight at top of layer	=	100.00000 pcf
Effective unit weight at bottom of layer	=	100.00000 pcf
Undrained cohesion at top of layer	=	8000.00000 psf
Undrained cohesion at bottom of layer	=	8000.00000 psf
Epsilon-50 at top of layer	=	0.00400
Epsilon-50 at bottom of layer	=	0.00400
Subgrade k at top of layer	=	2000.00000 pci
Subgrade k at bottom of layer	=	2000.00000 pci

Layer 3 is strong rock (vuggy limestone)

Distance from top of pile to top of layer	=	10.60000 ft
Distance from top of pile to bottom of layer	=	25.00000 ft
Effective unit weight at top of layer	=	160.00000 pcf
Effective unit weight at bottom of layer	=	160.00000 pcf
Uniaxial compressive strength at top of layer	=	4000.00000 psi
Uniaxial compressive strength at bottom of layer	=	4000.00000 psi

(Depth of lowest soil layer extends 11.00 ft below pile tip)

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

Values entered for effective unit weights of soil were outside
the limits of 0.011574 pci (20 pcf) or 0.0810019 pci (140 pcf)
This data may be erroneous. Please check your data.

Summary of Soil Properties

Layer Num.	Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	Strain Factor Epsilon 50	kpy pci
1	Sand (Reese, et al.)	2.600	57.600	--	30.000	--	--	60.000
		8.100	57.600	--	30.000	--	--	60.000
2	Stiff Clay w/o Free Water, using k	8.100	100.000	8000.000	--	--	0.00400	2000.000
		10.600	100.000	8000.000	--	--	0.00400	2000.000
3	Vuggy Limestone	10.600	160.000	--	--	4000.000	--	--
		25.000	160.000	--	--	4000.000	--	--

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 = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 5000.00000 lbs	M = 0.0000 in-lbs	120000.	No
2	2	V = 5000.00000 lbs	S = 0.0000 in/in	120000.	No

Note: These are Assumed Loads

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust 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

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

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 5000.000 lbs
Applied moment at pile head = 0.000 in-lbs
Axial thrust load on pile head = 120000.000 lbs

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/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2898	-2.690E-06	5000.0000	-0.003445	7741.9355	1.140E+10	0.000	0.000	0.000
0.140	0.2840	9094.5008	5000.0000	-0.003444	7881.3035	1.140E+10	0.000	0.000	0.000
0.280	0.2782	18189.	5000.0000	-0.003442	8020.6674	1.140E+10	0.000	0.000	0.000
0.420	0.2724	27282.	5000.0000	-0.003439	8160.0230	1.140E+10	0.000	0.000	0.000
0.560	0.2667	36375.	5000.0000	-0.003434	8299.3661	1.140E+10	0.000	0.000	0.000
0.700	0.2609	45467.	5000.0000	-0.003428	8438.6927	1.140E+10	0.000	0.000	0.000
0.840	0.2551	54558.	5000.0000	-0.003421	8577.9986	1.140E+10	0.000	0.000	0.000
0.980	0.2494	63646.	5000.0000	-0.003412	8717.2797	1.140E+10	0.000	0.000	0.000
1.120	0.2437	72733.	5000.0000	-0.003402	8856.5318	1.140E+10	0.000	0.000	0.000
1.260	0.2380	81818.	5000.0000	-0.003391	8995.7507	1.140E+10	0.000	0.000	0.000
1.400	0.2323	90900.	5000.0000	-0.003378	9134.9324	1.140E+10	0.000	0.000	0.000
1.540	0.2266	99980.	5000.0000	-0.003364	9274.0727	1.140E+10	0.000	0.000	0.000
1.680	0.2210	109057.	5000.0000	-0.003348	9413.1674	1.140E+10	0.000	0.000	0.000
1.820	0.2154	118130.	5000.0000	-0.003332	9552.2125	1.140E+10	0.000	0.000	0.000
1.960	0.2098	127200.	5000.0000	-0.003314	9691.2038	1.140E+10	0.000	0.000	0.000
2.100	0.2042	136266.	5000.0000	-0.003294	9830.1372	1.140E+10	0.000	0.000	0.000
2.240	0.1987	145328.	5000.0000	-0.003273	9969.0085	1.140E+10	0.000	0.000	0.000
2.380	0.1932	154386.	5000.0000	-0.003251	10108.	1.140E+10	0.000	0.000	0.000
2.520	0.1878	163439.	5000.0000	-0.003228	10247.	1.140E+10	0.000	0.000	0.000
2.660	0.1824	172488.	4998.6150	-0.003203	10385.	1.140E+10	-1.6489	15.1876	0.000
2.800	0.1770	181526.	4992.4202	-0.003177	10524.	1.140E+10	-5.7259	54.3380	0.000
2.940	0.1717	190543.	4979.1786	-0.003150	10662.	1.140E+10	-10.0379	98.2068	0.000
3.080	0.1664	199526.	4958.5846	-0.003121	10800.	1.140E+10	-14.4787	146.1369	0.000
3.220	0.1612	208462.	4930.4499	-0.003091	10937.	1.140E+10	-19.0150	198.1341	0.000
3.360	0.1561	217339.	4894.7040	-0.003059	11073.	1.140E+10	-23.5397	253.4026	0.000
3.500	0.1510	226142.	4851.4485	-0.003027	11207.	1.140E+10	-27.9548	311.1234	0.000
3.640	0.1459	234860.	4800.9126	-0.002993	11341.	1.140E+10	-32.2070	370.8729	0.000
3.780	0.1409	243480.	4743.3609	-0.002958	11473.	1.140E+10	-36.3069	432.9179	0.000
3.920	0.1360	251990.	4679.1787	-0.002921	11604.	1.140E+10	-40.1005	495.5210	0.000
4.060	0.1311	260380.	4608.9418	-0.002883	11732.	1.140E+10	-43.5148	557.7134	0.000
4.200	0.1263	268639.	4533.0468	-0.002844	11859.	1.140E+10	-46.8364	623.1607	0.000
4.340	0.1215	276758.	4451.7680	-0.002804	11983.	1.140E+10	-49.9240	690.1783	0.000
4.480	0.1168	284727.	4365.6742	-0.002763	12105.	1.140E+10	-52.5685	755.8235	0.000
4.620	0.1122	292540.	4275.5167	-0.002720	12225.	1.140E+10	-54.7619	819.6704	0.000
4.760	0.1077	300190.	4181.6842	-0.002676	12342.	1.140E+10	-56.9435	888.2010	0.000
4.900	0.1032	307670.	4084.5889	-0.002632	12457.	1.140E+10	-58.6462	954.2683	0.000
5.040	0.0989	314975.	3985.0683	-0.002586	12569.	1.140E+10	-59.8308	1016.7050	0.000
5.180	0.0946	322102.	3883.7971	-0.002539	12678.	1.140E+10	-60.7302	1078.9736	0.000
5.320	0.0903	329048.	3781.2560	-0.002491	12784.	1.140E+10	-61.3425	1140.8291	0.000
5.460	0.0862	335811.	3678.1682	-0.002442	12888.	1.140E+10	-61.3811	1196.4311	0.000
5.600	0.0821	342391.	3575.5230	-0.002392	12989.	1.140E+10	-60.8156	1244.0175	0.000
5.740	0.0782	348790.	3473.1971	-0.002341	13087.	1.140E+10	-61.0010	1311.2889	0.000
5.880	0.0743	355005.	3370.8713	-0.002289	13182.	1.140E+10	-60.8154	1375.7677	0.000
6.020	0.0705	361039.	3269.2795	-0.002236	13275.	1.140E+10	-60.1274	1433.5897	0.000
6.160	0.0668	366892.	3169.2751	-0.002183	13364.	1.140E+10	-58.9255	1483.0660	0.000
6.300	0.0631	372567.	3071.7253	-0.002128	13451.	1.140E+10	-57.2052	1522.3618	0.000
6.440	0.0596	378071.	2977.4975	-0.002073	13536.	1.140E+10	-54.9707	1549.5184	0.000
6.580	0.0562	383408.	2887.4440	-0.002017	13617.	1.140E+10	-52.2358	1562.4910	0.000
6.720	0.0528	388586.	2800.0337	-0.001960	13697.	1.140E+10	-51.8242	1648.2095	0.000
6.860	0.0496	393606.	2712.7296	-0.001902	13774.	1.140E+10	-52.1092	1765.7172	0.000
7.000	0.0464	398467.	2625.1220	-0.001844	13848.	1.140E+10	-52.1856	1888.1455	0.000
7.140	0.0434	403170.	2537.5644	-0.001785	13920.	1.140E+10	-52.0497	2015.5404	0.000

