



District 4 • 401 Main Street • Peoria, IL 61602

## Structure Geotechnical Report



### Bridge Replacement US 67 over Pope Creek Mercer County, Illinois

Region:	Three
District:	Four
Route:	FAP 310 (US 67)
Section:	103-BR
Structure Number:	066-0003 (Existing) 066-0019 (Proposed)
Contract Number:	68804
Job Number:	D-94-042-08
PTB Number:	151
Item Number:	33- Work Order #4
Date Revised:	June 6, 2012
Date Prepared:	March 15, 2012
Proposed Letting:	November 2013

Prepared For: Illinois Department of Transportation  
Bureau of Bridges and Structures  
2300 S. Dirksen Parkway  
Springfield, IL 62764  
(217) 782-7820

TERRA Engineering, Ltd.  
Orwin Youngquist, P.E., S.E.  
225 West Ohio St., 4<sup>th</sup> Floor  
Chicago, IL 60654  
(312) 467-0123

Prepared By:  
Ray Seneca, P.E.  
Lindsey Ford



401 Main Street • Suite 1130 • Peoria, IL 61602  
309.999.0123 • 309.999.0120 (fax)  
[www.terraengineering.com](http://www.terraengineering.com)

## TABLE OF CONTENTS

<b>1.0</b>	<b>PROJECT DESCRIPTION</b> .....	<b>3</b>
<b>2.0</b>	<b>SUBSURFACE CONDITIONS</b> .....	<b>4</b>
<b>3.0</b>	<b>GEOTECHNICAL EVALUATIONS</b> .....	<b>5</b>
3.1	Settlements .....	5
3.2	Slope Stability.....	5
3.3	Seismic Considerations .....	6
3.4	Scour .....	6
3.5	Mining Activities.....	6
3.6	Bridge Foundations .....	7
3.7	Lateral Pile Response.....	9
<b>4.0</b>	<b>CONSTRUCTION CONSIDERATIONS</b> .....	<b>9</b>

## TABLES

Table 3.4.1 .	Scour Evaluation .....	6
Table 3.6.1 .	Metal Shell Pile Capacities .....	7
Table 3.6.2 .	H-Pile Capacities.....	8

## APPENDICES

Appendix A .	Site Investigation Photo Log and Vicinity and Quadrangle Map .....	10
Appendix B .	Boring Location Site Plan.....	17
Appendix C .	Boring Logs .....	19
Appendix D .	Subsurface Data Profile .....	38
Appendix E .	Stability Analysis.....	41
Appendix F .	IDOT BBS Spreadsheet . Seismic Site Class Determination.....	53
Appendix G .	IDOT Static Method of Estimating Pile Length.....	55
	Part I- North Abutment.....	56
	Part II- South Abutment .....	65
	Part III- Pier 1 .....	74
	Part IV- Pier 2.....	84
Appendix H .	Soil Modulus Parameters (k) for LPILE Analysis.....	94

## Structure Geotechnical Report

**BRIDGE REPLACEMENT  
US 67 OVER POPE CREEK  
MERCER COUNTY, ILLINOIS  
FAP 310 (US 67)  
SECTION: 103-BR  
STRUCTURE NO.: 066-0003(EXISTING)  
066-0019(PROPOSED)**

### SITE INVESTIGATION

A site investigation was done by TERRA Engineering, Ltd. personnel in May 2011 and other than erosion, there were no signs of distress or deformation in the existing substructure foundation, nor distress in the existing embankment and pavement. Appendix A includes a project location map and pictures taken at the time of the investigation.

### 1.0 PROJECT DESCRIPTION

The geotechnical study summarized in this report was performed for the proposed replacement of the bridge that carries FAP 310 (US 67) over Pope Creek at station 864+38.47 in Mercer County, Illinois. The purpose of our study was to explore the subsurface conditions and develop design and construction recommendations for the bridge replacement.

The existing (SN 066-0003) two span precast prestressed concrete structure was built in 1931, which replaces the original steel truss. The structure is 103.33 feet in length from back to back of abutments and is 33 feet wide. The original superstructure was removed in 1971, as well as modifications were made to the abutments and a center pier was added to support the PCC box beams. In 2001 the deck beams and substructures were repaired and a 7 inch reinforced concrete overlay was placed over the deck beams. Temporary support beams were installed in both spans in 2008.

The proposed structure will be a three span rolled steel beam structure centered over the stream channel with integral abutments and single row pile bent piers. It will be constructed with 6 lines of beams and support an 8 inch deck. The total length will be 180 feet. The proposed roadway cross-section, curb to curb, for the bridge will measure 32q. 0+ and will provide one (1) 12 foot wide lane in the southbound direction and one (1) 12 foot wide lane in the northbound direction with a four (4) foot wide concrete shoulder on either side. A Type F parapet is proposed for both sides of the bridge. The proposed bridge cross-section, out to out, for the bridge will measure 35q. 2+. The horizontal alignment will be maintained as it currently exists. The vertical alignment will be adjusted to promote drainage.

## 2.0 SUBSURFACE CONDITIONS

The project site is located approximately three miles south of Viola, IL on US 67 in Mercer County. Physiographically the project is located in the Galesburg Plain. Four standard penetration test (SPT) borings were proposed, one at each abutments and one at each of the two piers. See Appendix B for the Boring Location Site Plan. All borings were advanced into shale bedrock at approximate elevations of 598.6 (B-1), 587.4 (B-2), 586.7 (B-3), and 607.0 (B-4). Detailed information regarding the nature and thickness of the soil and rock layers encountered, and the results of the field sampling and laboratory testing are shown on the Boring Logs in Appendix C. The field exploration was performed in general accordance with the procedures outlined in the 1999 IDOT Geotechnical Manual. The borings were staked and drilled by Testing Service Corporation of Bloomington, IL as a sub consultant to Thouvenot, Wade & Moerchen, Inc. An experienced technician from Testing Service Corporation was with the drill rig to monitor drilling, log borings, and perform unconfined compressive strength tests.

A Diedrich ATV-D50 with hollow-stem augers and automatic hammer was used to advance the borings. SPTs were performed with a split spoon sampler at 2.5 foot intervals to a depth of 30 feet, and then at 5 foot intervals to the boring termination depths. Unconfined compression strengths of cohesive samples were measured with a Rimac testing apparatus. In addition, a pocket penetrometer was also used to estimate the compressive strength if the sample was not conducive to Rimac testing.

The bridge site has five major soil layers. The first of these layers is a brown/gray-brown Silty Clay Loam with elevations ranging from 637.7 to 667.0. Moisture content varies from 16 to 33 percent, unconfined compressive strength ranges from 0.21 to 2.67 tons per square foot, and 2 to 20 blows per foot were required during the sampling of the Silty Clay Loam layer. This material is found in all four layers.

The second layer consists of sand and gravel, sand, sandy loam, and silt. The sand and gravel layer is encountered in Borings B-1 and B-2 between elevations 637.4 and 645.6. The layer is saturated and had blow counts ranging between 11 and 14 blows per foot. A 24 inch blow-in occurred at elevation 640.9 in this layer while boring B-2 was being drilled. A Sandy Loam layer is encountered in both boring B-1 and B-4. This material is found between elevations 635.0 to 645.6 and had moisture content between 17 and 23 percent, and blow counts ranging from 4 to 8 blows per foot. The sand layer is found in borings B-1, B-3, and B-4 with blow counts ranging from 4 to 15 blows per foot. This layer is saturated and has a friction angle ranging from 28.0 to 31.25 degrees. The silt layer is only encountered in boring B-4 and occurs between elevations 641.0 and 644.0. The moisture content is 23 percent and the blow count is 1 blow per foot.

The next layer ranges from elevation 620.7 to 637.6 and is comprised of Silty Loam. There is 20 to 31 percent moisture in this layer, it has a compressive strength ranging from 0.29 to 1.5 tons per square foot, and the blow counts were between 3 and 13 blows per foot. Silty Loam occurs in all four borings.

Silty Clay Loam- Weathered Shale is the layer below the Silty Loam. The moisture content for this layer falls between 11 and 17 percent and the unconfined compressive strength varies between 2.03 and 5.0 tons per square foot. The material is found in all four borings between elevations 601.7 and 626.6, and has blow counts ranging from 23 to 100 blows per foot.

Shale is the final material in all of the borings. The shale has moisture content between 1 and 16 percent, and the unconfined compressive strength was greater than 4.5 tons per square foot at all locations. Shale was encountered in borings B-1, B-2, B-3, and B-4 at elevations 608.6, 603.4, 601.7, and 615.0 respectively.

Rock coring was performed at the locations of boring B-2 and B-3. Ground water encountered during drilling and at completion are shown on the boring logs (Appendix C) and in the subsurface Data Profile in Appendix D. Based on the boring log data, the expected ground water elevation for the bridge site is 649.6 ft.

The uppermost bedrock in Mercer County consists of Pennsylvanian-aged shales and sandstones belonging to the Caseyville and Tradewater formations.

### **3.0 GEOTECHNICAL EVALUATIONS**

#### **3.1 Settlement**

There is little to no change to the profile at either abutment, therefore detrimental settlement is not anticipated.

#### **3.2 Slope Stability**

Slope stability analysis was performed on the side slope for both the north and the south abutment. Both side slopes have a proposed inclination of 2 horizontal to 1 vertical. Static and seismic conditions were both considered during the analysis. The results of the stability analysis (Appendix E) indicate that the new slopes should be stable under both static and seismic condition. The minimum safety factor for the north abutment under static conditions was 1.890 and the minimum for the south abutment was 1.931. Both static values meet the minimum allowable safety factor of 1.5. The minimum safety factor for the north abutment under seismic conditions was 1.751 and the minimum for the south abutment was 1.754. Both seismic values meet the minimum allowable safety factor of 1.0.

**3.3 Seismic Considerations**

According to the AASHTO LRFD Bridge Design Specifications (Fourth Edition), a site coefficient, which is a function of the soil profile types, is required for the calculation of minimum earthquake design forces. Based on the soils encountered and the depth to bedrock, the seismic performance zone is 1 and the soil site class is D. The global site class definition is based on the results of IDOT Bureau of Bridges and Structures Seismic Site Class Determination spreadsheet (Appendix F). The AASHTO specifications also indicate that the site has a Design Spectral Acceleration at 1.0 second ( $SD_1$ ) of 0.094 g, and a Design Spectral Acceleration ( $SD_s$ ) at 0.2 second of 0.137 g.

According to the USGS Earthquake Hazards Program website, the design earthquake at the site, which has a 5 percent probability of exceedance in 50 years, is 7.70 on the Richter scale with a peak horizontal ground acceleration of 0.03198 g. The peak horizontal acceleration coefficient at the ground surface ( $A_s$ ) is 0.058 g. Since this is less than 0.15g (as stated in All Geotechnical Manual Uses Design Guide 10.1) no liquefaction analysis is required.

**3.4 Scour**

Scour depth for a 100 year flood was determined for each of the piers for the proposed structure. Scour of 9.1 feet was calculated for Pier 1 and 7.1 feet was calculated for Pier 2. Table 3.4.1 shows the scour elevations.

**Table 3.4.1 – Scour Elevation**

<b>Abutment/Pier</b>	<b>Design Scour Elevation (ft) (100 Year)</b>	<b>Scour Elevation (ft) (500 Year)</b>
<b>North Abutment</b>	<b>662.3</b>	<b>662.3</b>
<b>Pier 1</b>	<b>637.0</b>	<b>634.8</b>
<b>Pier 2</b>	<b>639.0</b>	<b>636.8</b>
<b>South Abutment</b>	<b>662.3</b>	<b>662.3</b>

**3.5 Mining Activity**

According to the Directory of Coal Mines in Illinois . Mercer County, dated July 30, 2010, the subject site was not undermined. The listed disclaimer did indicate that the locations of some features on the mine map may be offset by 500 or more feet due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors. The subject site is more than 5,000 feet away from the closest mining area shown on the map.

### 3.6 Bridge Foundations

The foundation supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loads. Since integral abutment type design was selected for this bridge the only foundation permitted by IDOT Bridge Manual is a single row of vertical H-Piles or Metal Shell piles. Based on the bridge length of 180.0 feet, the pile foundation is further restricted to only H-Pile and 14 inch Metal Shell pile per the Bridge Design Manual.

The Modified IDOT Static Method of Estimating Pile Length spreadsheet (See Appendix G- Part I through Part IV for output) was used to analyze the various pile types and their loading for the north abutment, south abutment, Pier 1, and Pier 2. The anticipated total factored load on each abutment is 807 kip and the load on each pier is 1555 kip. The pile cut off elevation is 664.3 ft for the north and south abutments, and 664.96 ft for the piers. Table 3.6.1 lists the capacities of metal shell pile.

**Table 3.6.1 – Metal Shell Pile Capacities**

Substructure	Pile Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available <sup>1</sup> (kips)	Estimated Pile Length (ft)
North Abut.	MS 14+w/0.25+	413	124	45
North Abut.	MS 14+w/0.312+	513	124	45
South Abut.	MS 14+w/0.25+	413	96	37
South Abut.	MS 14+w/0.312+	513	96	37
Pier 1	MS 14+w/0.25+	413	17	36
Pier 1	MS 14+w/0.312+	513	208	46
Pier 2	MS 14+w/0.25+	413	37	37
Pier 2	MS 14+w/0.312+	513	250	42

Note: 1 . Assuming geotechnical resistance factor of 0.55 if WSDOT formula is specified for construction verification (if WSDOT not used, the factor shall be reduced to 0.5).

Conical tips are recommended if metal shell is selected due to the high blow counts encountered in the lower layers of the project site. The following table displays H-Pile capacities.