7.280	0.0404	407713.	2450.4153	-0.001725	13990.	1.140E+10	-51.6993	2147.9375	0.000
7.420	0.0376	412098.	2364.0356	-0.001664	14057.	1.140E+10	-51.1337	2285.3596	0.000
7.560	0.0348	416327.	2278.7860	-0.001603	14122.	1.140E+10	-50.3538	2427.8155	0.000
7.700	0.0322	420402.	2194.4952	-0.001542	14184.	1.140E+10	-49.9924	2608.1627	0.000
7.840	0.0297	424322.	2110.5718	-0.001479	14244.	1.140E+10	-49.9163	2827.0054	0.000
7.980	0.0272	428090.	2026.9131	-0.001417	14302.	1.140E+10	-49.6773	3064.8414	0.000
8.120	0.0249	431704.	1801.2258	-0.001353	14358.	1.140E+10	-218.9981	14774.	0.000
8.260	0.0227	434687.	1385.6850	-0.001289	14403.	1.140E+10	-275.6933	20418.	0.000
8.400	0.0206	436880.	886.0250	-0.001225	14437.	1.140E+10	-319.1400	26063.	0.000
8.540	0.0186	438159.	323.5833	-0.001161	14456.	1.140E+10	-350.4335	31708.	0.000
8.680	0.0167	438435.	-282.1448	-0.001096	14461.	1.140E+10	-370.6714	37353.	0.000
8.820	0.0149	437652.	-913.5062	-0.001031	14449.	1.140E+10	-380.9492	42998.	0.000
8.960	0.0132	435782.	-1554.6824	-0.000967	14420.	1.140E+10	-382.3558	48642.	0.000
9.100	0.0116	432819.	-2191.6750	-0.000903	14375.	1.140E+10	-375.9687	54287.	0.000
9.240	0.0102	428782.	-2812.2823	-0.000840	14313.	1.140E+10	-362.8495	59932.	0.000
9.380	0.008814	423708.	-3406.0691	-0.000777	14235.	1.140E+10	-344.0396	65577.	0.000
9.520	0.007561	417650.	-3964.3295	-0.000715	14142.	1.140E+10	-320.5561	71222.	0.000
9.660	0.006412	410676.	-4480.0425	-0.000654	14035.	1.140E+10	-293.3880	76866.	0.000
9.800	0.005365	402861.	-4947.8228	-0.000594	13916.	1.140E+10	-263.4932	82511.	0.000
9.940	0.004417	394291.	-5363.8649	-0.000535	13784.	1.140E+10	-231.7951	88156.	0.000
10.080	0.003567	385054.	-5725.8848	-0.000478	13643.	1.140E+10	-199.1809	93801.	0.000
10.220	0.002813	375244.	-6033.0564	-0.000422	13492.	1.140E+10	-166.4995	99446.	0.000
10.360	0.002151	364953.	-6285.9465	-0.000367	13335.	1.140E+10	-134.5601	105090.	0.000
10.500	0.001580	354271.	-6486.4474	-0.000314	13171.	1.140E+10	-104.1315	110735.	0.000
10.640	0.001096	343285.	-10257.	-0.000263	13003.	1.140E+10	-4384.9950	6720000.	0.000
10.780	0.000698	319913.	-16285.	-0.000214	12644.	1.140E+10	-2790.7852	6720000.	0.000
10.920	0.000378	288654.	-19901.	-0.000169	12165.	1.140E+10	-1513.4734	6720000.	0.000
11.060	0.000131	253115.	-21610.	-0.000129	11621.	1.140E+10	-522.0954	6720000.	0.000
11.200	-5.464E-05	216095.	-21865.	-9.429E-05	11053.	1.140E+10	218.5530	6720000.	0.000
11.340	-0.000186	179685.	-21056.	-6.512E-05	10496.	1.140E+10	745.1429	6720000.	0.000
11.480	-0.000273	145373.	-19511.	-4.116E-05	9969.6979	1.140E+10	1093.7409	6720000.	0.000
11.620	-0.000325	114144.	-17502.	-2.203E-05	9491.1276	1.140E+10	1298.3356	6720000.	0.000
11.760	-0.000347	86576.	-15244.	-7.239E-06	9068.6605	1.140E+10	1389.8618	6720000.	0.000
11.900	-0.000349	62928.	-12904.	3.780E-06	8706.2678	1.140E+10	1395.6281	6720000.	0.000
12.040	-0.000335	43217.	-10607.	1.160E-05	8404.2096	1.140E+10	1339.0596	6720000.	0.000
12.180	-0.000310	27284.	-8440.7109	1.680E-05	8160.0484	1.140E+10	1239.6814	6720000.	0.000
12.320	-0.000278	14849.	-6464.2264	1.990E-05	7969.4930	1.140E+10	1113.2763	6720000.	0.000
12.460	-0.000243	5556.2526	-4712.4584	2.141E-05	7827.0819	1.140E+10	972.1618	6720000.	0.000
12.600	-0.000206	-993.1615	-3202.3861	2.175E-05	7757.1551	1.140E+10	825.5434	6720000.	0.000
12.740	-0.000170	-5212.5324	-1937.8064	2.129E-05	7821.8146	1.140E+10	679.9087	6720000.	0.000
12.880	-0.000135	-7512.7740	-913.5555	2.035E-05	7857.0644	1.140E+10	539.4375	6720000.	0.000
13.020	-0.000102	-8290.2838	-119.0449	1.918E-05	7868.9793	1.140E+10	406.4083	6720000.	0.000
13.160	-7.040E-05	-7920.5003	458.8747	1.799E-05	7863.3126	1.140E+10	281.5913	6720000.	0.000
13.300	-4.116E-05	-6755.7183	833.6922	1.691E-05	7845.4630	1.140E+10	164.6201	6720000.	0.000
13.440	-1.359E-05	-5126.1119	1017.6195	1.603E-05	7820.4902	1.140E+10	54.3409	6720000.	0.000
13.580	1.272E-05	-3342.9813	1020.5431	1.541E-05	7793.1648	1.140E+10	-50.8604	6720000.	0.000
13.720	3.819E-05	-1703.2998	849.5101	1.504E-05	7768.0376	1.140E+10	-152.7503	6720000.	0.000
13.860	6.324E-05	-494.6901	508.7194	1.487E-05	7749.5163	1.140E+10	-252.9529	6720000.	0.000
14.000	8.817E-05	0.000	0.000	1.484E-05	7741.9355	1.140E+10	-352.6655	3360000.	0.000

1ST NEG → 11.200

MAX NEG → 11.900

Zero → 13.440

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

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.2897876 inches
Computed slope at pile head	=	-0.0034449 radians
Maximum bending moment	=	438435. inch-lbs
Maximum shear force	=	-21865. lbs
Depth of maximum bending moment	=	104.1600000 inches below pile head
Depth of maximum shear force	=	134.4000000 inches below pile head
Number of iterations	=	8
Number of zero deflection points	=	2

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

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

Shear force at pile head = 5000.000 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 120000.000 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/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.0684	-298422.	5000.0000	0.000	12315.	1.140E+10	0.000	0.000	0.000
0.140	0.0683	-290018.	5000.0000	-4.337E-05	12186.	1.140E+10	0.000	0.000	0.000
0.280	0.0682	-281605.	5000.0000	-8.550E-05	12057.	1.140E+10	0.000	0.000	0.000
0.420	0.0681	-273184.	5000.0000	-0.000126	11928.	1.140E+10	0.000	0.000	0.000
0.560	0.0678	-264754.	5000.0000	-0.000166	11799.	1.140E+10	0.000	0.000	0.000
0.700	0.0675	-256317.	5000.0000	-0.000204	11670.	1.140E+10	0.000	0.000	0.000
0.840	0.0671	-247872.	5000.0000	-0.000242	11540.	1.140E+10	0.000	0.000	0.000
0.980	0.0667	-239419.	5000.0000	-0.000278	11411.	1.140E+10	0.000	0.000	0.000
1.120	0.0662	-230960.	5000.0000	-0.000312	11281.	1.140E+10	0.000	0.000	0.000
1.260	0.0656	-222493.	5000.0000	-0.000346	11152.	1.140E+10	0.000	0.000	0.000
1.400	0.0650	-214020.	5000.0000	-0.000378	11022.	1.140E+10	0.000	0.000	0.000
1.540	0.0644	-205541.	5000.0000	-0.000409	10892.	1.140E+10	0.000	0.000	0.000
1.680	0.0637	-197056.	5000.0000	-0.000438	10762.	1.140E+10	0.000	0.000	0.000
1.820	0.0629	-188564.	5000.0000	-0.000467	10632.	1.140E+10	0.000	0.000	0.000
1.960	0.0621	-180067.	5000.0000	-0.000494	10501.	1.140E+10	0.000	0.000	0.000
2.100	0.0612	-171565.	5000.0000	-0.000520	10371.	1.140E+10	0.000	0.000	0.000
2.240	0.0603	-163058.	5000.0000	-0.000545	10241.	1.140E+10	0.000	0.000	0.000
2.380	0.0594	-154546.	5000.0000	-0.000568	10110.	1.140E+10	0.000	0.000	0.000
2.520	0.0584	-146029.	5000.0000	-0.000590	9979.7425	1.140E+10	0.000	0.000	0.000
2.660	0.0574	-137508.	4998.9752	-0.000611	9849.1610	1.140E+10	-1.2200	35.6935	0.000
2.800	0.0564	-128986.	4994.4085	-0.000631	9718.5696	1.140E+10	-4.2166	125.6490	0.000
2.940	0.0553	-120472.	4984.6903	-0.000649	9588.1018	1.140E+10	-7.3526	223.3606	0.000
3.080	0.0542	-111976.	4969.6589	-0.000666	9457.8972	1.140E+10	-10.5419	326.7748	0.000
3.220	0.0531	-103505.	4949.1878	-0.000682	9328.0976	1.140E+10	-13.8285	437.8045	0.000
3.360	0.0519	-95071.	4923.1989	-0.000697	9198.8489	1.140E+10	-17.1108	553.8141	0.000
3.500	0.0507	-86683.	4891.7712	-0.000710	9070.2970	1.140E+10	-20.3031	672.4541	0.000
3.640	0.0495	-78349.	4855.0858	-0.000722	8942.5838	1.140E+10	-23.3699	792.8413	0.000
3.780	0.0483	-70078.	4813.3346	-0.000733	8815.8457	1.140E+10	-26.3340	916.0253	0.000
3.920	0.0471	-61880.	4766.8011	-0.000743	8690.2146	1.140E+10	-29.0631	1037.6053	0.000
4.060	0.0458	-53762.	4715.9280	-0.000751	8565.8124	1.140E+10	-31.5001	1155.4480	0.000
4.200	0.0445	-45732.	4661.0373	-0.000759	8442.7482	1.140E+10	-33.8460	1276.8748	0.000
4.340	0.0433	-37795.	4602.3694	-0.000765	8321.1270	1.140E+10	-35.9967	1398.2157	0.000
4.480	0.0420	-29959.	4540.3809	-0.000770	8201.0455	1.140E+10	-37.7992	1513.3574	0.000
4.620	0.0407	-22229.	4475.6566	-0.000774	8082.5853	1.140E+10	-39.2536	1621.7211	0.000
4.760	0.0394	-14609.	4408.4382	-0.000776	7965.8127	1.140E+10	-40.7682	1740.0367	0.000
4.900	0.0381	-7103.7720	4338.9813	-0.000778	7850.7967	1.140E+10	-41.9186	1850.5511	0.000
5.040	0.0367	283.5271	4267.9234	-0.000779	7746.2804	1.140E+10	-42.6741	1950.9645	0.000
5.180	0.0354	7550.3744	4195.8988	-0.000778	7857.6406	1.140E+10	-43.0694	2041.7083	0.000
5.320	0.0341	14695.	4123.5260	-0.000776	7967.1347	1.140E+10	-43.0887	2120.7856	0.000
5.460	0.0328	21718.	4051.5026	-0.000774	8074.7583	1.140E+10	-42.6535	2182.6486	0.000
5.600	0.0315	28620.	3980.6049	-0.000770	8180.5273	1.140E+10	-41.7485	2224.2149	0.000
5.740	0.0302	35404.	3910.8365	-0.000765	8284.4775	1.140E+10	-41.3091	2294.6802	0.000
5.880	0.0290	42069.	3842.0461	-0.000760	8386.6249	1.140E+10	-40.5842	2354.1445	0.000
6.020	0.0277	48619.	3774.7785	-0.000753	8486.9978	1.140E+10	-39.4963	2396.1768	0.000
6.160	0.0264	55056.	3709.6383	-0.000745	8585.6403	1.140E+10	-38.0515	2418.4629	0.000
6.300	0.0252	61384.	3647.2140	-0.000737	8682.6119	1.140E+10	-36.2631	2418.7321	0.000
6.440	0.0240	67608.	3588.0655	-0.000727	8777.9871	1.140E+10	-34.1517	2394.8480	0.000
6.580	0.0227	73733.	3532.7110	-0.000717	8871.8544	1.140E+10	-31.7465	2344.9275	0.000
6.720	0.0215	79767.	3479.7756	-0.000705	8964.3151	1.140E+10	-31.2719	2437.9581	0.000
6.860	0.0204	85710.	3427.1417	-0.000693	9055.3868	1.140E+10	-31.3875	2588.1126	0.000
7.000	0.0192	91561.	3374.4198	-0.000680	9145.0620	1.140E+10	-31.3766	2742.5448	0.000

7.140	0.0181	97322.	3321.8238	-0.000666	9233.3384	1.140E+10	-31.2377	2901.1652	0.000
7.280	0.0170	102991.	3269.5689	-0.000651	9320.2194	1.140E+10	-30.9704	3063.8674	0.000
7.420	0.0159	108570.	3217.8708	-0.000636	9405.7139	1.140E+10	-30.5750	3230.5264	0.000
7.560	0.0148	114060.	3166.9432	-0.000619	9489.8366	1.140E+10	-30.0531	3400.9968	0.000
7.700	0.0138	119461.	3116.5909	-0.000602	9572.6075	1.140E+10	-29.8902	3633.8345	0.000
7.840	0.0128	124774.	3066.3034	-0.000584	9654.0312	1.140E+10	-29.9759	3927.6129	0.000
7.980	0.0119	129999.	3015.9539	-0.000565	9734.1016	1.140E+10	-29.9640	4245.9716	0.000
8.120	0.0109	135136.	2910.1063	-0.000546	9812.8167	1.140E+10	-96.0451	14774.	0.000
8.260	0.0100	139997.	2727.1168	-0.000526	9887.3163	1.140E+10	-121.7996	20418.	0.000
8.400	0.009156	144511.	2505.4905	-0.000505	9956.4840	1.140E+10	-142.0412	26063.	0.000
8.540	0.008326	148619.	2254.1779	-0.000483	10019.	1.140E+10	-157.1405	31708.	0.000
8.680	0.007533	152280.	1981.4959	-0.000461	10076.	1.140E+10	-167.4809	37353.	0.000
8.820	0.006777	155463.	1695.1085	-0.000438	10124.	1.140E+10	-173.4565	42998.	0.000
8.960	0.006060	158152.	1402.0099	-0.000415	10166.	1.140E+10	-175.4703	48642.	0.000
9.100	0.005383	160341.	1108.5119	-0.000392	10199.	1.140E+10	-173.9320	54287.	0.000
9.240	0.004745	162035.	820.2345	-0.000368	10225.	1.140E+10	-169.2555	59932.	0.000
9.380	0.004147	163245.	542.0995	-0.000344	10244.	1.140E+10	-161.8576	65577.	0.000
9.520	0.003589	163995.	278.3285	-0.000320	10255.	1.140E+10	-152.1554	71222.	0.000
9.660	0.003072	164310.	32.4434	-0.000296	10260.	1.140E+10	-140.5650	76866.	0.000
9.800	0.002596	164223.	-192.7306	-0.000271	10259.	1.140E+10	-127.4994	82511.	0.000
9.940	0.002160	163771.	-395.0591	-0.000247	10252.	1.140E+10	-113.3678	88156.	0.000
10.080	0.001765	162995.	-573.0902	-0.000223	10240.	1.140E+10	-98.5739	93801.	0.000
10.220	0.001411	161936.	-726.0450	-0.000199	10224.	1.140E+10	-83.5151	99446.	0.000
10.360	0.001096	160636.	-853.8065	-0.000175	10204.	1.140E+10	-68.5819	105090.	0.000
10.500	0.000822	159138.	-956.9073	-0.000152	10181.	1.140E+10	-54.1572	110735.	0.000
10.640	0.000586	157482.	-2972.4225	-0.000128	10155.	1.140E+10	-2345.2658	6720000.	0.000
10.780	0.000390	149202.	-6252.8309	-0.000106	10028.	1.140E+10	-1559.9822	6720000.	0.000
10.920	0.000231	136515.	-8338.1115	-8.480E-05	9833.9508	1.140E+10	-922.4948	6720000.	0.000
11.060	0.000105	121220.	-9466.0054	-6.581E-05	9599.5670	1.140E+10	-420.2360	6720000.	0.000
11.200	9.514E-06	104736.	-9850.9700	-4.915E-05	9346.9521	1.140E+10	-38.0552	6720000.	0.000
11.340	-6.009E-05	88141.	-9681.0198	-3.494E-05	9092.6435	1.140E+10	240.3768	6720000.	0.000
11.480	-0.000108	72222.	-9116.6445	-2.312E-05	8848.6915	1.140E+10	431.4986	6720000.	0.000
11.620	-0.000138	57518.	-8291.2792	-1.356E-05	8623.3696	1.140E+10	551.0792	6720000.	0.000
11.760	-0.000153	44368.	-7312.8784	-6.046E-06	8421.8567	1.140E+10	613.6836	6720000.	0.000
11.900	-0.000158	32949.	-6266.2205	-3.474E-07	8246.8663	1.140E+10	632.3377	6720000.	0.000
12.040	-0.000155	23314.	-5215.6404	3.799E-06	8099.2106	1.140E+10	618.3528	6720000.	0.000
12.180	-0.000145	15423.	-4207.9542	6.654E-06	7978.2891	1.140E+10	581.2736	6720000.	0.000
12.320	-0.000132	9172.6849	-3275.3946	8.467E-06	7882.5016	1.140E+10	528.9164	6720000.	0.000
12.460	-0.000117	4414.5855	-2438.4275	9.469E-06	7809.5865	1.140E+10	467.4729	6720000.	0.000
12.600	-0.000100	975.7505	-1708.3588	9.866E-06	7756.8883	1.140E+10	401.6565	6720000.	0.000
12.740	-8.372E-05	-1329.4781	-1089.6736	9.840E-06	7762.3090	1.140E+10	334.8735	6720000.	0.000
12.880	-6.735E-05	-2689.5203	-582.0776	9.544E-06	7783.1508	1.140E+10	269.4074	6720000.	0.000
13.020	-5.165E-05	-3289.1070	-182.2267	9.103E-06	7792.3392	1.140E+10	206.6056	6720000.	0.000
13.160	-3.677E-05	-3305.4724	114.8539	8.617E-06	7792.5900	1.140E+10	147.0618	6720000.	0.000
13.300	-2.270E-05	-2906.6724	314.6514	8.159E-06	7786.4786	1.140E+10	90.7924	6720000.	0.000
13.440	-9.351E-06	-2251.5335	422.3348	7.779E-06	7776.4389	1.140E+10	37.4022	6720000.	0.000
13.580	3.439E-06	-1490.7638	442.1963	7.503E-06	7764.7806	1.140E+10	-13.7576	6720000.	0.000
13.720	1.586E-05	-768.7794	377.3496	7.337E-06	7753.7166	1.140E+10	-63.4408	6720000.	0.000
13.860	2.809E-05	-225.8273	229.6750	7.263E-06	7745.3962	1.140E+10	-112.3624	6720000.	0.000
14.000	4.027E-05	0.000	0.000	7.247E-06	7741.9355	1.140E+10	-161.0602	3360000.	0.000

1st NEG →

→

MAX NEG →

→ Zero

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

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.0683790 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-298422. inch-lbs
Maximum shear force	=	-9850.9699895 lbs
Depth of maximum bending moment	=	0.000000 inches below pile head
Depth of maximum shear force	=	134.4000000 inches below pile head
Number of iterations	=	7
Number of zero deflection points	=	2

Summary of Pile Response(s)

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	1	V = 5000.0000	M = 0.000	120000.	0.28978763	438435.	-21865.	-0.00344494
2	2	V = 5000.0000	S = 0.000	120000.	0.06837904	-298422.	-9850.9700	0.00000000

The analysis ended normally.