**Table 3.6.2 – H-Pile Capacities**

Substructure	Pile Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available <sup>1</sup> (kips)	Estimated Pile Length (ft)
North Abut.	HP 10X42	335	152	60
North Abut.	HP 12X53	418	193	60
North Abut.	HP 12X63	497	197	60
North Abut.	HP 14X73	578	234	60
North Abut.	HP 14X89	705	238	60
South Abut.	HP 10X42	335	143	52
South Abut.	HP 12X53	418	177	52
South Abut.	HP 12X63	497	181	52
South Abut.	HP 14X73	578	214	52
South Abut.	HP 14X89	705	218	52
Pier 1	HP 10X42	335	163	59
Pier 1	HP 12X53	418	207	59
Pier 1	HP 12X63	497	264	61
Pier 1	HP 14X73	578	292	60
Pier 1	HP 14X89	705	361	62
Pier 1	HP 14X117	929	504	66
Pier 2	HP 10X42	335	178	60
Pier 2	HP 12X53	418	226	60
Pier 2	HP 12X63	497	256	61
Pier 2	HP 14X73	578	313	61
Pier 2	HP 14X89	705	383	63
Pier 2	HP 14X117	929	506	67

Note: 1 . Assuming geotechnical resistance factor of 0.55 if WSDOT formula is specified for construction verification (if WSDOT not used, the factor shall be reduced to 0.5).

Metal shell pile is not the most efficient pile choice for this site due to the pile becoming overstressed long before the maximum nominal bearing capacity is reached. H-Pile is recommended to support the substructures at this location due to the larger loading available and less chance of damage being done to the pile during driving.

Bearing capacity reductions due to negative skin friction, and liquefaction have been considered and are not present at this bridge site. Scour is present and has been taken into account. Hard driving conditions are not anticipated, therefore pile shoes are not recommended for the H-Piles. It is recommended that one test pile be driven at each abutment and each pier. The pile lengths used in construction should be longer than the estimated length to ensure sufficient depth is achieved.



### **3.7 Lateral Pile Response**

A representation of the pile response under lateral loading is required for design of the bridge superstructure. The lateral pile response can be developed by modeling the soil/pile interaction with the computer program LPILE. Discrete elements are used in LPILE to represent the pile and non-linear soil springs. The non-linear soil springs are commonly referred to as P-Y curves.

Based on the encountered subsurface conditions, tables for B-1, B-2, B-3, and B-4 summarizing appropriate soil parameters  $\phi$ ,  $c$ , wet and saturated soil unit weights for the LPILE analysis, are included in Appendix H (Reference: LPILE User's Manual, Ensoft, Inc., October 2000). When pile design details and load information are available LPILE analyses can be performed.

### **4.0 CONSTRUCTION CONSIDERATIONS**

Stage construction will be used to remove and replace this structure. A Temporary Soil Retention System should be utilized for stage construction. The Estimated Water Surface Elevation (EWSE) is 652.71 ft. The elevation at the bottom of Pier 1 and Pier 2 is 646.1 ft. Both piers will require a Cofferdam (Type 2) for construction due to the EWSE being 6.61 feet higher than the bottom of the pier (See ABD Memo 11.2). It is anticipated that a seal coat will be required. In general, stream related work should not occur during periods of flooding. The construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction and any pertinent special provisions or policies.

# Appendix A



Picture # 1  
Northwest ditch



Picture # 2  
Northwest creek bank



Picture # 3  
Northeast ditch



Picture # 4  
Northeast creek bank



Picture # 5  
Southwest ditch



Picture # 6  
Southwest creek bank



Picture # 7  
Southeast ditch



Picture # 8  
Southeast creek bank

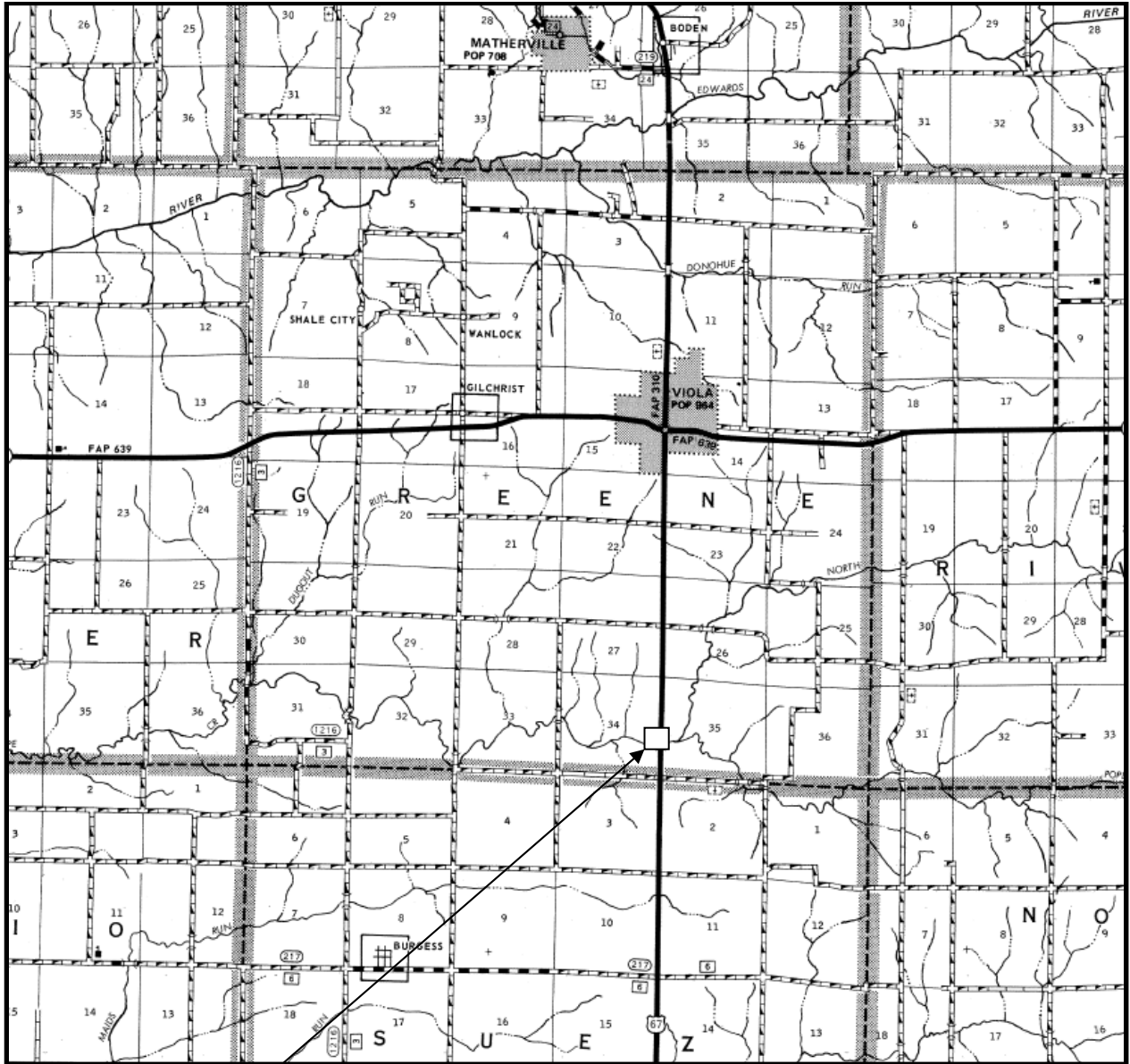
# Location Map



Project Location



# Quadrangle Map

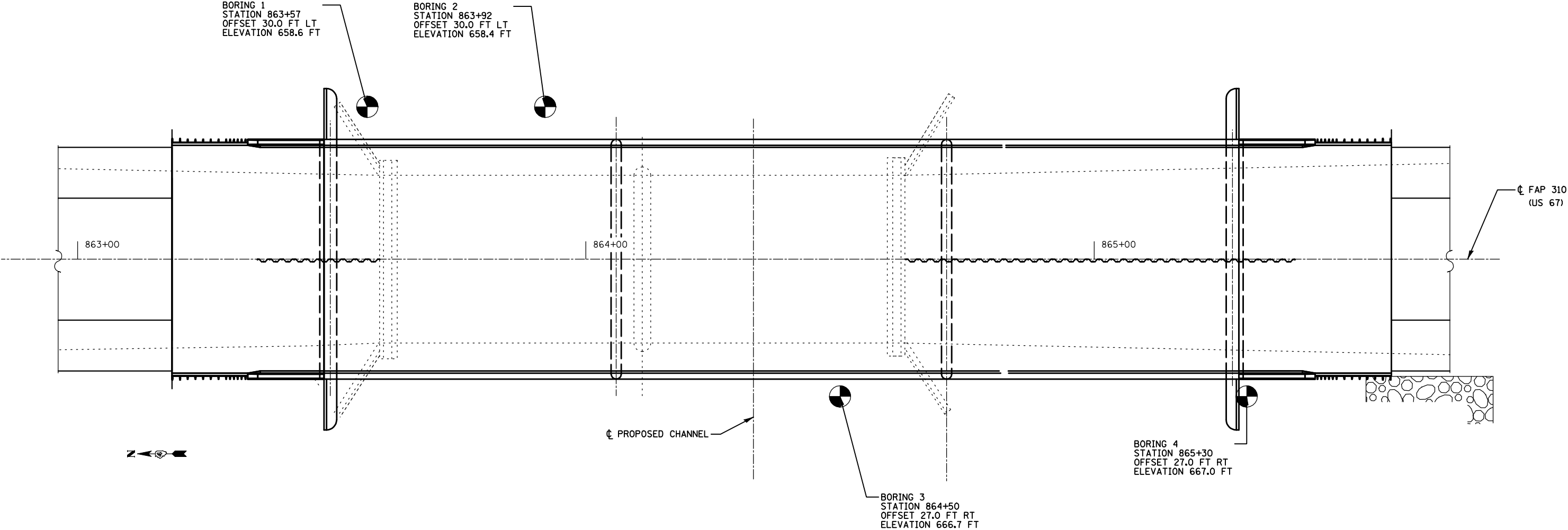


Project Location



## Appendix B

STATE OF ILLINOIS  
DEPARTMENT OF TRANSPORTATION



BORING LOCATION PLAN VIEW  
US 67 OVER POPE CREEK  
F.A.P. 310 - SECTION 103-BR  
MERCER COUNTY  
STATION 864+38.47  
STRUCTURE NO. 066-0019

DESIGNED -	200
CHECKED -	EXAMINED
DRAWN -	ENGINEER OF BRIDGE DESIGN
CHECKED -	PASSED
	ENGINEER OF BRIDGES AND STRUCTURES



401 MAIN STREET, SUITE 1130  
PEORIA, IL 61602  
W(309)999-0123 F(309)999-0120  
www.terraengineering.com

SHEET NO. 1  
1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
310	103-BR	MERCER		
BORING LOCATION PLAN VIEW			CONTRACT NO.	
FED. ROAD DIST. NO. - ILLINOIS FED. AID PROJECT				

## Appendix C

ILLINOIS DEPARTMENT OF TRANSPORTATION  
Testing Service Corporation  
STRUCTURE BORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek  
 SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson  
 COUNTY Mercer LOCATION Greene Township S.34/35, TWP. 14N, RNG. 2W

Boring No.	Station	Offset	Surface Elev.	DEPTH	BLOW	Qu	W	Surface Water Elev.	Groundwater Elev.:	DEPTH	BLOW	Qu	W
			ft	H	S	tsf	%		when drilling	H	S	tsf	%
B-1 N. Abutment	863+57	30.00ft LT	658.60					650.1					
									647.6				
									649.6				
Stiff dark brown SILTY CLAY LOAM, moist			655.60		3 4 5	P 1.5	26				2 4 5	P 1.0	28
Soft dark brown SILTY CLAY LOAM, very moist			653.10		2 2 3	P 0.5	33				2 3 5	B 0.78	23
Soft brown-gray SILTY CLAY LOAM, moist					0 2 3	B 0.45	26						
					2 3 4	P 0.5	28	626.60			4 8 15	B 3.08	16
Medium dense brown coarse SAND and small GRAVEL, saturated			647.60		4 6 5								
Loose brown SANDY LOAM, saturated			645.60		2 4 4		17				8 19 28	B 2.53	14
Medium dense brown fine SAND, saturated			642.60		4 10 5								
					10 7 3						12 28 30	S 2.03	17
Stiff gray SILTY LOAM, moist			637.60		3 5 7	B 1.35	29						
					3 5 8	B 1.15	20				13 46	P 4.5+	16
								608.60			50/3"		

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test  
 Stations. Depths. Offset. and Elevations are in Feet





ILLINOIS DEPARTMENT OF TRANSPORTATION  
 Testing Service Corporation  
 STRUCTURE BORING LOG

STRUCTURE NO. 066-0019  
 ROUTE U. S. 67  
 SECTION 103-BR  
 COUNTY Mercer

Boring No.	Station	Offset	Elevation	DEPTH	BLOWS	Qu tsf	W %
<u>B-2 Pier 1</u>	<u>863+92</u>	<u>30.00ft LT</u>	<u>608.40</u> ft				
Hard light gray to dark gray SILTY CLAY LOAM - WEATHERED SHALE							
Boring continued with rock core					14	P	13
			603.40	-55	41	4.5+	
					100/4"		
				-60			
				-65			
				-70			
				-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test  
 Stations, Depths, Offset, and Elevations are in Feet

# Testing Service Corporation

## STRUCTURE ROCK CORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek

SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson

COUNTY Mercer

Boring No. B-2 Pier 1 Core Type NX  
 Station 863+92 Core Diameter 2 in  
 Offset 30.00ft LT Core Length 16 ft  
 Surface Elev. 658.40 ft

R E C O V E R Y	R · Q · D ·	C O R E T I M E	C O M P. S T R N G T H
(%)	(%)	(Min/ ft)	(tsf)
75	51		47.5
			172.1
97	83		121.7
			192.2

Top Elev. ft	Coring Notes and Rock Description	Core Run (#)
603.40	Hard gray to dark gray SHALE  Moisture Content = 7%  Moisture Content = 6%	1
	-60.0	
	Moisture Content = 1%  Moisture Content = 1%	2
	-65.0	
	-70.0	
587.40	End of Boring at 71.0'	
	-75.0	

Color pictures of the cores Yes

Cores will be stored for examination until \_\_\_\_\_





0 ft to 2 ft



2 ft to 4 ft



4 ft to 6 ft



6 ft to 8 ft



10 ft to 12 ft



12 ft to 14 ft



14 ft to 16 ft

ILLINOIS DEPARTMENT OF TRANSPORTATION  
Testing Service Corporation  
STRUCTURE BORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek  
 SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson  
 COUNTY Mercer LOCATION Greene Township S.34/35, TWP. 14N, RNG. 2W