SINCE 1881

FROEHLING & ROBERTSON, INC.
Engineering • Environmental • Geotechnical

SHEET NO. 1 OF 1

JOB Bridge 011 - GRAHAM
DATE July 2013

COMPUTATIONS FOR Pile Excavation Qty EB-1
BY MJW CHKD

END BENT 1 — 7 piles (3.5 Lt, 3.5 Rt)

BOC = 2085.6', Tip = 2072.0'

EB1-A

Soil = 2085.6 - 2082.5 = 3.1'

WR = 2082.5 - 2074.0 = 8.5'

CR = 2074.0 - 2072.0 = 2.0'

use 1/2 WR As "In Soil" AND 1/2 WR As "Not In Soil"

- In Soil = 3.1 + 4.3 = 7.4' x 3.5 = 25.9' = 26'
- Not In Soil = 4.3 + 2.0 = 6.3' x 3.5 = 22.1' = 22'

EB1-B

Soil = 2085.6 - 2077.5 = 8.1'

WR = 2077.5 - 2075.0 = 2.5'

CR = 2075.0 - 2072.0 = 3.0'

- In Soil = 8.1 + 1.3 = 9.4' x 3.5 = 32.9' = 33'
- Not In Soil = 1.3 + 3.0 = 4.3' x 3.5 = 15.0' = 15'

FOR END BENT 1

Total In Soil = 26' + 33' = 59'

Total Not In Soil = 22' + 15' = 37'

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	TIP BD-5114W	COUNTY Graham	GEOLOGIST R. Kral
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			GROUND WTR (ft)
BORING NO. EB2-A	STATION 14+42	OFFSET 25 ft LT	ALIGNMENT -L-	0 HR. 6.0
COLLAR ELEV. 2,091.0 ft	TOTAL DEPTH 11.5 ft	NORTHING 602,771	EASTING 564,383	24 HR. Dry
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 04/15/13	COMP. DATE 04/15/13	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
						Boc = 2085.5'				ELEV. (ft) DEPTH (ft)
2095										
	2,091.0	0.0								2,091.0 GROUND SURFACE 0.0
2090			5	5	5	10		M		**ROADWAY EMBANKMENT** Brown, silty fine to coarse SAND (A-2-4), with little to some gravel.
	2,087.5	3.5	6	6	12	18		M		
2085						Boc				
	2,082.5	8.5	22	41	59/0.2	Scour				2,082.0 9.0
2080	2,079.5	11.5	60/0.0			100/0.7 60/0.0				**WEATHERED ROCK** Orange and brown, (BIOTITE SCHIST). 2,079.5 11.5
										Boring Terminated with Standard Penetration Test Refusal at Elevation 2,079.5 ft On CRYSTALLINE ROCK (BIOTITE SCHIST)

Boc = 2085.5'. Per L-Pile, Set MinTip @ Elev 2074' to Account for Scour. Pile Excavation is Required

L = Boc - TipEL + 1.0 Embed

= 2085.5 - 2074.0 + 1.0

= 12.5'

Anticipated Pile Length = 13'

Ave. Pile Length = 15'

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 45360.1.23	TIP BD-5114W	COUNTY Graham	GEOLOGIST R. Kral / J. Harris
SITE DESCRIPTION Bridge No. 370011 on NC 143B over Long Creek			GROUND WTR (ft)
BORING NO. EB2-B	STATION 14+17	OFFSET 21 ft RT	ALIGNMENT -L-	0 HR. 6.0
COLLAR ELEV. 2,091.0 ft	TOTAL DEPTH 23.0 ft	NORTHING 602,722	EASTING 564,402	24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE F&R3763 CME-550X 82% 10/5/2012		DRILL METHOD NW Casing W/SPT & Core	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 04/23/13	COMP. DATE 04/23/13	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2095						BOC = 2085.5'				
	2,091.0	0.0	2	3	3	6		M		2,091.0 GROUND SURFACE 0.0
2090										**ROADWAY EMBANKMENT** Dark brown, silty fine to coarse SAND (A-2-4).
	2,087.5	3.5	7	12	25	37 BOC		M		2,087.5 3.5
2085										**RESIDUAL** Tan and brown, silty fine to coarse SAND (A-2-4), with some gravel-sized rock fragments.
	2,082.5	8.5	15	16	13	29 Scour		M		2,082.5 8.5
2080										Tan, brown and black, silty GRAVEL (A-1-a).
	2,078.0	13.0	60/0.0			60/0.0				2,078.0 13.0
2075										**CRYSTALLINE ROCK** Tan and gray, (METAGRAYWACKE).
2070										2,068.0 23.0
										Boring Terminated at Elevation 2,068.0 ft In CRYSTALLINE ROCK (METAGRAYWACKE)

END BENT 2

Per BSR, end bent piles
Must be designed for scour

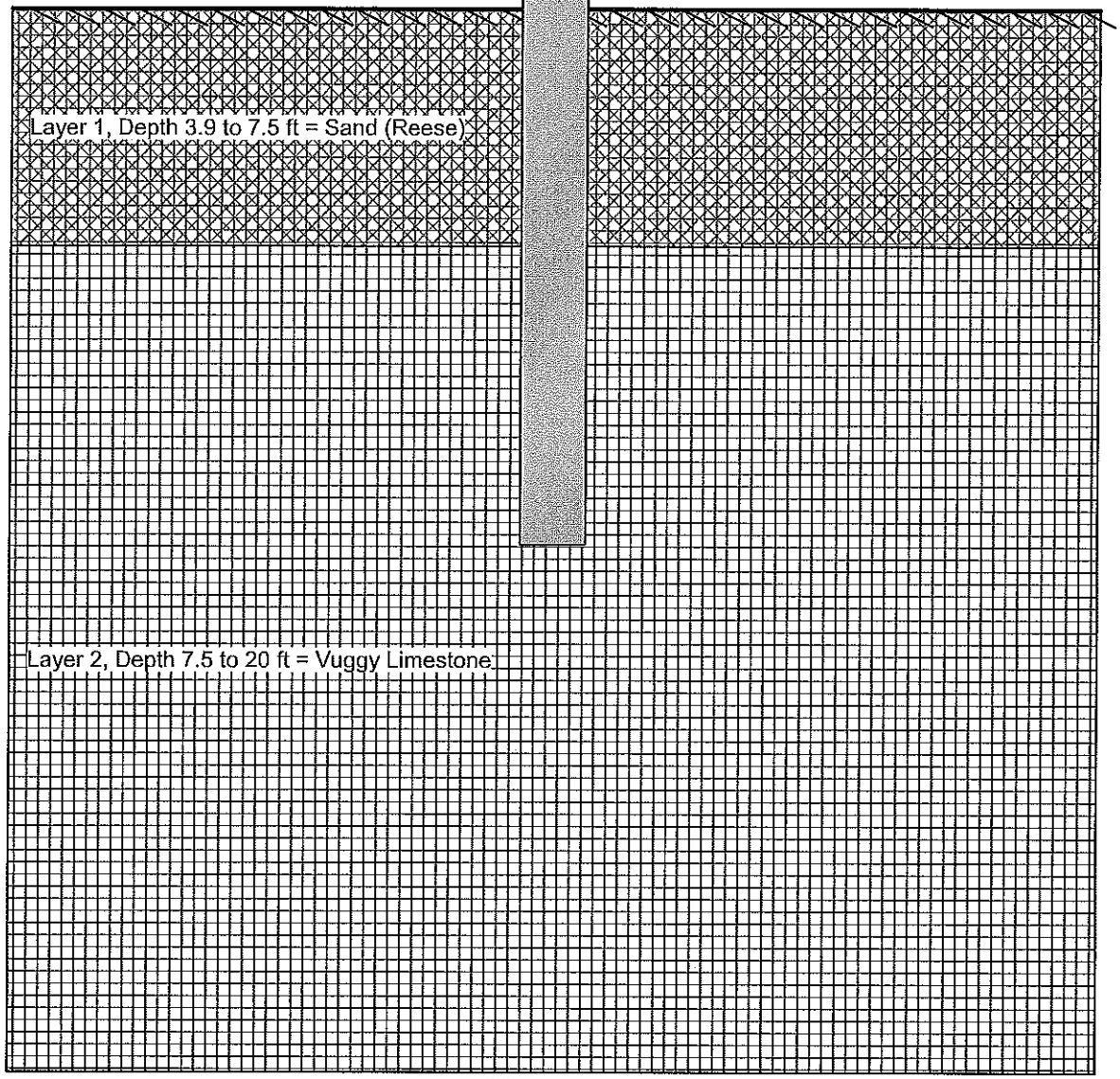
BOC = 2085.5

Scour = 2081.6

SAND

2078.0

CR

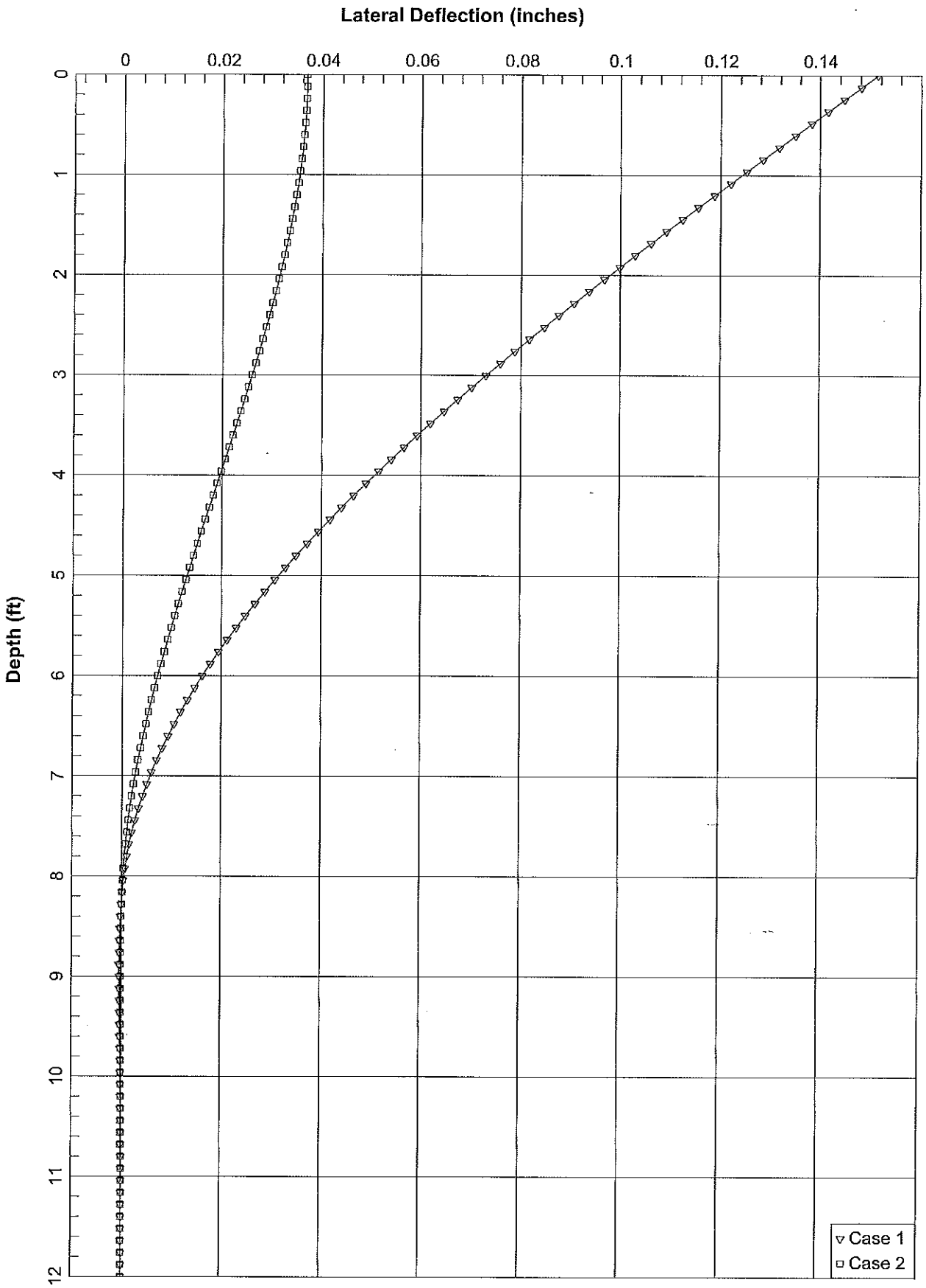


① $f = 0.15''$ 1ST Neg = 8.3' (EL = 2077.2) POF = 2077 ft
MAX Neg = 8.9' (EL = 2076.6)

② $f = 0.04''$ 1ST Neg = 8.3' (EL = 2077.2) POF = 2077 ft
MAX Neg = 9.0' (EL = 2076.5)

Set MIN TIP ELEVATION to a depth below where curve crosses back to zero.

SAY MIN TIP ELEV = 2074 ft


Lateral Deflection (inches)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
Case 1
Case 2

LPile Plus for Windows, Version 2012-06.034

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

This copy of LPile is licensed to:

testt
test

Serial Number of Security Device: 293783516
Company Name Stored in Security Device: Froehling & Robertson, Inc.

Files Used for Analysis

Path to file locations: E:\Lpile 2012\Branch63\Division 14 Vaughn and Melton\
Name of input data file: Graham 011 EB-2.lp6d
Name of output report file: Graham 011 EB-2.lp6o
Name of plot output file: Graham 011 EB-2.lp6p
Name of runtime messeage file: Graham 011 EB-2.lp6r

Date and Time of Analysis

Date: July 18, 2013 Time: 15:46:45

Problem Title

Project Name: Division 14 - Bridge 011

Job Number: 63P-0310-0011

Client: Vaughn & Melton Engineers

Engineer: F&R

Description: Bridge 011 - End Bent 2 Lateral Analysis

Program Options

Engineering units are US Customary Units: pounds, inches, feet

Basic Program Options:

This analysis computes pile response to lateral loading and will compute nonlinear moment-curvature and nominal moment capacity for section types with nonlinear properties.

Computation Options:
- Analysis does not use p-y multipliers (individual pile or shaft only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix values
- Report pile response for full length of pile
- Analysis assumes no loading by soil movements acting on pile
- No p-y curves to be computed and reported for user-specified depths

Solution Control Parameters:

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

Pile Response Output Options:
- 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

Pile Structural Properties and Geometry

Total number of pile sections = 1

Total length of pile = 12.00 ft

Depth of ground surface below top of pile = 3.90 ft

Pile diameter values 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.

Point	Depth X ft	Pile Diameter in
1	0.00000	12.0450000
2	12.000000	12.0450000

Input Structural Properties:

Pile Section No. 1:

Section Type	=	Elastic Pile	
Cross-sectional Shape	=	Strong H-Pile	
Section Length	=	12.00000000	ft
Flange Width	=	12.04500000	in
Section Depth	=	11.78000000	in
Flange Thickness	=	0.43500000	in
Web Thickness	=	0.43500000	in
Section Area	=	15.50000000	Sq. in
Moment of Inertia	=	393.00000000	in^4
Elastic Modulus	=	29000000.	lbs/in^2

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	=	3.90000 ft
Distance from top of pile to bottom of layer	=	7.50000 ft
Effective unit weight at top of layer	=	57.60000 pcf
Effective unit weight at bottom of layer	=	57.60000 pcf
Friction angle at top of layer	=	30.00000 deg.
Friction angle at bottom of layer	=	30.00000 deg.
Subgrade k at top of layer	=	60.00000 pci
Subgrade k at bottom of layer	=	60.00000 pci

Layer 2 is strong rock (vuggy limestone)

Distance from top of pile to top of layer	=	7.50000 ft
Distance from top of pile to bottom of layer	=	20.00000 ft
Effective unit weight at top of layer	=	160.00000 pcf
Effective unit weight at bottom of layer	=	160.00000 pcf
Uniaxial compressive strength at top of layer	=	4000.00000 psi
Uniaxial compressive strength at bottom of layer	=	4000.00000 psi

(Depth of lowest soil layer extends 8.00 ft below pile tip)

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

Values entered for effective unit weights of soil were outside
the limits of 0.011574 pci (20 pcf) or 0.0810019 pci (140 pcf)
This data may be erroneous. Please check your data.