Boring No.	Station	Offset	Surface Elev.	DEPTH	BLOW S	Qu tsf	W %	Surface Water Elev.	Groundwater Elev.:	DEPTH	BLOW S	Qu tsf	W %
B-3 Pier 2	864+50	27.00ft RT	666.70 ft					650.1					
								640.7					
Stiff brown SILTY CLAY LOAM, moist													
					1	P	16				0	B	24
					1	1.0					1	0.21	
					2						2		
					2	B	19	637.70			1	P	28
					2	1.85					2	0.5	
					4						2		
				-5									
660.70													
Stiff dark brown SILTY CLAY LOAM, moist													
					2	B	23						
					4	1.93							
					4								
								633.70					
					1	B	19				1	P	20
					3	1.44					2	1.5	
					4						3		
				-10									
655.70													
Very stiff brown-gray SILTY CLAY LOAM, moist													
					1	B	25						
					3	2.21							
					6								
					1	B	21				1	P	27
					3	2.62					3	1.0	
					6						4		
				-15									
650.70													
Stiff gray-brown SILTY CLAY LOAM, moist													
					1	B	22						
					3	1.27							
					4								
648.70													
Soft to medium stiff gray-brown SILTY CLAY LOAM, moist													
					0	B	27				1	B	26
					2	0.49					2	1.15	
					2						4		
				-20									
					1	B	29	620.70					
					2	0.62							
					3								
643.70													
Soft gray SILTY CLAY LOAM, moist													
					0	B	26				5	P	11
					1	0.41					40	4.5+	
					2						35		
				-25									

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test Stations. Depths. Offset. and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION  
 Testing Service Corporation  
 STRUCTURE BORING LOG

STRUCTURE NO. 066-0019  
 ROUTE U. S. 67  
 SECTION 103-BR  
 COUNTY Mercer

Boring No.	Station	Offset	Elevation	DEPTH	BLOWS	Qu tsf	W %
<u>B-3 Pier 2</u>	<u>864+50</u>	<u>27.00ft RT</u>	<u>616.70</u> ft				
Hard gray to dark gray SILTY CLAY LOAM - WEATHERED SHALE							
					11 25 39	P 4.5+	14
				-55			
					42 58	P 4.5+	10
				-60			
					100/5"	P 4.5+	15
Boring continued with rock core	601.70			-65			
				-70			
				-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test  
 Stations, Depths, Offset, and Elevations are in Feet

# Testing Service Corporation

## STRUCTURE ROCK CORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek

SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson

COUNTY Mercer

Boring No. B-3 Pier 2 Core Type NX  
 Station 864+50 Core Diameter 2 in  
 Offset 27.00ft RT Core Length 15 ft  
 Surface Elev. 666.70 ft

R E C O V E R Y	R · Q · D ·	C O R E T I M E	C O M P. S T R N G T H
(%)	(%)	(Min/ ft)	(tsf)
97	82		
			132.5
			162.7
93	77		227.5
			160.6

Top Elev. ft	Coring Notes and Rock Description	Core Run (#)
601.70	Hard gray to dark gray SHALE	1
	-70.0	
	Moisture Content = 1%	
	-75.0	
	Moisture Content = 1%	
	Moisture Content = 1%	2
	-80.0	
	Moisture Content = 1%	
586.70	End of Boring at 80'	
	-85.0	

Color pictures of the cores Yes

Cores will be stored for examination until \_\_\_\_\_



0 ft to 2 ft



2 ft to 4 ft





4 ft to 6 ft



6 ft to 8 ft



10 ft to 12 ft



10 ft to 12 ft



12 ft to 14 ft



14 ft to 16 ft

**ILLINOIS DEPARTMENT OF TRANSPORTATION**  
**Testing Service Corporation**  
**STRUCTURE BORING LOG**

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek  
 SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson  
 COUNTY Mercer LOCATION Greene Township S.34/35, TWP. 14N, RNG. 2W

Boring No.	Station	Offset	Surface Elev.	DEPTH	BLOW S	Qu tsf	W %	Surface Water Elev.	Groundwater Elev.:	DEPTH	BLOW S	Qu tsf	W %
B-4 S. Abutment	865+30	27.00ft RT	667.00 ft					650.1					
								645.0					
Stiff brown SILTY CLAY LOAM, moist			664.00		2 2 3	B 1.05	19	641.00			0 0 2		20
Stiff brown SILTY LOAM, moist			661.00		1 3 5	B 1.15	21	639.00 638.00			1 1 3		23
Stiff dark brown SILTY CLAY LOAM, moist			659.00		2 3 5	P 2.0	23	635.00					
Stiff brown brown SILTY CLAY LOAM, moist			657.00	-10	1 3 4	P 1.5	25				2 3 5	P 1.5	21
Very stiff to stiff brown-gray SILTY CLAY LOAM, moist					2 5 6	B 2.46	23						
								629.00					
					2 5 5	B 2.67	24				3 5 6	P 2.0	24
			649.00		1 3 4	B 1.03	27						
Soft brown-gray SILTY CLAY LOAM, very moist					1 3 3	B 0.49	28				3 4 9	P 1.5	21
								622.00					
					0 1 2	B 0.41	30						
			644.00										
Very loose brown-gray SILT, wet					0 0 1		23				6 23 90	P 4.5+	10

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test Stations. Depths. Offset. and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION  
Testing Service Corporation  
STRUCTURE BORING LOG

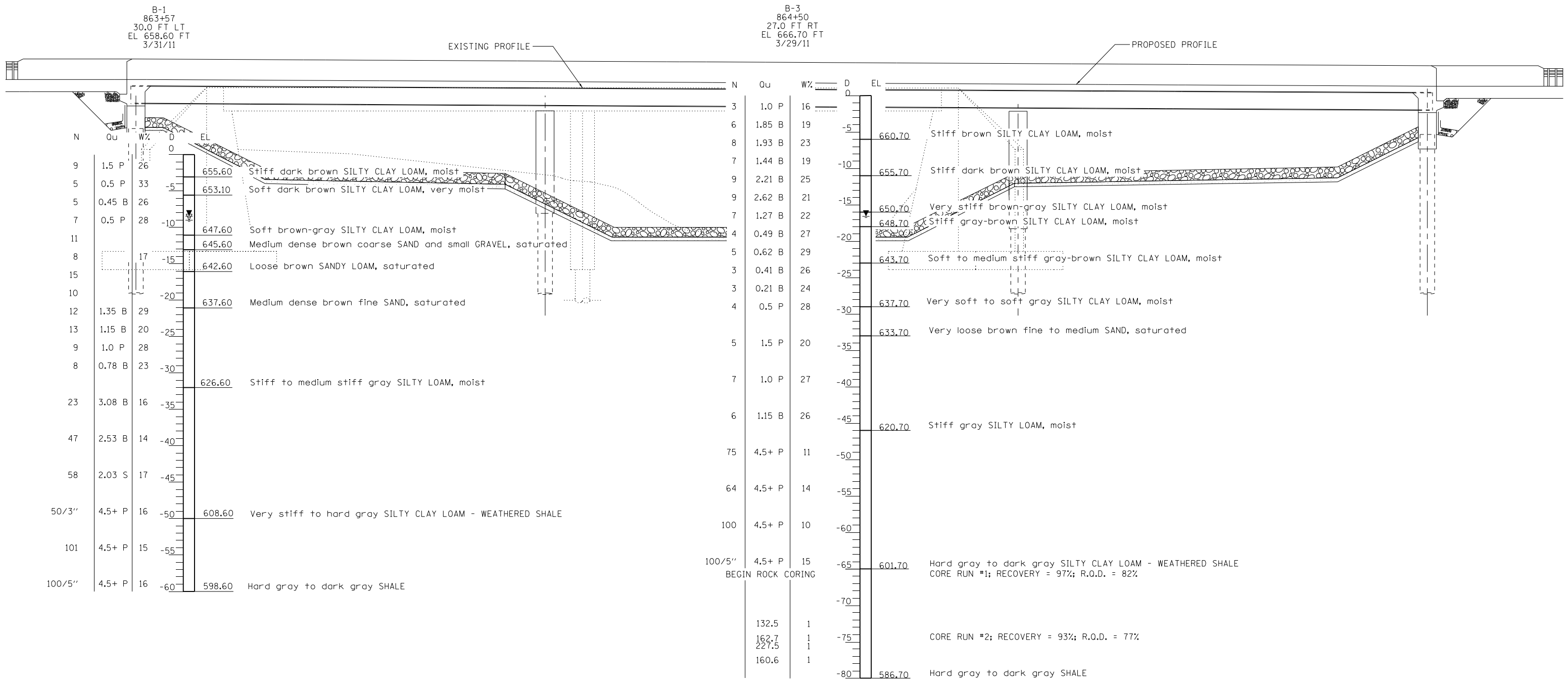
STRUCTURE NO. 066-0019  
 ROUTE U. S. 67  
 SECTION 103-BR  
 COUNTY Mercer

Boring No. <u>B-4 S. Abutment</u>	D	B	Qu	W
Station <u>865+30</u>	E	L	tsf	%
Offset <u>27.00ft RT</u>	P	O		
Elevation <u>617.00</u> ft	H	W		
		S		
Hard gray SILTY CLAY LOAM - WEATHERED SHALE	615.00			
Hard gray SHALE				
		20	P	9
		100/5"	4.5+	
	-55			
		60	9	9
	607.00	-60	100/3"	4.5+
End of Boring at 60' - Auger Refusal				
	-65			
	-70			
	-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test  
 Stations, Depths, Offset, and Elevations are in Feet

## Appendix D

STATE OF ILLINOIS  
DEPARTMENT OF TRANSPORTATION



SUBSURFACE DATA PROFILE  
US 67 OVER POPE CREEK  
F.A.P. 310 - SECTION 103-BR  
MERCER COUNTY  
STATION 864+38.47  
STRUCTURE NO. 066-0019

NOT TO SCALE

LEGEND

EL = Elevation (ft)  
D = Depth Below Existing Ground Surface (ft)  
N = SPT N-Value (AASHTO T206)  
Qu = Unconfined compressive Strength in tons per tsf (tsf)  
Failure Mode (B= Bulge, S= shear, P= penetrometer)  
w% = Moisture Content Percentage

WATER TABLE LEGEND

▽ = Groundwater Level First Encountered  
▽ = Groundwater Level Upon Completion  
▽ = Groundwater Level After -- hours

DESIGNED -
CHECKED -
DRAWN -
CHECKED -

200	EXAMINED
ENGINEER OF BRIDGE DESIGN	PASSED
ENGINEER OF BRIDGES AND STRUCTURES	

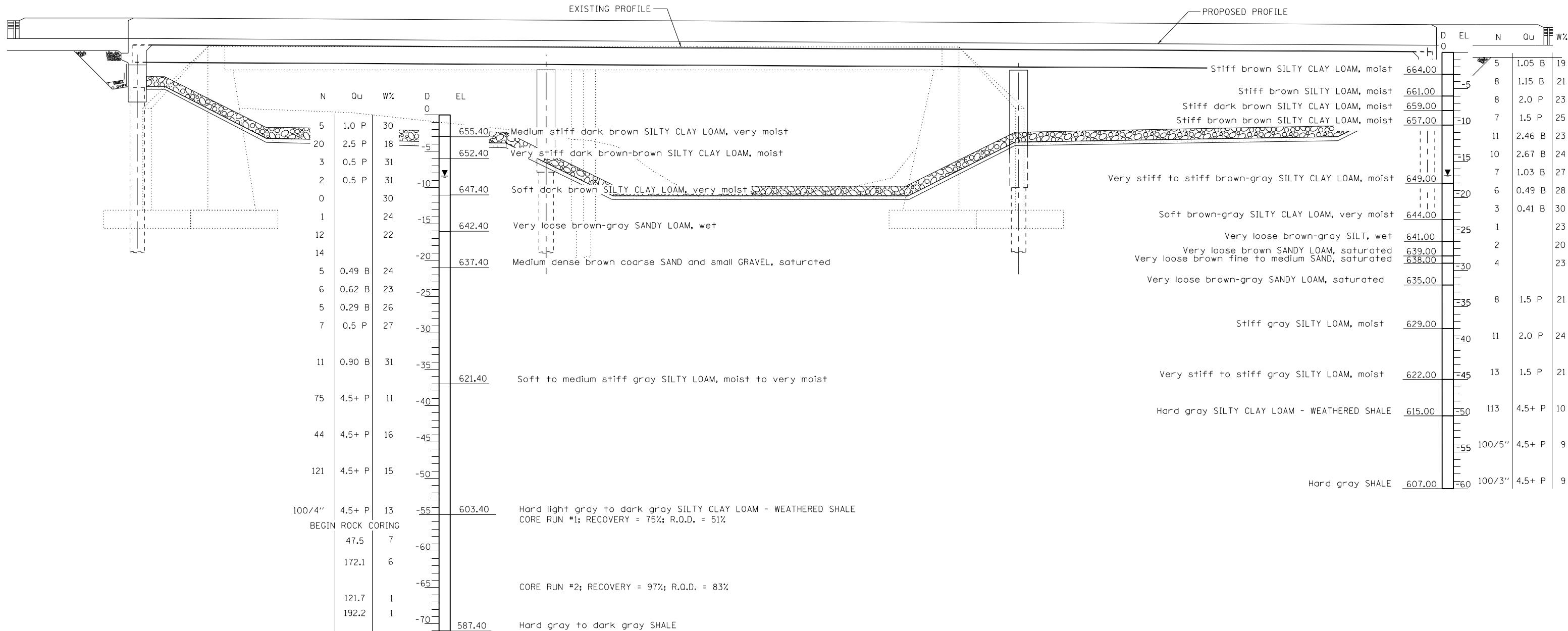
**TERRA ENGINEERING LTD.**  
401 MAIN STREET, SUITE 1130  
PEORIA, IL 61602  
W(309)999-0123 F(309)999-0120  
www.terraengineering.com

SHEET NO. 1	F.A.P. RTE. 310	SECTION 103-BR	COUNTY MERCER	TOTAL SHEETS	SHEET NO.
2 SHEETS	BORINGS 1 AND 3		CONTRACT NO.		
FED. ROAD DIST. NO. - ILLINOIS FED. AID PROJECT					