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	Uniaxial qu psi	kpy pci
1	Sand (Reese, et al.)	3.900	57.600	30.000	--	60.000
		7.500	57.600	30.000	--	60.000
2	Vuggy Limestone	7.500	160.000	--	4000.000	--
		20.000	160.000	--	4000.000	--

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 = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 5000.00000 lbs	M = 0.0000 in-lbs	120000.	No
2	2	V = 5000.00000 lbs	S = 0.0000 in/in	120000.	No

Note: These are Assumed Loads

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust 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

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

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 5000.000 lbs
Applied moment at pile head = 0.000 in-lbs
Axial thrust load on pile head = 120000.000 lbs

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/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1514	2.746E-06	5000.0000	-0.002276	7741.9355	1.140E+10	0.000	0.000	0.000
0.120	0.1481	7593.2525	5000.0000	-0.002275	7858.2977	1.140E+10	0.000	0.000	0.000
0.240	0.1448	15186.	5000.0000	-0.002274	7974.6574	1.140E+10	0.000	0.000	0.000
0.360	0.1415	22779.	5000.0000	-0.002271	8091.0121	1.140E+10	0.000	0.000	0.000
0.480	0.1383	30371.	5000.0000	-0.002268	8207.3591	1.140E+10	0.000	0.000	0.000
0.600	0.1350	37963.	5000.0000	-0.002264	8323.6959	1.140E+10	0.000	0.000	0.000
0.720	0.1317	45554.	5000.0000	-0.002258	8440.0200	1.140E+10	0.000	0.000	0.000
0.840	0.1285	53143.	5000.0000	-0.002252	8556.3289	1.140E+10	0.000	0.000	0.000
0.960	0.1253	60732.	5000.0000	-0.002245	8672.6201	1.140E+10	0.000	0.000	0.000
1.080	0.1220	68319.	5000.0000	-0.002237	8788.8909	1.140E+10	0.000	0.000	0.000
1.200	0.1188	75905.	5000.0000	-0.002228	8905.1388	1.140E+10	0.000	0.000	0.000

1.320	0.1156	83489.	5000.0000	-0.002218	9021.3613	1.140E+10	0.000	0.000	0.000
1.440	0.1124	91072.	5000.0000	-0.002207	9137.5560	1.140E+10	0.000	0.000	0.000
1.560	0.1093	98652.	5000.0000	-0.002195	9253.7201	1.140E+10	0.000	0.000	0.000
1.680	0.1061	106230.	5000.0000	-0.002182	9369.8512	1.140E+10	0.000	0.000	0.000
1.800	0.1030	113806.	5000.0000	-0.002168	9485.9468	1.140E+10	0.000	0.000	0.000
1.920	0.0999	121379.	5000.0000	-0.002153	9602.0043	1.140E+10	0.000	0.000	0.000
2.040	0.0968	128950.	5000.0000	-0.002137	9718.0212	1.140E+10	0.000	0.000	0.000
2.160	0.0937	136518.	5000.0000	-0.002120	9833.9950	1.140E+10	0.000	0.000	0.000
2.280	0.0907	144083.	5000.0000	-0.002103	9949.9231	1.140E+10	0.000	0.000	0.000
2.400	0.0877	151645.	5000.0000	-0.002084	10066.	1.140E+10	0.000	0.000	0.000
2.520	0.0847	159203.	5000.0000	-0.002064	10182.	1.140E+10	0.000	0.000	0.000
2.640	0.0817	166758.	5000.0000	-0.002044	10297.	1.140E+10	0.000	0.000	0.000
2.760	0.0788	174309.	5000.0000	-0.002022	10413.	1.140E+10	0.000	0.000	0.000
2.880	0.0759	181857.	5000.0000	-0.002000	10529.	1.140E+10	0.000	0.000	0.000
3.000	0.0730	189401.	5000.0000	-0.001976	10644.	1.140E+10	0.000	0.000	0.000
3.120	0.0702	196940.	5000.0000	-0.001952	10760.	1.140E+10	0.000	0.000	0.000
3.240	0.0674	204475.	5000.0000	-0.001927	10875.	1.140E+10	0.000	0.000	0.000
3.360	0.0646	212006.	5000.0000	-0.001900	10991.	1.140E+10	0.000	0.000	0.000
3.480	0.0619	219532.	5000.0000	-0.001873	11106.	1.140E+10	0.000	0.000	0.000
3.600	0.0592	227053.	5000.0000	-0.001845	11221.	1.140E+10	0.000	0.000	0.000
3.720	0.0566	234569.	5000.0000	-0.001816	11337.	1.140E+10	0.000	0.000	0.000
3.840	0.0540	242081.	5000.0000	-0.001785	11452.	1.140E+10	0.000	0.000	0.000
3.960	0.0515	249586.	4999.1463	-0.001754	11567.	1.140E+10	-1.1857	33.1706	0.000
4.080	0.0490	257084.	4995.6747	-0.001722	11682.	1.140E+10	-3.6360	106.9247	0.000
4.200	0.0465	264569.	4988.6355	-0.001689	11796.	1.140E+10	-6.1406	190.1170	0.000
4.320	0.0441	272036.	4977.9940	-0.001656	11911.	1.140E+10	-8.6394	282.0882	0.000
4.440	0.0417	279478.	4963.7739	-0.001621	12025.	1.140E+10	-11.1107	383.2842	0.000
4.560	0.0394	286891.	4945.9916	-0.001585	12138.	1.140E+10	-13.5869	496.1427	0.000
4.680	0.0372	294270.	4924.7136	-0.001548	12251.	1.140E+10	-15.9660	618.3982	0.000
4.800	0.0350	301610.	4900.1101	-0.001511	12364.	1.140E+10	-18.2054	749.5440	0.000
4.920	0.0328	308905.	4872.4020	-0.001472	12476.	1.140E+10	-20.2781	889.5011	0.000
5.040	0.0307	316151.	4841.7926	-0.001433	12587.	1.140E+10	-22.2349	1041.7073	0.000
5.160	0.0287	323344.	4808.5241	-0.001392	12697.	1.140E+10	-23.9714	1202.6513	0.000
5.280	0.0267	330480.	4772.9358	-0.001351	12806.	1.140E+10	-25.4568	1371.5573	0.000
5.400	0.0248	337557.	4735.4099	-0.001309	12915.	1.140E+10	-26.6626	1547.4026	0.000
5.520	0.0230	344571.	4696.9322	-0.001266	13022.	1.140E+10	-26.7786	1679.6160	0.000
5.640	0.0212	351521.	4658.5584	-0.001222	13129.	1.140E+10	-26.5184	1804.0320	0.000
5.760	0.0194	358410.	4620.7203	-0.001177	13234.	1.140E+10	-26.0345	1928.4480	0.000
5.880	0.0178	365236.	4583.7270	-0.001131	13339.	1.140E+10	-25.3450	2052.8640	0.000
6.000	0.0162	372002.	4547.8610	-0.001084	13443.	1.140E+10	-24.4689	2177.2800	0.000
6.120	0.0147	378708.	4513.3772	-0.001037	13545.	1.140E+10	-23.4253	2301.6960	0.000
6.240	0.0132	385358.	4480.5027	-0.000989	13647.	1.140E+10	-22.2338	2426.1120	0.000
6.360	0.0118	391954.	4449.4360	-0.000940	13748.	1.140E+10	-20.9144	2550.5280	0.000
6.480	0.0105	398498.	4420.3467	-0.000890	13849.	1.140E+10	-19.4875	2674.9440	0.000
6.600	0.009246	404992.	4393.3745	-0.000839	13948.	1.140E+10	-17.9739	2799.3600	0.000
6.720	0.008075	411440.	4368.6291	-0.000787	14047.	1.140E+10	-16.3948	2923.7760	0.000
6.840	0.006978	417846.	4346.1891	-0.000735	14145.	1.140E+10	-14.7718	3048.1920	0.000
6.960	0.005958	424211.	4326.1021	-0.000682	14243.	1.140E+10	-13.1268	3172.6080	0.000
7.080	0.005015	430541.	4308.3835	-0.000628	14340.	1.140E+10	-11.4823	3297.0240	0.000
7.200	0.004150	436836.	4293.0164	-0.000573	14436.	1.140E+10	-9.8609	3421.4400	0.000
7.320	0.003365	443102.	4279.9507	-0.000517	14532.	1.140E+10	-8.2858	3545.8560	0.000
7.440	0.002660	449342.	4269.1029	-0.000461	14628.	1.140E+10	-6.7805	3670.2720	0.000
7.560	0.002037	455557.	-1603.3981	-0.000404	14723.	1.140E+10	-8149.4709	5760000.	0.000
7.680	0.001497	444863.	-11783.	-0.000347	14559.	1.140E+10	-5989.3733	5760000.	0.000
7.800	0.001038	421741.	-19086.	-0.000292	14205.	1.140E+10	-4153.0341	5760000.	0.000
7.920	0.000656	389997.	-23965.	-0.000241	13718.	1.140E+10	-2623.6251	5760000.	0.000
8.040	0.000345	352804.	-26846.	-0.000194	13148.	1.140E+10	-1378.0444	5760000.	0.000
8.160	9.731E-05	312747.	-28119.	-0.000152	12535.	1.140E+10	-389.2242	5760000.	0.000
8.280	-9.300E-05	271875.	-28131.	-0.000115	11908.	1.140E+10	371.9882	5760000.	0.000
8.400	-0.000234	231769.	-27190.	-8.316E-05	11294.	1.140E+10	935.3382	5760000.	0.000
8.520	-0.000333	193597.	-25559.	-5.629E-05	10709.	1.140E+10	1330.0138	5760000.	0.000
8.640	-0.000396	158179.	-23461.	-3.407E-05	10166.	1.140E+10	1583.7953	5760000.	0.000
8.760	-0.000431	126041.	-21080.	-1.611E-05	9673.4460	1.140E+10	1722.4591	5760000.	0.000
8.880	-0.000442	97473.	-18566.	-1.991E-06	9235.6506	1.140E+10	1769.3937	5760000.	0.000
9.000	-0.000436	72571.	-16036.	8.752E-06	8854.0480	1.140E+10	1745.3905	5760000.	0.000
9.120	-0.000417	51287.	-13578.	1.658E-05	8527.8840	1.140E+10	1668.5721	5760000.	0.000
9.240	-0.000389	33462.	-11257.	2.193E-05	8254.7246	1.140E+10	1554.4284	5760000.	0.000

1ST NEG → 8.280

→ 8.880 MAX NEG

9.360	-0.000354	18860.	-9118.3136	2.524E-05	8030.9487	1.140E+10	1415.9318	5760000.	0.000
9.480	-0.000316	7192.7401	-7188.9717	2.688E-05	7852.1601	1.140E+10	1263.7097	5760000.	0.000
9.600	-0.000277	-1853.8886	-5482.5986	2.722E-05	7770.3453	1.140E+10	1106.2530	5760000.	0.000
9.720	-0.000238	-8606.5506	-4001.9917	2.656E-05	7873.8259	1.140E+10	950.1454	5760000.	0.000
9.840	-0.000200	-13389.	-2741.6699	2.517E-05	7947.1112	1.140E+10	800.3015	5760000.	0.000
9.960	-0.000165	-16511.	-1690.1077	2.328E-05	7994.9611	1.140E+10	660.2015	5760000.	0.000
10.080	-0.000133	-18264.	-831.6376	2.108E-05	8021.8263	1.140E+10	532.1180	5760000.	0.000
10.200	-0.000104	-18914.	-148.0374	1.873E-05	8031.7765	1.140E+10	417.3267	5760000.	0.000
10.320	-7.908E-05	-18697.	380.1740	1.636E-05	8028.4591	1.140E+10	316.3002	5760000.	0.000
10.440	-5.722E-05	-17824.	772.7044	1.405E-05	8015.0844	1.140E+10	228.8810	5760000.	0.000
10.560	-3.861E-05	-16477.	1048.6911	1.188E-05	7994.4307	1.140E+10	154.4338	5760000.	0.000
10.680	-2.299E-05	-14808.	1226.1075	9.908E-06	7968.8641	1.140E+10	91.9779	5760000.	0.000
10.800	-1.007E-05	-12949.	1321.3469	8.154E-06	7940.3697	1.140E+10	40.2990	5760000.	0.000
10.920	4.890E-07	-11006.	1348.9537	6.641E-06	7910.5904	1.140E+10	-1.9561	5760000.	0.000
11.040	9.050E-06	-9066.1911	1321.4802	5.373E-06	7880.8697	1.140E+10	-36.2016	5760000.	0.000
11.160	1.596E-05	-7201.6229	1249.4438	4.345E-06	7852.2962	1.140E+10	-63.8490	5760000.	0.000
11.280	2.156E-05	-5469.2947	1141.3687	3.544E-06	7825.7493	1.140E+10	-86.2553	5760000.	0.000
11.400	2.617E-05	-3915.7060	1003.8944	2.952E-06	7801.9414	1.140E+10	-104.6812	5760000.	0.000
11.520	3.006E-05	-2579.0988	841.9387	2.541E-06	7781.4587	1.140E+10	-120.2573	5760000.	0.000
11.640	3.349E-05	-1491.8008	658.9048	2.284E-06	7764.7965	1.140E+10	-133.9565	5760000.	0.000
11.760	3.664E-05	-682.2424	456.9258	2.147E-06	7752.3905	1.140E+10	-146.5700	5760000.	0.000
11.880	3.967E-05	-176.5965	237.1408	2.092E-06	7744.6417	1.140E+10	-158.6869	5760000.	0.000
12.000	4.267E-05	0.000	0.000	2.081E-06	7741.9355	1.140E+10	-170.6753	2880000.	0.000

→ 10.920 4.890E-07 -11006. 1348.9537 6.641E-06 7910.5904 1.140E+10 -1.9561 5760000. 0.000

Zero

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

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.1513585 inches
Computed slope at pile head	=	-0.0022758 radians
Maximum bending moment	=	455557. inch-lbs
Maximum shear force	=	-28131. lbs
Depth of maximum bending moment	=	90.7200000 inches below pile head
Depth of maximum shear force	=	99.3600000 inches below pile head
Number of iterations	=	6
Number of zero deflection points	=	2

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

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

Shear force at pile head	=	5000.000 lbs
Rotation of pile head	=	0.000E+00 radians
Axial load at pile head	=	120000.000 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/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.0368	-251242.	5000.0000	0.000	11592.	1.140E+10	0.000	0.000	0.000
0.120	0.0368	-244039.	5000.0000	-3.129E-05	11482.	1.140E+10	0.000	0.000	0.000
0.240	0.0367	-236831.	5000.0000	-6.167E-05	11371.	1.140E+10	0.000	0.000	0.000
0.360	0.0366	-229618.	5000.0000	-9.114E-05	11261.	1.140E+10	0.000	0.000	0.000
0.480	0.0365	-222400.	5000.0000	-0.000120	11150.	1.140E+10	0.000	0.000	0.000
0.600	0.0363	-215176.	5000.0000	-0.000147	11039.	1.140E+10	0.000	0.000	0.000
0.720	0.0360	-207949.	5000.0000	-0.000174	10929.	1.140E+10	0.000	0.000	0.000
0.840	0.0358	-200716.	5000.0000	-0.000200	10818.	1.140E+10	0.000	0.000	0.000
0.960	0.0355	-193480.	5000.0000	-0.000225	10707.	1.140E+10	0.000	0.000	0.000
1.080	0.0351	-186239.	5000.0000	-0.000249	10596.	1.140E+10	0.000	0.000	0.000

1.200	0.0347	-178994.	5000.0000	-0.000272	10485.	1.140E+10	0.000	0.000	0.000
1.320	0.0343	-171745.	5000.0000	-0.000294	10374.	1.140E+10	0.000	0.000	0.000
1.440	0.0339	-164492.	5000.0000	-0.000315	10263.	1.140E+10	0.000	0.000	0.000
1.560	0.0334	-157236.	5000.0000	-0.000336	10151.	1.140E+10	0.000	0.000	0.000
1.680	0.0329	-149976.	5000.0000	-0.000355	10040.	1.140E+10	0.000	0.000	0.000
1.800	0.0324	-142713.	5000.0000	-0.000373	9928.9303	1.140E+10	0.000	0.000	0.000
1.920	0.0319	-135447.	5000.0000	-0.000391	9817.5816	1.140E+10	0.000	0.000	0.000
2.040	0.0313	-128178.	5000.0000	-0.000408	9706.1875	1.140E+10	0.000	0.000	0.000
2.160	0.0307	-120906.	5000.0000	-0.000423	9594.7506	1.140E+10	0.000	0.000	0.000
2.280	0.0301	-113632.	5000.0000	-0.000438	9483.2732	1.140E+10	0.000	0.000	0.000
2.400	0.0294	-106355.	5000.0000	-0.000452	9371.7578	1.140E+10	0.000	0.000	0.000
2.520	0.0288	-99075.	5000.0000	-0.000465	9260.2068	1.140E+10	0.000	0.000	0.000
2.640	0.0281	-91794.	5000.0000	-0.000477	9148.6227	1.140E+10	0.000	0.000	0.000
2.760	0.0274	-84510.	5000.0000	-0.000488	9037.0079	1.140E+10	0.000	0.000	0.000
2.880	0.0267	-77225.	5000.0000	-0.000499	8925.3647	1.140E+10	0.000	0.000	0.000
3.000	0.0260	-69938.	5000.0000	-0.000508	8813.6958	1.140E+10	0.000	0.000	0.000
3.120	0.0252	-62650.	5000.0000	-0.000516	8702.0034	1.140E+10	0.000	0.000	0.000
3.240	0.0245	-55360.	5000.0000	-0.000524	8590.2901	1.140E+10	0.000	0.000	0.000
3.360	0.0237	-48069.	5000.0000	-0.000530	8478.5583	1.140E+10	0.000	0.000	0.000
3.480	0.0229	-40776.	5000.0000	-0.000536	8366.8103	1.140E+10	0.000	0.000	0.000
3.600	0.0222	-33483.	5000.0000	-0.000541	8255.0488	1.140E+10	0.000	0.000	0.000
3.720	0.0214	-26190.	5000.0000	-0.000544	8143.2760	1.140E+10	0.000	0.000	0.000
3.840	0.0206	-18895.	5000.0000	-0.000547	8031.4945	1.140E+10	0.000	0.000	0.000
3.960	0.0198	-11601.	4999.3840	-0.000549	7919.7066	1.140E+10	-0.8555	62.2080	0.000
4.080	0.0190	-4307.2781	4996.9939	-0.000550	7807.9421	1.140E+10	-2.4640	186.6240	0.000
4.200	0.0182	2980.9350	4992.3862	-0.000550	7787.6166	1.140E+10	-3.9355	311.0400	0.000
4.320	0.0174	10261.	4985.7580	-0.000549	7899.1782	1.140E+10	-5.2703	435.4560	0.000
4.440	0.0166	17530.	4977.3058	-0.000548	8010.5690	1.140E+10	-6.4689	559.8720	0.000
4.560	0.0159	24785.	4967.2248	-0.000545	8121.7483	1.140E+10	-7.5325	684.2880	0.000
4.680	0.0151	32024.	4955.7083	-0.000541	8232.6799	1.140E+10	-8.4627	808.7040	0.000
4.800	0.0143	39244.	4942.9469	-0.000537	8343.3320	1.140E+10	-9.2614	933.1200	0.000
4.920	0.0135	46445.	4929.1282	-0.000531	8453.6766	1.140E+10	-9.9312	1057.5360	0.000
5.040	0.0128	53624.	4914.4356	-0.000525	8563.6900	1.140E+10	-10.4750	1181.9520	0.000
5.160	0.0120	60780.	4899.0483	-0.000518	8673.3527	1.140E+10	-10.8962	1306.3680	0.000
5.280	0.0113	67912.	4883.1401	-0.000510	8782.6488	1.140E+10	-11.1985	1430.7840	0.000
5.400	0.0105	75019.	4866.8790	-0.000501	8891.5663	1.140E+10	-11.3863	1555.2000	0.000
5.520	0.009829	82102.	4850.4266	-0.000491	9000.0969	1.140E+10	-11.4643	1679.6160	0.000
5.640	0.009130	89158.	4833.9373	-0.000480	9108.2357	1.140E+10	-11.4375	1804.0320	0.000
5.760	0.008447	96189.	4817.5578	-0.000468	9215.9813	1.140E+10	-11.3117	1928.4480	0.000
5.880	0.007781	103195.	4801.4265	-0.000456	9323.3352	1.140E+10	-11.0928	2052.8640	0.000
6.000	0.007134	110175.	4785.6728	-0.000442	9430.3021	1.140E+10	-10.7873	2177.2800	0.000
6.120	0.006508	117130.	4770.4165	-0.000428	9536.8893	1.140E+10	-10.4021	2301.6960	0.000
6.240	0.005902	124061.	4755.7669	-0.000413	9643.1068	1.140E+10	-9.9445	2426.1120	0.000
6.360	0.005320	130969.	4741.8228	-0.000396	9748.9668	1.140E+10	-9.4223	2550.5280	0.000
6.480	0.004761	137855.	4728.6713	-0.000379	9854.4836	1.140E+10	-8.8436	2674.9440	0.000
6.600	0.004227	144719.	4716.3876	-0.000362	9959.6732	1.140E+10	-8.2172	2799.3600	0.000
6.720	0.003719	151563.	4705.0338	-0.000343	10065.	1.140E+10	-7.5519	2923.7760	0.000
6.840	0.003239	158388.	4694.6592	-0.000323	10169.	1.140E+10	-6.8573	3048.1920	0.000
6.960	0.002788	165195.	4685.2987	-0.000303	10273.	1.140E+10	-6.1433	3172.6080	0.000
7.080	0.002367	171986.	4676.9731	-0.000282	10378.	1.140E+10	-5.4201	3297.0240	0.000
7.200	0.001977	178762.	4669.6876	-0.000259	10481.	1.140E+10	-4.6985	3421.4400	0.000
7.320	0.001620	185525.	4663.4321	-0.000236	10585.	1.140E+10	-3.9897	3545.8560	0.000
7.440	0.001297	192275.	4658.1799	-0.000213	10688.	1.140E+10	-3.3051	3670.2720	0.000
7.560	0.001008	199014.	1752.1089	-0.000188	10792.	1.140E+10	-4032.9045	5760000.	0.000
7.680	0.000756	197386.	-3328.6269	-0.000163	10767.	1.140E+10	-3023.6731	5760000.	0.000
7.800	0.000540	189484.	-7059.4987	-0.000138	10646.	1.140E+10	-2158.0932	5760000.	0.000
7.920	0.000358	177102.	-9643.2238	-0.000115	10456.	1.140E+10	-1430.4139	5760000.	0.000
8.040	0.000208	161751.	-11272.	-9.374E-05	10221.	1.140E+10	-831.6244	5760000.	0.000
8.160	8.764E-05	144672.	-12123.	-7.438E-05	9958.9446	1.140E+10	-350.5524	5760000.	0.000
8.280	-6.308E-06	126862.	-12357.	-5.723E-05	9686.0259	1.140E+10	25.2319	5760000.	0.000
8.400	-7.717E-05	109102.	-12117.	-4.232E-05	9413.8667	1.140E+10	308.6896	5760000.	0.000
8.520	-0.000128	91980.	-11525.	-2.962E-05	9151.4800	1.140E+10	512.7459	5760000.	0.000
8.640	-0.000162	75919.	-10688.	-1.901E-05	8905.3560	1.140E+10	649.8616	5760000.	0.000
8.760	-0.000183	61204.	-9693.6125	-1.035E-05	8679.8571	1.140E+10	731.7255	5760000.	0.000
8.880	-0.000192	48005.	-8613.0565	-3.447E-06	8477.5895	1.140E+10	769.0467	5760000.	0.000
9.000	-0.000193	36400.	-7503.9125	1.886E-06	8299.7437	1.140E+10	771.4310	5760000.	0.000
9.120	-0.000187	26393.	-6410.4084	5.853E-06	8146.3992	1.140E+10	747.3246	5760000.	0.000