STATE OF ILLINOIS  
DEPARTMENT OF TRANSPORTATION

B-2  
863+92  
30.0 FT LT  
EL 658.40 FT  
3/31/11

B-4  
865+30  
27.0 FT RT  
EL 667.00 FT  
3/30/11



SUBSURFACE DATA PROFILE  
US 67 OVER POPE CREEK  
F.A.P. 310 - SECTION 103-BR  
MERCER COUNTY  
STATION 864+38.47  
STRUCTURE NO. 066-0019

NOT TO SCALE

LEGEND

EL = Elevation (ft)  
D = Depth Below Existing Ground Surface (ft)  
N = SPT N-Value (AASHTO T206)  
Qu = Unconfined compressive Strength in tons per tsf (tsf)  
Failure Mode (B= Bulge, S= shear, P= penetrometer)  
w% = Moisture Content Percentage

WATER TABLE LEGEND

▽ = Groundwater Level First Encountered  
▽ = Groundwater Level Upon Completion  
▽ = Groundwater Level After ... hours

DESIGNED -
CHECKED -
DRAWN -
CHECKED -

200
EXAMINED
ENGINEER OF BRIDGE DESIGN
PASSED
ENGINEER OF BRIDGES AND STRUCTURES

	401 MAIN STREET, SUITE 1130 PEORIA, IL 61602 W(309)999-0123 F(309)999-0120 www.terraengineering.com	SHEET NO. 2	F.A.P. RTE. 310	SECTION 103-BR	COUNTY MERCER	TOTAL SHEETS	SHEET NO.
	2 SHEETS		BORINGS 2 AND 4		CONTRACT NO.		
		FED. ROAD DIST. NO.		ILLINOIS FED. AID PROJECT			



# Appendix E

# ***Slide Analysis Information***

## **Document Name**

File Name: SLIDE\_POPE CREEK\_NORTH ABUTMENT\_SEISMIC.sli

## **Project Settings**

Project Title: SLIDE - An Interactive Slope Stability Program  
Failure Direction: Left to Right  
Units of Measurement: Imperial Units  
Pore Fluid Unit Weight: 62.4 lb/ft<sup>3</sup>  
Groundwater Method: Water Surfaces  
Data Output: Standard  
Calculate Excess Pore Pressure: Off  
Allow Ru with Water Surfaces or Grids: Off  
Random Numbers: Pseudo-random Seed  
Random Number Seed: 10116  
Random Number Generation Method: Park and Miller v.3

## **Analysis Methods**

Analysis Methods used:  
Bishop simplified  
Janbu simplified

Number of slices: 25  
Tolerance: 0.005  
Maximum number of iterations: 50

## **Surface Options**

Surface Type: Circular  
Search Method: Grid Search  
Radius increment: 10  
Composite Surfaces: Disabled  
Reverse Curvature: Create Tension Crack  
Minimum Elevation: Not Defined  
Minimum Depth: Not Defined

## **Loading**

Seismic Load Coefficient (Horizontal): 0.03198

## **Material Properties**

Material: 1-Silty Clay Loam  
Strength Type: Mohr-Coulomb  
Unit Weight: 127.26 lb/ft<sup>3</sup>  
Cohesion: 1000 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 3- Silty Clay Loam

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 124.23 lb/ft<sup>3</sup>  
Saturated Unit Weight: 128.27 lb/ft<sup>3</sup>  
Cohesion: 460 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 4-Sand and Gravel

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 110.66 lb/ft<sup>3</sup>  
Saturated Unit Weight: 121 lb/ft<sup>3</sup>  
Cohesion: 0 psf  
Friction Angle: 31 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 5-Sandy Loam

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 128.4 lb/ft<sup>3</sup>  
Saturated Unit Weight: 140.4 lb/ft<sup>3</sup>  
Cohesion: 0 psf  
Friction Angle: 29 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 6- Sand

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 110.66 lb/ft<sup>3</sup>  
Saturated Unit Weight: 121 lb/ft<sup>3</sup>  
Cohesion: 0 psf  
Friction Angle: 32 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 7-Silty Loam

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 119.04 lb/ft<sup>3</sup>  
Saturated Unit Weight: 120 lb/ft<sup>3</sup>  
Cohesion: 1080 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 8- Silty Clay Loam-Weathered Shale

Strength Type: Mohr-Coulomb  
Unit Weight: 143.43 lb/ft<sup>3</sup>  
Cohesion: 2540 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 9-Shale

Strength Type: Mohr-Coulomb  
Unit Weight: 149 lb/ft<sup>3</sup>

Cohesion: 5000 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 2- Silty Clay Loam  
Strength Type: Mohr-Coulomb  
Unit Weight: 134.33 lb/ft3  
Cohesion: 480 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

### **List of All Coordinates**

#### Material Boundary

0.000	649.600
140.000	649.600

#### Material Boundary

0.000	647.600
242.000	647.600

#### Material Boundary

0.000	645.600
242.000	645.600

#### Material Boundary

0.000	642.600
242.000	642.600

#### Material Boundary

0.000	637.600
242.000	637.600

#### Material Boundary

0.000	626.600
242.000	626.600

#### Material Boundary

0.000	613.600
242.000	613.600

#### Material Boundary

0.000	655.600
128.060	655.600

#### External Boundary

0.000	669.630
0.000	655.600
0.000	649.600
0.000	647.600
0.000	645.600
0.000	642.600
0.000	637.600

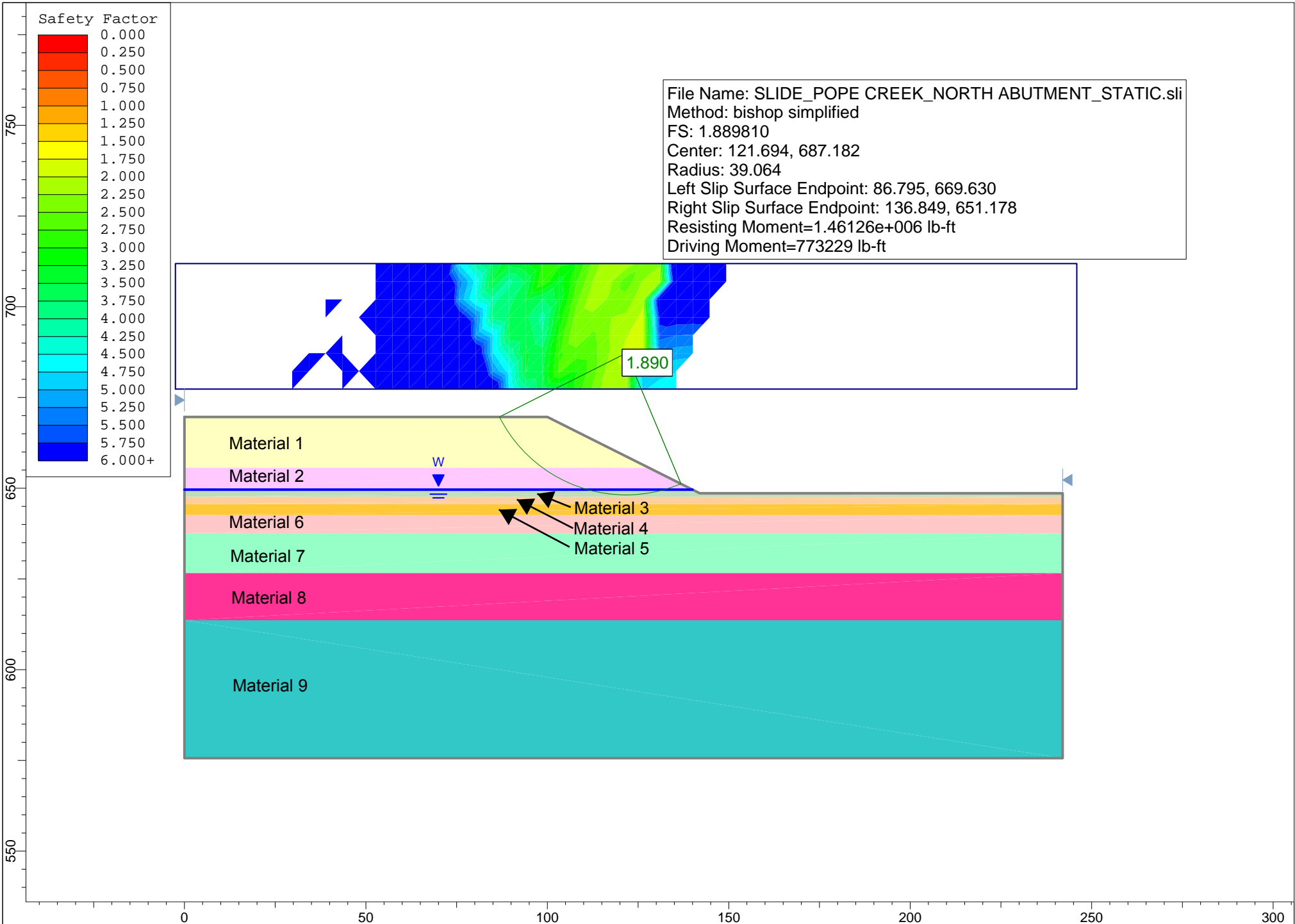
0.000	626.600
0.000	613.600
0.000	575.600
242.000	575.600
242.000	613.600
242.000	626.600
242.000	637.600
242.000	642.600
242.000	645.600
242.000	647.600
242.000	648.600
142.000	648.600
140.000	649.600
128.060	655.600
100.000	669.630

Water Table

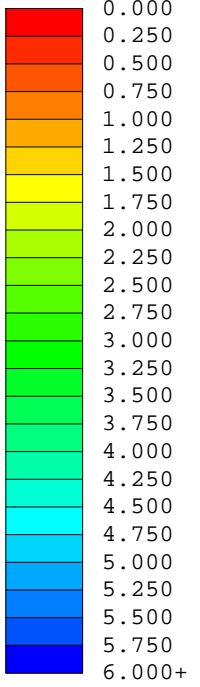
0.000	649.600
140.000	649.600

Search Grid

-2.493	677.299
245.880	677.299
245.880	711.889
-2.493	711.889



Safety Factor



File Name: SLIDE\_POPE CREEK\_NORTH ABUTMENT\_SEISMIC.sli  
Seismic Load Coefficient (Horizontal): 0.03198  
Method: bishop simplified  
FS: 1.750890  
Center: 121.694, 687.182  
Radius: 39.064  
Left Slip Surface Endpoint: 86.795, 669.630  
Right Slip Surface Endpoint: 136.849, 651.178  
Resisting Moment=1.46126e+006 lb-ft  
Driving Moment=834580 lb-ft



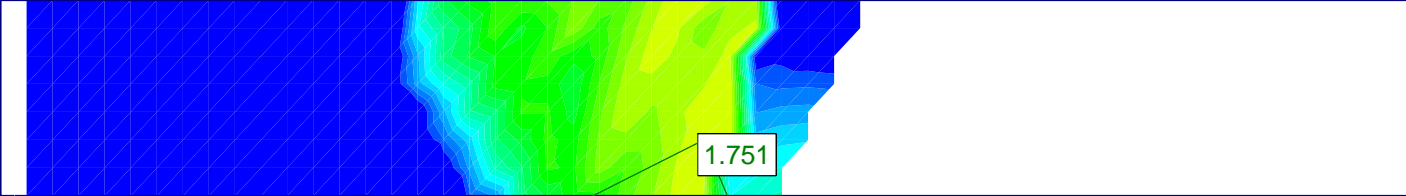
750

700

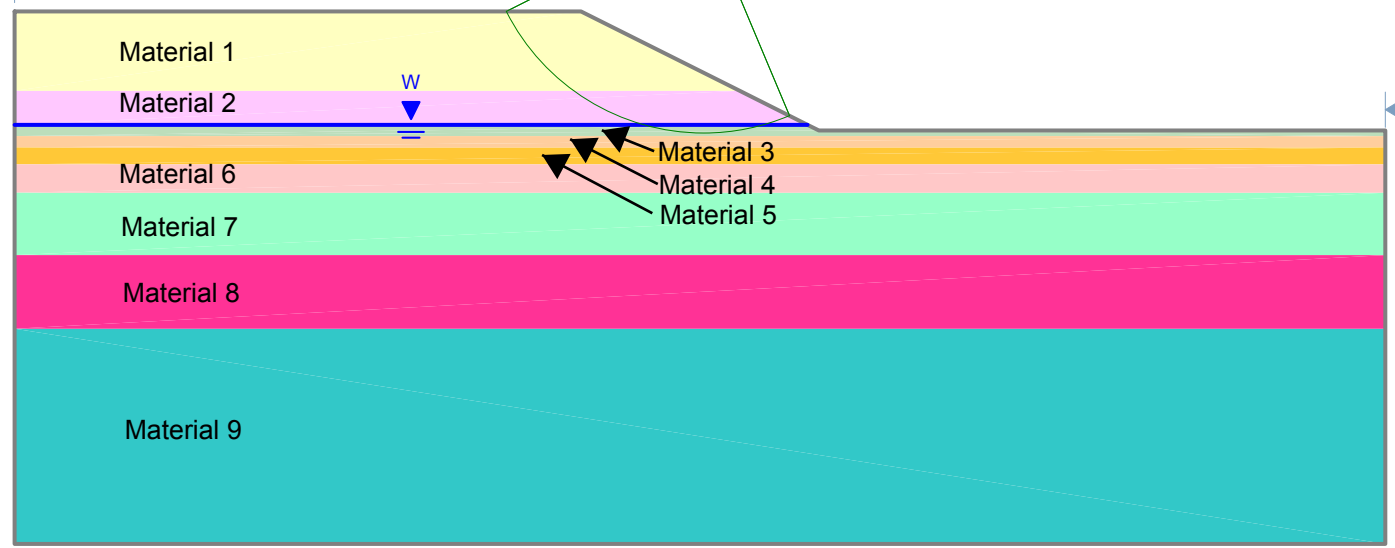
650

600

550



1.751



0

50

100

150

200

250

300

# ***Slide Analysis Information***

## **Document Name**

File Name: SLIDE\_POPE CREEK\_SOUTH ABUTMENT\_SEISMIC.sli

## **Project Settings**

Project Title: SLIDE - An Interactive Slope Stability Program  
Failure Direction: Left to Right  
Units of Measurement: Imperial Units  
Pore Fluid Unit Weight: 62.4 lb/ft<sup>3</sup>  
Groundwater Method: Water Surfaces  
Data Output: Standard  
Calculate Excess Pore Pressure: Off  
Allow Ru with Water Surfaces or Grids: Off  
Random Numbers: Pseudo-random Seed  
Random Number Seed: 10116  
Random Number Generation Method: Park and Miller v.3