1ST NEG →

→ MAX NEG

9.240	-0.000176	17936.	-5365.4477	8.653E-06	8016.7935	1.140E+10	704.0098	5760000.	0.000
9.360	-0.000162	10938.	-4392.2587	1.048E-05	7909.5528	1.140E+10	647.6417	5760000.	0.000
9.480	-0.000146	5282.6127	-3505.9710	1.150E-05	7822.8885	1.140E+10	583.3134	5760000.	0.000
9.600	-0.000129	836.7485	-2715.0842	1.189E-05	7754.7582	1.140E+10	515.1405	5760000.	0.000
9.720	-0.000112	-2540.9386	-2022.8049	1.178E-05	7780.8739	1.140E+10	446.3586	5760000.	0.000
9.840	-9.486E-05	-4993.0009	-1428.2399	1.130E-05	7818.4504	1.140E+10	379.4260	5760000.	0.000
9.960	-7.903E-05	-6658.1764	-927.4416	1.057E-05	7843.9682	1.140E+10	316.1272	5760000.	0.000
10.080	-6.442E-05	-7667.6853	-514.3048	9.664E-06	7859.4384	1.140E+10	257.6739	5760000.	0.000
10.200	-5.120E-05	-8142.7140	-181.3228	8.665E-06	7866.7179	1.140E+10	204.8010	5760000.	0.000
10.320	-3.946E-05	-8192.8896	79.7889	7.633E-06	7867.4868	1.140E+10	157.8541	5760000.	0.000
10.440	-2.922E-05	-7915.5601	277.5900	6.615E-06	7863.2369	1.140E+10	116.8698	5760000.	0.000
10.560	-2.041E-05	-7395.7165	420.5215	5.648E-06	7855.2706	1.140E+10	81.6461	5760000.	0.000
10.680	-1.295E-05	-6706.4101	516.6062	4.757E-06	7844.7074	1.140E+10	51.8049	5760000.	0.000
10.800	-6.711E-06	-5909.5347	573.2336	3.960E-06	7832.4957	1.140E+10	26.8443	5760000.	0.000
10.920	-1.546E-06	-5056.8659	597.0145	3.267E-06	7819.4291	1.140E+10	6.1846	5760000.	0.000
11.040	2.699E-06	-4191.2622	593.6950	2.683E-06	7806.1642	1.140E+10	-10.7949	5760000.	0.000
11.160	6.181E-06	-3347.9514	568.1213	2.207E-06	7793.2409	1.140E+10	-24.7241	5760000.	0.000
11.280	9.054E-06	-2555.8355	524.2438	1.834E-06	7781.1022	1.140E+10	-36.2168	5760000.	0.000
11.400	1.146E-05	-1838.7629	465.1561	1.556E-06	7770.1135	1.140E+10	-45.8495	5760000.	0.000
11.520	1.354E-05	-1216.7237	393.1609	1.363E-06	7760.5811	1.140E+10	-54.1439	5760000.	0.000
11.640	1.539E-05	-706.9306	309.8593	1.242E-06	7752.7688	1.140E+10	-61.5528	5760000.	0.000
11.760	1.711E-05	-324.7581	216.2592	1.176E-06	7746.9122	1.140E+10	-68.4473	5760000.	0.000
11.880	1.878E-05	-84.5107	112.9013	1.151E-06	7743.2306	1.140E+10	-75.1054	5760000.	0.000
12.000	2.043E-05	0.000	0.000	1.145E-06	7741.9355	1.140E+10	-81.7020	2880000.	0.000

Zero

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

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.0368153 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-251242. inch-lbs
Maximum shear force	=	-12357. lbs
Depth of maximum bending moment	=	0.000000 inches below pile head
Depth of maximum shear force	=	99.3600000 inches below pile head
Number of iterations	=	6
Number of zero deflection points	=	2

Summary of Pile Response(s)

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	1	V = 5000.0000	M = 0.000	120000.	0.15135847	455557.	-28131.	-0.00227577
2	2	V = 5000.0000	S = 0.000	120000.	0.03681531	-251242.	-12357.	0.00000000

The analysis ended normally.

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FROEHLING & ROBERTSON, INC.

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SHEET NO. 1 OF 1

JOB Bridge 011 - GRAHAM

DATE July 2013

COMPUTATIONS FOR Pile Excavation Qty - EB-2

BY MJLO CHKD

END BENT 2 — 7 Piles (3.5 Lt, 3.5 Rt)

BOC = 2085.5' Tip = 2074.0'

EB2-A

Soil = 2085.5 - 2082.0 = 3.5'

WR = 2082.0 - 2079.5 = 2.5'

CR = 2079.5 - 2074.0 = 5.5'

Use 1/2 WR as "In Soil" and 1/2 WR as "Not In Soil"

- In Soil = 3.5 + 1.3 = 4.8' x 3.5 = 16.8' = 17'
- Not In Soil = 1.3 + 5.5 = 6.8' x 3.5 = 23.8' = 24'

EB2-B

Soil = 2085.5 - 2078.0 = 7.5'

CR = 2078.0 - 2074.0 = 4.0'

- In Soil = 7.5' x 3.5 = 26.3 = 27'
- Not In Soil = 4.0 x 3.5 = 14.0' = 14'

For End Bent 2

Total In Soil = 17' + 27' = 44'

Total Not In Soil = 24' + 14' = 38'

Form No. 502
Revised 05/2008

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