## **Analysis Methods**

Analysis Methods used:  
Bishop simplified  
Janbu simplified

Number of slices: 25  
Tolerance: 0.005  
Maximum number of iterations: 50

## **Surface Options**

Surface Type: Circular  
Search Method: Grid Search  
Radius increment: 10  
Composite Surfaces: Disabled  
Reverse Curvature: Create Tension Crack  
Minimum Elevation: Not Defined  
Minimum Depth: Not Defined

## **Loading**

Seismic Load Coefficient (Horizontal): 0.03198

## **Material Properties**

Material: 1-Silty Clay Loam/ Silty Loam  
Strength Type: Mohr-Coulomb  
Unit Weight: 123.76 lb/ft<sup>3</sup>  
Cohesion: 1000 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1



Material: 2- Silty Clay Loam

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 124.23 lb/ft<sup>3</sup>  
Saturated Unit Weight: 128.27 lb/ft<sup>3</sup>  
Cohesion: 500 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 3-Silt

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 109.48 lb/ft<sup>3</sup>  
Saturated Unit Weight: 113.16 lb/ft<sup>3</sup>  
Cohesion: 0 psf  
Friction Angle: 27 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 4-Sandy Loam

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 141.6 lb/ft<sup>3</sup>  
Saturated Unit Weight: 145.8 lb/ft<sup>3</sup>  
Cohesion: 0 psf  
Friction Angle: 29 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 5-Silty Loam

Strength Type: Mohr-Coulomb  
Unsaturated Unit Weight: 125.39 lb/ft<sup>3</sup>  
Saturated Unit Weight: 128.69 lb/ft<sup>3</sup>  
Cohesion: 1630 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 6-Silty Clay Loam-Weathered Shale

Strength Type: Mohr-Coulomb  
Unit Weight: 136.4 lb/ft<sup>3</sup>  
Cohesion: 5000 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

Material: 7-Shale

Strength Type: Mohr-Coulomb  
Unit Weight: 149 lb/ft<sup>3</sup>  
Cohesion: 5000 psf  
Friction Angle: 0 degrees  
Water Surface: Water Table  
Custom Hu value: 1

**List of All Coordinates**

Material Boundary

0.000      649.600

140.000 649.600

Material Boundary

0.000 644.000  
242.000 644.000

Material Boundary

0.000 641.000  
242.000 641.000

Material Boundary

0.000 635.000  
242.000 635.000

Material Boundary

0.000 622.000  
242.000 622.000

Material Boundary

0.000 615.000  
242.000 615.000

External Boundary

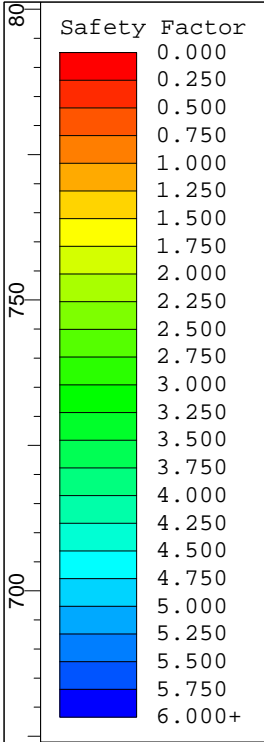
0.000 669.630  
0.000 649.600  
0.000 644.000  
0.000 641.000  
0.000 635.000  
0.000 622.000  
0.000 615.000  
0.000 600.000  
242.000 600.000  
242.000 615.000  
242.000 622.000  
242.000 635.000  
242.000 641.000  
242.000 644.000  
242.000 648.600  
142.000 648.600  
140.000 649.600  
100.000 669.630

Water Table

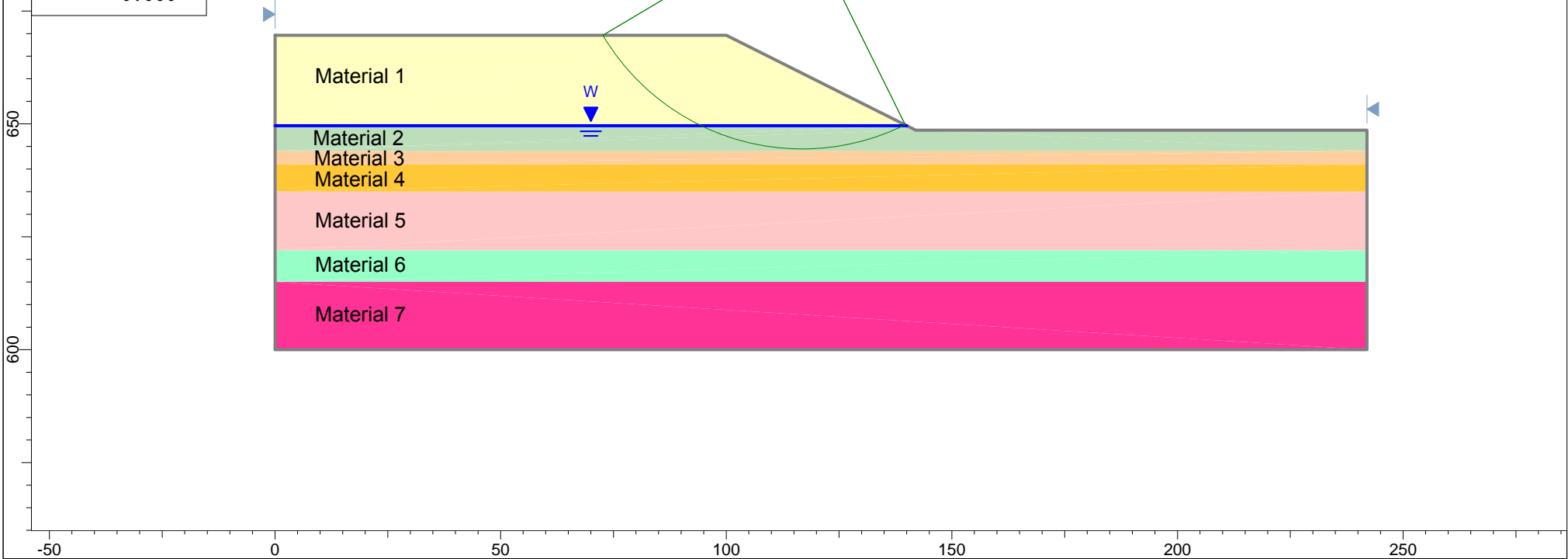
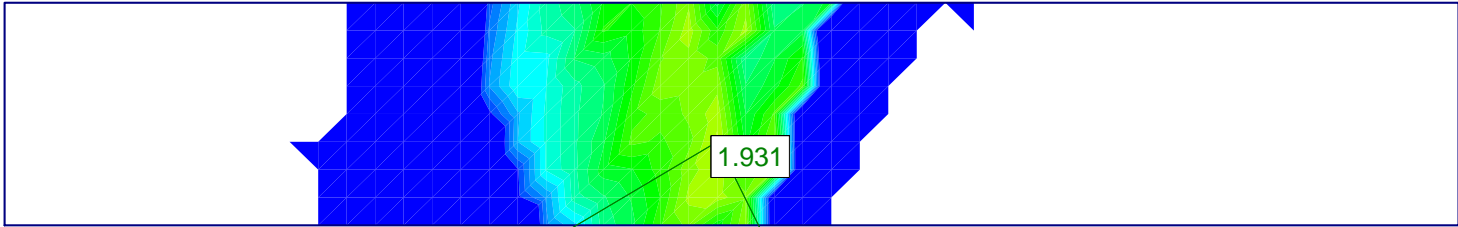
0.000 649.600  
140.000 649.600

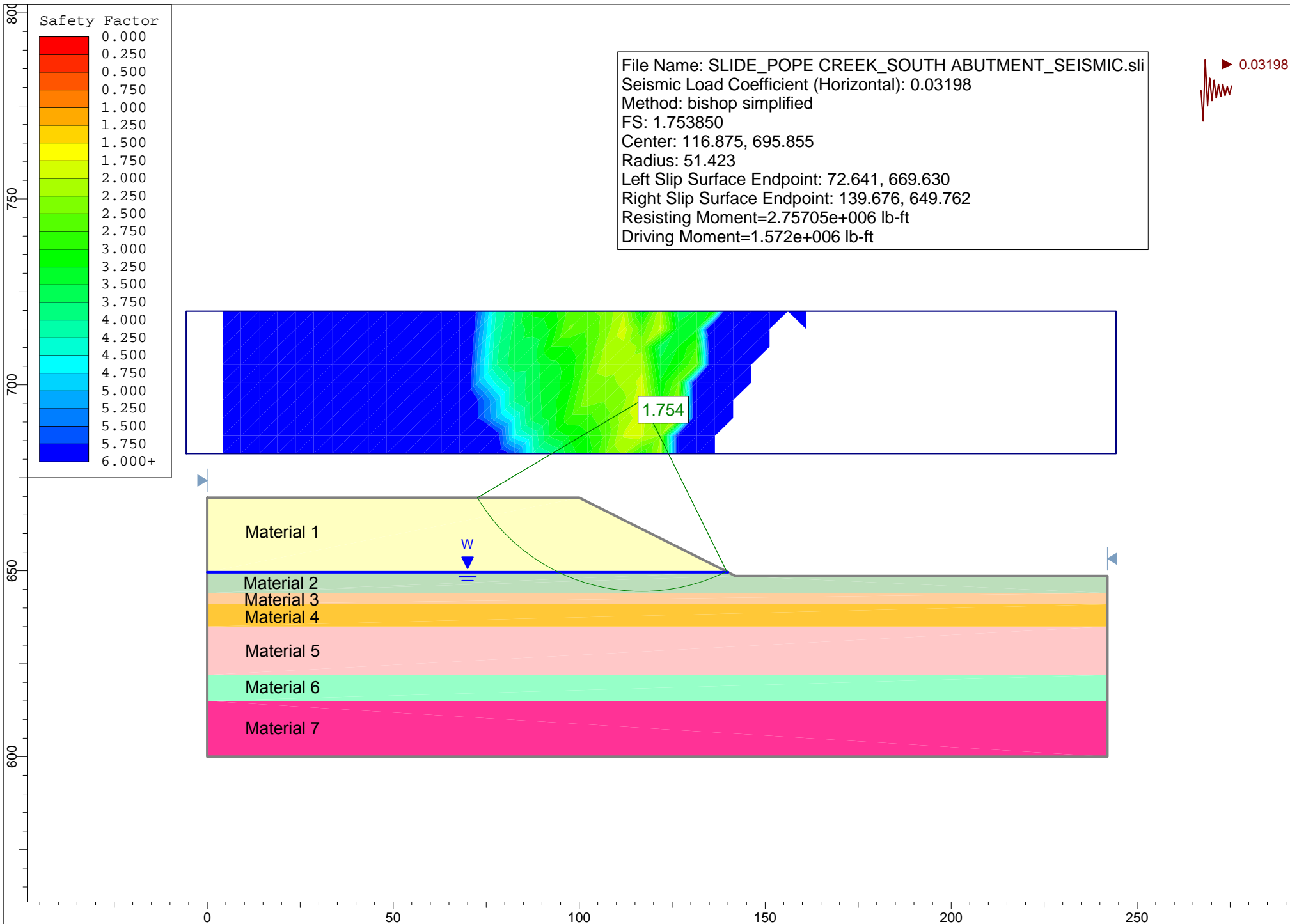
Search Grid

-5.671 681.497  
244.323 681.497  
244.323 719.784  
-5.671 719.784

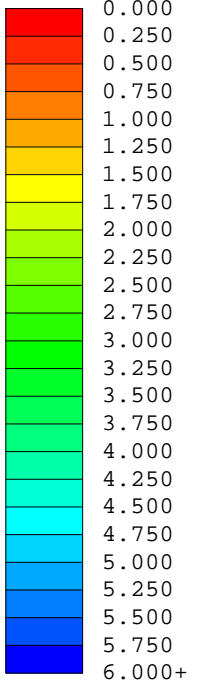


File Name: SLIDE\_POPE CREEK\_SOUTH ABUTMENT\_STATIC.sli  
 Method: bishop simplified  
 FS: 1.931070  
 Center: 116.875, 695.855  
 Radius: 51.423  
 Left Slip Surface Endpoint: 72.641, 669.630  
 Right Slip Surface Endpoint: 139.676, 649.762  
 Resisting Moment=2.75705e+006 lb-ft  
 Driving Moment=1.42773e+006 lb-ft

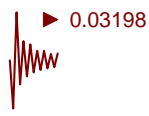




Safety Factor



File Name: SLIDE\_POPE CREEK\_SOUTH ABUTMENT\_SEISMIC.sli  
 Seismic Load Coefficient (Horizontal): 0.03198  
 Method: bishop simplified  
 FS: 1.753850  
 Center: 116.875, 695.855  
 Radius: 51.423  
 Left Slip Surface Endpoint: 72.641, 669.630  
 Right Slip Surface Endpoint: 139.676, 649.762  
 Resisting Moment=2.75705e+006 lb-ft  
 Driving Moment=1.572e+006 lb-ft



1.754

Material 1

Material 2

Material 3

Material 4

Material 5

Material 6

Material 7

W

## Appendix F

# SEISMIC SITE CLASS DETERMINATION

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified on 12/10/10

PROJECT TITLE=====**US 67 over Pope Creek SN 066-0003 (EX) 066-0019 (PR)**

**Substructure 1**

Base of Substruct. Elev. (or ground surf for bents) **662.3** ft.  
 Pile or Shaft Dia. **12** inches  
 Boring Number **B-1**  
 Top of Boring Elev. **658.6** ft.  
 Approximate Fixity Elev. **656.3** ft.

**Individual Site Class Definition:**  
 N (bar): 26 (Blows/ft.) Soil Site Class D  
 N<sub>ch</sub> (bar): 45 (Blows/ft.) Soil Site Class D <----Controls  
 s<sub>u</sub> (bar): 2.2 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	Layer Description		
			N	u	
	657.1	1.50	9	1.50	B
1.7	654.6	2.50	5	0.50	B
4.2	652.1	2.50	5	0.45	
6.7	649.6	2.50	7	0.50	B
9.2	647.1	2.50	11		B
11.7	644.6	2.50	8		B
14.2	642.1	2.50	15		
16.7	639.6	2.50	10		B
19.2	637.1	2.50	12	1.35	
21.7	634.6	2.50	13	1.15	
24.2	632.1	2.50	9	1.00	
26.7	629.6	2.50	8	0.78	B
34.2	622.1	7.50	23	3.08	
39.2	617.1	5.00	47	2.53	
44.2	612.1	5.00	58	2.03	B
49.2	607.1	5.00	100	5.00	
54.2	602.1	5.00	100	5.00	
101.8	554.5	47.60	100	5.00	R

**Substructure 2**

Base of Substruct. Elev. (or ground surf for bents) **652.69** ft.  
 Pile or Shaft Dia. **12** inches  
 Boring Number **B-2**  
 Top of Boring Elev. **658.4** ft.  
 Approximate Fixity Elev. **646.69** ft.

**Individual Site Class Definition:**  
 N (bar): 17 (Blows/ft.) Soil Site Class D  
 N<sub>ch</sub> (bar): 24 (Blows/ft.) Soil Site Class D <----Controls  
 s<sub>u</sub> (bar): 2.19 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	Layer Description		
			N	u	
	656.9	1.50	5	1.00	B
	654.4	2.50	20	2.50	B
	651.9	2.50	3	0.50	
	649.4	2.50	2	0.50	B
	646.9	2.50	0		
2.3	644.4	2.50	1		B
4.8	641.9	2.50	12		
7.3	639.4	2.50	14		B
9.8	636.9	2.50	5	0.49	
12.3	634.4	2.50	6	0.62	
14.8	631.9	2.50	5	0.29	
17.3	629.4	2.50	7	0.50	
22.3	624.4	5.00	11	0.90	B
27.3	619.4	5.00	75	5.00	
32.3	614.4	5.00	44	5.00	
37.3	609.4	5.00	100	5.00	
42.3	604.4	5.00	100	5.00	
100.0	546.7	57.70	100	5.00	R

**Substructure 3**

Base of Substruct. Elev. (or ground surf for bents) **656.01** ft.  
 Pile or Shaft Dia. **12** inches  
 Boring Number **B-3**  
 Top of Boring Elev. **666.7** ft.  
 Approximate Fixity Elev. **650.01** ft.

**Individual Site Class Definition:**  
 N (bar): 14 (Blows/ft.) Soil Site Class E  
 N<sub>ch</sub> (bar): 88 (Blows/ft.) Soil Site Class C  
 s<sub>u</sub> (bar): 1.81 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	Layer Description		
			N	u	
	665.2	1.50	3	1.00	
	662.7	2.50	6	1.85	B
	660.2	2.50	8	1.93	
	658.2	2.00	7	1.44	B
	655.7	2.50	9	2.21	
	653.2	2.50	9	2.62	B
	650.7	2.50	7	1.27	B
1.8	648.2	2.50	4	0.49	
4.3	645.7	2.50	5	0.62	B
6.8	643.2	2.50	3	0.41	
9.3	640.7	2.50	3	0.21	
11.8	638.2	2.50	4	0.50	B
16.8	633.2	5.00	3	1.50	B
21.8	628.2	5.00	7	1.00	
26.8	623.2	5.00	6	1.15	B
31.8	618.2	5.00	75	5.00	
36.8	613.2	5.00	64	5.00	
41.8	608.2	5.00	100	5.00	
46.8	603.2	5.00	100	5.00	
100.0	550.0	53.20	100	5.00	R

**Substructure 4**

Base of Substruct. Elev. (or ground surf for bents) **662.26** ft.  
 Pile or Shaft Dia. **12** inches  
 Boring Number **B-4**  
 Top of Boring Elev. **667** ft.  
 Approximate Fixity Elev. **656.26** ft.

**Individual Site Class Definition:**  
 N (bar): 12 (Blows/ft.) Soil Site Class E  
 N<sub>ch</sub> (bar): 15 (Blows/ft.) Soil Site Class D <----Controls  
 s<sub>u</sub> (bar): 2.57 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	Layer Description		
			N	u	
	665.5	1.50	5	1.05	B
	663.0	2.50	8	1.15	B
	660.5	2.50	8	2.00	B
	658.0	2.50	7	1.50	B
0.8	655.5	2.50	11	2.46	
3.3	653.0	2.50	10	2.67	
5.8	650.5	2.50	7	1.03	B
8.3	648.0	2.50	6	0.49	
10.8	645.5	2.50	3	0.41	B
13.3	643.0	2.50	1		B
15.8	640.5	2.50	2		B
18.3	638.0	2.50	4		B
23.3	633.0	5.00	8	1.50	B
28.3	628.0	5.00	11	2.00	
33.3	623.0	5.00	13	1.50	B
38.3	618.0	5.00	100	5.00	
43.3	613.0	5.00	100	5.00	
101.8	554.5	58.50	100	5.00	R

**Global Site Class Definition: Substructures 1 through 4**

N (bar): 17 (Blows/ft.) Soil Site Class D  
 N<sub>ch</sub> (bar): 42 (Blows/ft.) Soil Site Class D <----Controls  
 s<sub>u</sub> (bar): 2.19 (ksf) Soil Site Class C

## Appendix G

# Appendix G

## Part - I



# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>413</b> KIPS	<b>226</b> KIPS	<b>124</b> KIPS	<b>45</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Metal Shell 14"Φ w/.25" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		15.1		32.7	33	0	0	18	6
657.10	1.50	1.50	9		8.3	17.6	29.2	29	0	0	16	7
654.60	2.50	0.50	5		5.6	5.9	34.2	34	0	0	19	10
652.10	2.50	0.45	5		5.1	5.3	39.9	40	0	0	22	12
649.60	2.50	0.50	7		5.6	5.9	113.6	114	0	0	63	15
647.10	2.50		11	Medium Sand	9.3	74.0	89.3	89	0	0	49	17
644.60	2.50		8	Very Fine Silty Sand	5.8	40.4	155.6	156	0	0	86	20
642.10	2.50		15	Medium Sand	12.7	100.9	134.6	135	0	0	74	22
639.60	2.50		10	Medium Sand	8.4	67.3	91.6	92	0	0	50	25
637.10	2.50	1.35	12		12.8	15.8	102.1	102	0	0	56	27
634.60	2.50	1.15	13		11.4	13.5	111.7	112	0	0	61	30
632.10	2.50	1.00	9		10.2	11.7	119.3	119	0	0	66	32
629.60	2.50	0.78	8		8.3	9.1	154.5	155	0	0	85	35
624.60	5.00	3.08	23		44.7	36.1	192.8	193	0	0	106	40
619.60	5.00	2.53	47		39.0	29.7	225.9	226	0	0	124	45
614.60	5.00	2.03	58		33.7	23.8	740.5	744	0	0	407	50
609.60	5.00		100	Hard Till	199.6	504.7	940.1	949	0	0	547	55
604.60	5.00		100	Hard Till	199.6	504.7	971.5	974	0	0	534	60
603.60	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>513</b> KIPS	<b>226</b> KIPS	<b>124</b> KIPS	<b>45</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE =====Metal Shell 14"Φ w/.312" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		15.1		32.7	33	0	0	18	6
657.10	1.50	1.50	9		8.3	17.6	29.2	29	0	0	16	7
654.60	2.50	0.50	5		5.6	5.9	34.2	34	0	0	19	10
652.10	2.50	0.45	5		5.1	5.3	39.9	40	0	0	22	12
649.60	2.50	0.50	7		5.6	5.9	113.6	114	0	0	63	15
647.10	2.50		11	Medium Sand	9.3	74.0	89.3	89	0	0	49	17
644.60	2.50		8	Very Fine Silty Sand	5.8	40.4	155.6	156	0	0	86	20
642.10	2.50		15	Medium Sand	12.7	100.9	134.6	135	0	0	74	22
639.60	2.50		10	Medium Sand	8.4	67.3	91.6	92	0	0	50	25
637.10	2.50	1.35	12		12.8	15.8	102.1	102	0	0	56	27
634.60	2.50	1.15	13		11.4	13.5	111.7	112	0	0	61	30
632.10	2.50	1.00	9		10.2	11.7	119.3	119	0	0	66	32
629.60	2.50	0.78	8		8.3	9.1	154.5	155	0	0	85	35
624.60	5.00	3.08	23		44.7	36.1	192.8	193	0	0	106	40
619.60	5.00	2.53	47		39.0	29.7	225.9	226	0	0	124	45
614.60	5.00	2.03	58		33.7	23.8	740.5	744	0	0	407	50
609.60	5.00		100	Hard Till	199.6	504.7	940.1	949	0	0	547	55
604.60	5.00		100	Hard Till	199.6	504.7	971.5	974	0	0	534	60
603.60	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>335</b> KIPS	<b>277</b> KIPS	<b>152</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 10 X 42

Plugged Pile Perimeter===== 3.300 FT. Unplugged Pile Perimeter===== 4.858 FT.  
 Plugged Pile End Bearing Area===== 0.680 SQFT. Unplugged Pile End Bearing Area===== 0.086 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		8.7		23.0	12.8		14.6	15	0	0	8	6
657.10	1.50	1.50	9		4.8	14.3	18.2	7.0	1.8	20.4	18	0	0	10	7
654.60	2.50	0.50	5		3.2	4.8	20.9	4.7	0.6	25.1	21	0	0	12	10
652.10	2.50	0.45	5		2.9	4.3	24.3	4.3	0.5	29.4	24	0	0	13	12
649.60	2.50	0.50	7		3.2	4.8	41.4	4.7	0.6	35.9	36	0	0	20	15
647.10	2.50		11	Medium Sand	1.7	18.6	34.6	2.4	2.4	37.3	35	0	0	19	17
644.60	2.50		8	Very Fine Silty Sand	1.0	10.2	50.9	1.5	1.3	40.7	41	0	0	22	20
642.10	2.50		15	Medium Sand	2.3	25.4	44.7	3.3	3.2	43.0	43	0	0	24	22
639.60	2.50		10	Medium Sand	1.5	17.0	42.1	2.2	2.1	44.7	42	0	0	23	25
637.10	2.50	1.35	12		7.4	12.9	47.6	10.9	1.6	55.3	48	0	0	26	27
634.60	2.50	1.15	13		6.5	11.0	52.7	9.6	1.4	64.7	53	0	0	29	30
632.10	2.50	1.00	9		5.9	9.5	56.4	8.6	1.2	73.1	56	0	0	31	32
629.60	2.50	0.78	8		4.8	7.4	83.1	7.0	0.9	82.9	83	0	0	46	35
624.60	5.00	3.08	23		25.7	29.4	103.6	37.9	3.7	120.1	104	0	0	57	40
619.60	5.00	2.53	47		22.4	24.1	121.3	33.0	3.1	152.5	121	0	0	67	45
614.60	5.00	2.03	58		19.4	19.4	248.4	28.5	2.4	194.7	195	0	0	107	50
609.60	5.00		100	Hard Till	35.6	127.1	284.0	52.4	16.1	247.0	247	0	0	136	55
604.60	5.00		100	Hard Till	35.6	127.1	277.2	52.4	16.1	294.0	277	0	0	152	60
603.60	1.00			Shale		84.8			10.7						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>418</b> KIPS	<b>352</b> KIPS	<b>193</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 53

Plugged Pile Perimeter===== 3.967 FT. Unplugged Pile Perimeter===== 5.800 FT.  
 Plugged Pile End Bearing Area===== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED LOSS FROM SCOUR or DD (KIPS)	FACTORED LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		10.4		31.1	15.2		17.5	18	0	0	10	6
657.10	1.50	1.50	9		5.7	20.7	23.0	8.4	2.3	24.4	23	0	0	13	7
654.60	2.50	0.50	5		3.9	6.9	26.2	5.7	0.8	29.9	26	0	0	14	10
652.10	2.50	0.45	5		3.5	6.2	30.4	5.1	0.7	35.2	30	0	0	17	12
649.60	2.50	0.50	7		3.9	6.9	54.3	5.7	0.8	43.0	43	0	0	24	15
647.10	2.50		11	Medium Sand	2.0	26.9	44.1	2.9	2.9	44.6	44	0	0	24	17
644.60	2.50		8	Very Fine Silty Sand	1.2	14.7	67.4	1.8	1.6	48.8	49	0	0	27	20
642.10	2.50		15	Medium Sand	2.7	36.7	57.8	4.0	4.0	51.4	51	0	0	28	22
639.60	2.50		10	Medium Sand	1.8	24.5	53.7	2.6	2.7	53.4	53	0	0	29	25
637.10	2.50	1.35	12		8.9	18.6	59.8	13.0	2.0	66.1	60	0	0	33	27
634.60	2.50	1.15	13		7.9	15.8	65.6	11.5	1.7	77.3	66	0	0	36	30
632.10	2.50	1.00	9		7.0	13.8	69.7	10.3	1.5	87.3	70	0	0	38	32
629.60	2.50	0.78	8		5.7	10.7	107.1	8.4	1.2	99.2	99	0	0	55	35
624.60	5.00	3.08	23		30.9	42.4	130.4	45.2	4.6	143.5	130	0	0	72	40
619.60	5.00	2.53	47		26.9	34.9	150.5	39.4	3.8	182.2	150	0	0	83	45
614.60	5.00	2.03	58		23.3	28.0	329.5	34.1	3.1	233.3	233	0	0	128	50
609.60	5.00		100	Hard Till	42.7	183.7	372.3	62.5	20.1	295.8	296	0	0	163	55
604.60	5.00		100	Hard Till	42.7	183.7	353.8	62.5	20.1	351.6	352	0	0	193	60
603.60	1.00			Shale			122.5		13.4						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>497</b> KIPS	<b>358</b> KIPS	<b>197</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 63

Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		10.5		31.5	15.5		18.2	18	0	0	10	6
657.10	1.50	1.50	9		5.8	21.0	23.3	8.5	2.7	24.9	23	0	0	13	7
654.60	2.50	0.50	5		3.9	7.0	26.5	5.7	0.9	30.5	26	0	0	15	10
652.10	2.50	0.45	5		3.5	6.3	30.7	5.2	0.8	35.8	31	0	0	17	12
649.60	2.50	0.50	7		3.9	7.0	55.0	5.7	0.9	44.1	44	0	0	24	15
647.10	2.50		11	Medium Sand	2.0	27.4	44.6	2.9	3.5	45.5	45	0	0	25	17
644.60	2.50		8	Very Fine Silty Sand	1.2	14.9	68.2	1.8	1.9	50.2	50	0	0	28	20
642.10	2.50		15	Medium Sand	2.7	37.4	58.5	4.0	4.8	52.6	53	0	0	29	22
639.60	2.50		10	Medium Sand	1.8	24.9	54.3	2.7	3.2	54.5	54	0	0	30	25
637.10	2.50	1.35	12		8.9	18.9	60.5	13.1	2.4	67.3	60	0	0	33	27
634.60	2.50	1.15	13		7.9	16.1	66.3	11.7	2.1	78.7	66	0	0	36	30
632.10	2.50	1.00	9		7.1	14.0	70.3	10.5	1.8	88.8	70	0	0	39	32
629.60	2.50	0.78	8		5.8	10.9	108.3	8.5	1.4	101.4	101	0	0	56	35
624.60	5.00	3.08	23		31.2	43.2	131.8	45.9	5.5	146.3	132	0	0	73	40
619.60	5.00	2.53	47		27.2	35.5	152.0	39.9	4.5	185.3	152	0	0	84	45
614.60	5.00	2.03	58		23.5	28.4	333.9	34.6	3.6	240.1	240	0	0	132	50
609.60	5.00		100	Hard Till	43.1	186.8	377.0	63.4	23.9	303.5	304	0	0	167	55
604.60	5.00		100	Hard Till	43.1	186.8	357.8	63.4	23.9	359.0	358	0	0	197	60
603.60	1.00			Shale		124.6			15.9						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>578</b> KIPS	<b>425</b> KIPS	<b>234</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 14 X 73

Plugged Pile Perimeter===== 4.700 FT. Unplugged Pile Perimeter===== 6.975 FT.  
 Plugged Pile End Bearing Area===== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		12.4		41.3	18.3		21.5	21	0	0	12	6
657.10	1.50	1.50	9		6.8	29.0	28.8	10.1	3.1	29.4	29	0	0	16	7
654.60	2.50	0.50	5		4.6	9.7	32.4	6.8	1.0	36.1	32	0	0	18	10
652.10	2.50	0.45	5		4.2	8.7	37.5	6.2	0.9	42.4	38	0	0	21	12
649.60	2.50	0.50	7		4.6	9.7	70.2	6.8	1.0	52.2	52	0	0	29	15
647.10	2.50		11	Medium Sand	2.4	37.8	55.4	3.5	4.1	53.9	54	0	0	30	17
644.60	2.50		8	Very Fine Silty Sand	1.5	20.6	87.8	2.2	2.2	59.4	59	0	0	33	20
642.10	2.50		15	Medium Sand	3.2	51.5	73.8	4.8	5.6	62.3	62	0	0	34	22
639.60	2.50		10	Medium Sand	2.1	34.4	67.7	3.2	3.7	64.6	65	0	0	36	25
637.10	2.50	1.35	12		10.5	26.1	74.4	15.6	2.8	79.8	74	0	0	41	27
634.60	2.50	1.15	13		9.3	22.2	80.8	13.8	2.4	93.3	81	0	0	44	30
632.10	2.50	1.00	9		8.3	19.3	84.9	12.4	2.1	105.2	85	0	0	47	32
629.60	2.50	0.78	8		6.8	15.1	136.1	10.1	1.6	120.1	120	0	0	66	35
624.60	5.00	3.08	23		36.6	59.5	162.1	54.4	6.4	173.3	162	0	0	89	40
619.60	5.00	2.53	47		31.9	48.9	184.4	47.4	5.3	219.6	184	0	0	101	45
614.60	5.00	2.03	58		27.6	39.2	430.4	41.0	4.2	284.1	284	0	0	156	50
609.60	5.00		100	Hard Till	50.7	257.7	481.1	75.2	27.8	359.3	359	0	0	198	55
604.60	5.00		100	Hard Till	50.7	257.7	445.8	75.2	27.8	425.2	425	0	0	234	60
603.60	1.00			Shale			171.8		18.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====North Abutment  
 REFERENCE BORING =====B-1  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.30 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.30 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>705</b> KIPS	<b>433</b> KIPS	<b>238</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 14 X 89

Plugged Pile Perimeter===== 4.750 FT. Unplugged Pile Perimeter===== 7.033 FT.  
 Plugged Pile End Bearing Area===== 1.409 SQFT. Unplugged Pile End Bearing Area===== 0.181 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
658.60	3.70	1.00	8		12.5		42.1	18.5		22.3	22	0	0	12	6
657.10	1.50	1.50	9		6.9	29.6	29.2	10.1	3.8	29.9	29	0	0	16	7
654.60	2.50	0.50	5		4.6	9.9	32.9	6.9	1.3	36.6	33	0	0	18	10
652.10	2.50	0.45	5		4.2	8.9	38.0	6.2	1.1	43.0	38	0	0	21	12
649.60	2.50	0.50	7		4.6	9.9	71.4	6.9	1.3	53.5	54	0	0	29	15
647.10	2.50		11	Medium Sand	2.4	38.6	56.2	3.5	5.0	54.8	55	0	0	30	17
644.60	2.50		8	Very Fine Silty Sand	1.5	21.1	89.3	2.2	2.7	61.1	61	0	0	34	20
642.10	2.50		15	Medium Sand	3.2	52.6	75.0	4.8	6.8	63.6	64	0	0	35	22
639.60	2.50		10	Medium Sand	2.2	35.1	68.7	3.2	4.5	65.7	66	0	0	36	25
637.10	2.50	1.35	12		10.6	26.7	75.4	15.7	3.4	80.9	75	0	0	41	27
634.60	2.50	1.15	13		9.4	22.7	81.8	13.9	2.9	94.5	82	0	0	45	30
632.10	2.50	1.00	9		8.4	19.7	85.9	12.5	2.5	106.4	86	0	0	47	32
629.60	2.50	0.78	8		6.9	15.4	138.2	10.2	2.0	122.4	122	0	0	67	35
624.60	5.00	3.08	23		37.0	60.8	164.4	54.8	7.8	175.9	164	0	0	90	40
619.60	5.00	2.53	47		32.3	49.9	186.8	47.8	6.4	222.4	187	0	0	103	45
614.60	5.00	2.03	58		27.9	40.1	437.8	41.3	5.2	292.4	292	0	0	161	50
609.60	5.00		100	Hard Till	51.2	263.2	489.0	75.8	33.9	368.2	368	0	0	203	55
604.60	5.00		100	Hard Till	51.2	263.2	452.5	75.8	33.9	432.7	433	0	0	238	60
603.60	1.00			Shale			175.5			22.6					

**Pile Design Table for North Abutment utilizing Boring #B-1**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.179" walls</b>			<b>Steel HP 10 X 57</b>			<b>Steel HP 14 X 73</b>		
101	56	32	124	68	45	120	66	35
128	70	35	201	111	50	162	89	40
162	89	40	254	140	55	184	101	45
191	105	45	284	156	60	284	156	50
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 12 X 53</b>			359 198 55		
101	56	32	99	55	35	425	234	60
128	70	35	130	72	40	<b>Steel HP 14 X 89</b>		
162	89	40	150	83	45	122	67	35
191	105	45	233	128	50	164	90	40
<b>Metal Shell 14"Φ w/.25" walls</b>			296	163	55	187	103	45
119	66	32	352	193	60	292	161	50
155	85	35	<b>Steel HP 12 X 63</b>			368	203	55
193	106	40	101	56	35	433	238	60
226	124	45	132	73	40	<b>Steel HP 14 X 102</b>		
<b>Metal Shell 14"Φ w/.312" walls</b>			152	84	45	124	68	35
119	66	32	240	132	50	167	92	40
155	85	35	304	167	55	189	104	45
193	106	40	358	197	60	298	164	50
226	124	45	<b>Steel HP 12 X 74</b>			374	206	55
<b>Steel HP 8 X 36</b>			103	57	35	438	241	60
96	53	45	134	74	40	<b>Steel HP 14 X 117</b>		
157	86	50	154	85	45	88	48	32
199	109	55	245	135	50	126	69	35
214	118	60	309	170	55	169	93	40
<b>Steel HP 10 X 42</b>			363	200	60	192	105	45
121	67	45	<b>Steel HP 12 X 84</b>			306	168	50
195	107	50	104	57	35	383	211	55
247	136	55	136	75	40	445	245	60
277	152	60	157	86	45	<b>Precast 14"x 14"</b>		
			250	138	50	117	64	25
			314	173	55	130	71	27
			368	202	60	142	78	30
						152	84	32
						197	108	35
						246	135	40
						<b>Timber Pile</b>		
						111	61	35
						147	81	40



# Appendix G

## Part- II

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====South Abutment  
 REFERENCE BORING =====B-4  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.26 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.26 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>413</b> KIPS	<b>175</b> KIPS	<b>96</b> KIPS	<b>37</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Metal Shell 14"Φ w/.25" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
662.00	0.26	1.15	8		1.2		24.6	25	0	0	14	2
659.50	2.50	2.00	8		16.7	23.5	35.5	35	0	0	20	5
657.00	2.50	1.50	7		13.8	17.6	60.5	61	0	0	33	7
654.50	2.50	2.46	11		19.1	28.8	82.1	82	0	0	45	10
652.00	2.50	2.67	10		20.2	31.3	83.1	83	0	0	46	12
649.50	2.50	1.03	7		10.4	12.1	87.2	87	0	0	48	15
647.00	2.50	0.49	6		5.5	5.7	91.7	92	0	0	50	17
644.50	2.50	0.41	3		4.7	4.8	96.6	97	0	0	53	20
642.00	2.50		1	Very Fine Silty Sand	0.7	5.0	102.4	102	0	0	56	22
639.50	2.50		2	Very Fine Silty Sand	1.4	10.1	113.9	114	0	0	63	25
637.00	2.50		4	Very Fine Silty Sand	2.9	20.2	114.2	114	0	0	63	27
632.00	5.00	1.50	8		27.6	17.6	147.7	148	0	0	81	32
627.00	5.00	2.00	11		33.4	23.5	175.2	175	0	0	96	37
622.00	5.00	1.50	13		27.6	17.6	689.9	690	0	0	379	42
617.00	5.00		100	Hard Till	199.6	504.7	889.5	890	0	0	489	47
612.00	5.00		100	Hard Till	199.6	504.7	920.9	921	0	0	506	52
611.00	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====South Abutment  
 REFERENCE BORING =====B-4  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.26 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.26 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>513</b> KIPS	<b>175</b> KIPS	<b>96</b> KIPS	<b>37</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE =====Metal Shell 14"Φ w/.312" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL						NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)								
662.00	0.26	1.15	8		1.2		24.6				25	0	0	14	2
659.50	2.50	2.00	8		16.7	23.5	35.5				35	0	0	20	5
657.00	2.50	1.50	7		13.8	17.6	60.5				61	0	0	33	7
654.50	2.50	2.46	11		19.1	28.8	82.1				82	0	0	45	10
652.00	2.50	2.67	10		20.2	31.3	83.1				83	0	0	46	12
649.50	2.50	1.03	7		10.4	12.1	87.2				87	0	0	48	15
647.00	2.50	0.49	6		5.5	5.7	91.7				92	0	0	50	17
644.50	2.50	0.41	3		4.7	4.8	96.6				97	0	0	53	20
642.00	2.50		1	Very Fine Silty Sand	0.7	5.0	102.4				102	0	0	56	22
639.50	2.50		2	Very Fine Silty Sand	1.4	10.1	113.9				114	0	0	63	25
637.00	2.50		4	Very Fine Silty Sand	2.9	20.2	114.2				114	0	0	63	27
632.00	5.00	1.50	8		27.6	17.6	147.7				148	0	0	81	32
627.00	5.00	2.00	11		33.4	23.5	175.2				175	0	0	96	37
622.00	5.00	1.50	13		27.6	17.6	689.9				690	0	0	379	42
617.00	5.00		100	Hard Till	199.6	504.7	889.5				890	0	0	489	47
612.00	5.00		100	Hard Till	199.6	504.7	920.9				921	0	0	506	52
611.00	1.00			Shale		336.5									

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== **South Abutment**  
 REFERENCE BORING ===== **B-4**  
 LRFD or ASD or SEISMIC ===== **LRFD**  
 PILE CUTOFF ELEV. ===== **664.26** ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR **662.26** ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) **None**  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>335</b> KIPS	<b>260</b> KIPS	<b>143</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== **807** kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== **35.17** ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = **1**  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== **Steel HP 10 X 42**  
 Plugged Pile Perimeter===== 3.300 FT. Unplugged Pile Perimeter===== 4.858 FT.  
 Plugged Pile End Bearing Area===== 0.680 SQFT. Unplugged Pile End Bearing Area===== 0.086 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
662.00	0.26	1.15	8		0.7		19.7	1.0		3.4	3	0	0	2	2
659.50	2.50	2.00	8		9.6	19.1	24.6	14.1	2.4	16.9	17	0	0	9	5
657.00	2.50	1.50	7		7.9	14.3	41.7	11.7	1.8	29.8	30	0	0	16	7
654.50	2.50	2.46	11		11.0	23.5	54.7	16.2	3.0	46.2	46	0	0	25	10
652.00	2.50	2.67	10		11.6	25.5	50.7	17.1	3.2	61.4	51	0	0	28	12
649.50	2.50	1.03	7		6.0	9.8	51.5	8.8	1.2	69.5	52	0	0	28	15
647.00	2.50	0.49	6		3.2	4.7	53.9	4.6	0.6	74.1	54	0	0	30	17
644.50	2.50	0.41	3		2.7	3.9	53.9	3.9	0.5	77.7	54	0	0	30	20
642.00	2.50		1	Very Fine Silty Sand	0.1	1.3	55.3	0.2	0.2	78.1	55	0	0	30	22
639.50	2.50		2	Very Fine Silty Sand	0.3	2.5	58.1	0.4	0.3	78.8	58	0	0	32	25
637.00	2.50		4	Very Fine Silty Sand	0.5	5.1	67.9	0.8	0.6	80.7	68	0	0	37	27
632.00	5.00	1.50	8		15.9	14.3	88.5	23.4	1.8	104.7	89	0	0	49	32
627.00	5.00	2.00	11		19.2	19.1	103.0	28.3	2.4	132.3	103	0	0	57	37
622.00	5.00	1.50	13		15.9	14.3	231.6	23.4	1.8	170.0	170	0	0	93	42
617.00	5.00		100	Hard Till	35.6	127.1	267.2	52.4	16.1	222.3	222	0	0	122	47
612.00	5.00		100	Hard Till	35.6	127.1	260.4	52.4	16.1	269.3	260	0	0	143	52
611.00	1.00			Shale		84.8			10.7						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====South Abutment  
 REFERENCE BORING =====B-4  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.26 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.26 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>418</b> KIPS	<b>322</b> KIPS	<b>177</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 53

Plugged Pile Perimeter===== 3.967 FT. Unplugged Pile Perimeter===== 5.800 FT.  
 Plugged Pile End Bearing Area===== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
662.00	0.26	1.15	8		0.8		28.4	1.2		4.2	4	0	0	2	2
659.50	2.50	2.00	8		11.5	27.6	33.0	16.9	3.0	20.3	20	0	0	11	5
657.00	2.50	1.50	7		9.5	20.7	55.8	13.9	2.3	35.7	36	0	0	20	7
654.50	2.50	2.46	11		13.2	33.9	71.9	19.3	3.7	55.4	55	0	0	30	10
652.00	2.50	2.67	10		14.0	36.8	63.3	20.4	4.0	73.3	63	0	0	35	12
649.50	2.50	1.03	7		7.2	14.2	63.1	10.5	1.6	83.1	63	0	0	35	15
647.00	2.50	0.49	6		3.8	6.8	65.7	5.5	0.7	88.5	66	0	0	36	17
644.50	2.50	0.41	3		3.2	5.7	65.2	4.7	0.6	92.8	65	0	0	36	20
642.00	2.50		1	Very Fine Silty Sand	0.2	1.8	67.1	0.2	0.2	93.2	67	0	0	37	22
639.50	2.50		2	Very Fine Silty Sand	0.3	3.7	71.1	0.5	0.4	94.1	71	0	0	39	25
637.00	2.50		4	Very Fine Silty Sand	0.6	7.3	85.1	0.9	0.8	96.4	85	0	0	47	27
632.00	5.00	1.50	8		19.1	20.7	111.0	27.9	2.3	125.1	111	0	0	61	32
627.00	5.00	2.00	11		23.1	27.6	127.2	33.8	3.0	158.1	127	0	0	70	37
622.00	5.00	1.50	13		19.1	20.7	309.4	27.9	2.3	203.8	204	0	0	112	42
617.00	5.00		100	Hard Till	42.7	183.7	352.1	62.5	20.1	266.3	266	0	0	146	47
612.00	5.00		100	Hard Till	42.7	183.7	333.6	62.5	20.1	322.1	322	0	0	177	52
611.00	1.00			Shale		122.5			13.4						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====South Abutment  
 REFERENCE BORING =====B-4  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.26 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.26 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>497</b> KIPS	<b>329</b> KIPS	<b>181</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 63

Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
662.00	0.26	1.15	8		0.8		28.9	1.2		4.8	5	0	0	3	2
659.50	2.50	2.00	8		11.6	28.0	33.5	17.1	3.6	21.0	21	0	0	12	5
657.00	2.50	1.50	7		9.6	21.0	56.6	14.1	2.7	36.9	37	0	0	20	7
654.50	2.50	2.46	11		13.3	34.5	72.8	19.6	4.4	56.9	57	0	0	31	10
652.00	2.50	2.67	10		14.1	37.4	63.9	20.7	4.8	74.6	64	0	0	35	12
649.50	2.50	1.03	7		7.3	14.4	63.6	10.7	1.8	84.4	64	0	0	35	15
647.00	2.50	0.49	6		3.8	6.9	66.3	5.6	0.9	89.9	66	0	0	36	17
644.50	2.50	0.41	3		3.2	5.7	65.7	4.8	0.7	94.1	66	0	0	36	20
642.00	2.50		1	Very Fine Silty Sand	0.2	1.9	67.7	0.2	0.2	94.6	68	0	0	37	22
639.50	2.50		2	Very Fine Silty Sand	0.3	3.7	71.8	0.5	0.5	95.6	72	0	0	39	25
637.00	2.50		4	Very Fine Silty Sand	0.6	7.5	86.0	0.9	1.0	98.2	86	0	0	47	27
632.00	5.00	1.50	8		19.2	21.0	112.2	28.3	2.7	127.4	112	0	0	62	32
627.00	5.00	2.00	11		23.3	28.0	128.5	34.2	3.6	160.7	128	0	0	71	37
622.00	5.00	1.50	13		19.2	21.0	313.5	28.3	2.7	210.2	210	0	0	116	42
617.00	5.00		100	Hard Till	43.1	186.8	356.6	63.4	23.9	273.6	274	0	0	150	47
612.00	5.00		100	Hard Till	43.1	186.8	337.5	63.4	23.9	329.1	329	0	0	181	52
611.00	1.00			Shale		124.6			15.9						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE=====South Abutment  
 REFERENCE BORING =====B-4  
 LRFD or ASD or SEISMIC =====LRFD  
 PILE CUTOFF ELEV. =====664.26 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====662.26 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====None  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>578</b> KIPS	<b>390</b> KIPS	<b>214</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 807 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== Steel HP 14 X 73  
 Plugged Pile Perimeter===== 4.700 FT. Unplugged Pile Perimeter===== 6.975 FT.  
 Plugged Pile End Bearing Area===== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
662.00	0.26	1.15	8		1.0		39.6	1.4		5.6	6	0	0	3	2
659.50	2.50	2.00	8		13.7	38.6	43.6	20.3	4.2	24.9	25	0	0	14	5
657.00	2.50	1.50	7		11.3	29.0	73.5	16.8	3.1	43.6	44	0	0	24	7
654.50	2.50	2.46	11		15.7	47.5	93.2	23.2	5.1	67.3	67	0	0	37	10
652.00	2.50	2.67	10		16.6	51.6	78.1	24.6	5.6	88.5	78	0	0	43	12
649.50	2.50	1.03	7		8.5	19.9	76.2	12.7	2.1	100.0	76	0	0	42	15
647.00	2.50	0.49	6		4.5	9.5	79.1	6.7	1.0	106.5	79	0	0	44	17
644.50	2.50	0.41	3		3.8	7.9	77.6	5.7	0.9	111.6	78	0	0	43	20
642.00	2.50		1	Very Fine Silty Sand	0.2	2.6	80.4	0.3	0.3	112.2	80	0	0	44	22
639.50	2.50		2	Very Fine Silty Sand	0.4	5.2	85.9	0.5	0.6	113.3	86	0	0	47	25
637.00	2.50		4	Very Fine Silty Sand	0.7	10.3	105.3	1.1	1.1	116.4	105	0	0	58	27
632.00	5.00	1.50	8		22.6	29.0	137.6	33.5	3.1	150.9	138	0	0	76	32
627.00	5.00	2.00	11		27.4	38.6	155.2	40.6	4.2	190.5	155	0	0	85	37
622.00	5.00	1.50	13		22.6	29.0	406.5	33.5	3.1	248.7	249	0	0	137	42
617.00	5.00		100	Hard Till	50.7	257.7	457.2	75.2	27.8	323.9	324	0	0	178	47
612.00	5.00		100	Hard Till	50.7	257.7	421.9	75.2	27.8	389.8	390	0	0	214	52
611.00	1.00			Shale		171.8			18.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== **South Abutment**  
 REFERENCE BORING ===== **B-4**  
 LRFD or ASD or SEISMIC ===== **LRFD**  
 PILE CUTOFF ELEV. ===== **664.26** ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR **662.26** ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) **None**  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req.d Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
<b>705</b> KIPS	<b>397</b> KIPS	<b>218</b> KIPS	Below Boring

TOTAL FACTORED SUBSTRUCTURE LOAD ===== **807** kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== **35.17** ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = **1**  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 183.57 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 68.84 KIPS

PILE TYPE AND SIZE ===== **Steel HP 14 X 89**  
 Plugged Pile Perimeter===== 4.750 FT. Unplugged Pile Perimeter===== 7.033 FT.  
 Plugged Pile End Bearing Area===== 1.409 SQFT. Unplugged Pile End Bearing Area===== 0.181 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
662.00	0.26	1.15	8		1.0		40.5	1.5		6.5	7	0	0	4	2
659.50	2.50	2.00	8		13.8	39.5	44.4	20.5	5.1	25.7	26	0	0	14	5
657.00	2.50	1.50	7		11.4	29.6	74.8	16.9	3.8	45.1	45	0	0	25	7
654.50	2.50	2.46	11		15.8	48.6	94.8	23.4	6.3	69.0	69	0	0	38	10
652.00	2.50	2.67	10		16.7	52.7	79.1	24.8	6.8	89.6	79	0	0	44	12
649.50	2.50	1.03	7		8.6	20.3	77.1	12.8	2.6	101.1	77	0	0	42	15
647.00	2.50	0.49	6		4.5	9.7	80.1	6.7	1.2	107.6	80	0	0	44	17
644.50	2.50	0.41	3		3.9	8.1	78.5	5.7	1.0	112.6	78	0	0	43	20
642.00	2.50		1	Very Fine Silty Sand	0.2	2.6	81.3	0.3	0.3	113.2	81	0	0	45	22
639.50	2.50		2	Very Fine Silty Sand	0.4	5.3	86.9	0.5	0.7	114.4	87	0	0	48	25
637.00	2.50		4	Very Fine Silty Sand	0.7	10.5	106.7	1.1	1.4	118.0	107	0	0	59	27
632.00	5.00	1.50	8		22.8	29.6	139.4	33.8	3.8	153.1	139	0	0	77	32
627.00	5.00	2.00	11		27.6	39.5	157.2	40.9	5.1	192.8	157	0	0	86	37
622.00	5.00	1.50	13		22.8	29.6	413.7	33.8	3.8	256.6	257	0	0	141	42
617.00	5.00		100	Hard Till	51.2	263.2	464.9	75.8	33.9	332.4	332	0	0	183	47
612.00	5.00		100	Hard Till	51.2	263.2	428.3	75.8	33.9	396.9	397	0	0	218	52
611.00	1.00			Shale		175.5			22.6						



**Pile Design Table for South Abutment utilizing Boring #B-4**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.179" walls</b>			<b>Steel HP 10 X 57</b>			<b>Steel HP 14 X 73</b>		
124	68	32	105	58	37	105	58	27
148	81	37	176	97	42	138	76	32
<b>Metal Shell 12"Φ w/.25" walls</b>			229	126	47	155	85	37
124	68	32	267	147	52	249	137	42
148	81	37	<b>Steel HP 12 X 53</b>			324	178	47
<b>Metal Shell 14"Φ w/.25" walls</b>			111	61	32	390	214	52
114	63	27	127	70	37	<b>Steel HP 14 X 89</b>		
148	81	32	204	112	42	107	59	27
175	96	37	266	146	47	139	77	32
<b>Metal Shell 14"Φ w/.312" walls</b>			322	177	52	157	86	37
114	63	27	<b>Steel HP 12 X 63</b>			257	141	42
148	81	32	112	62	32	332	183	47
175	96	37	128	71	37	397	218	52
<b>Steel HP 8 X 36</b>			210	116	42	<b>Steel HP 14 X 102</b>		
82	45	37	274	150	47	108	59	27
137	75	42	329	181	52	141	78	32
179	98	47	<b>Steel HP 12 X 74</b>			159	88	37
200	110	52	114	63	32	262	144	42
<b>Steel HP 10 X 42</b>			130	72	37	339	186	47
103	57	37	215	118	42	402	221	52
170	93	42	279	154	47	<b>Steel HP 14 X 117</b>		
222	122	47	333	183	52	110	60	27
260	143	52	<b>Steel HP 12 X 84</b>			143	79	32
			116	64	32	161	89	37
			132	73	37	270	149	42
			220	121	42	347	191	47
			284	156	47	409	225	52
			338	186	52	<b>Precast 14"x 14"</b>		
						123	68	20
						130	72	22
						145	80	25
						145	80	27
						188	103	32
						223	123	37
						<b>Timber Pile</b>		
						112	62	32
						139	77	37

# Appendix G

## Part- III

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>413</b> KIPS	<b>60</b> KIPS	<b>17</b> KIPS	<b>36</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Metal Shell 14" w/.25" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.5		29.6	30	0	0	16	21
641.90	2.50		12	Sandy Gravel	13.0	29.1	67.6	68	7	0	30	23
639.40	2.50		14	Sandy Gravel	15.1	54.1	34.4	34	16	0	3	26
636.90	2.50	0.49	5		5.5	5.7	41.4	41	16	0	7	28
634.40	2.50	0.62	6		6.8	7.3	44.3	44	16	0	9	31
631.90	2.50	0.29	5		3.4	3.4	50.1	50	16	0	12	33
629.40	2.50	0.50	7		5.6	5.9	60.4	60	16	0	17	36
624.40	5.00	0.90	11		18.7	10.6	447.1	447	46	0	230	44
619.40	5.00		75	Hard Till	117.0	378.5	407.6	408	16	0	208	46
614.40	5.00		44	Hard Till	48.6	222.1	738.9	739	46	0	394	54
609.40	5.00		100	Hard Till	199.6	504.7	770.2	770	46	0	408	56
608.40	1.00			Shale	230.7	336.5	1001.0	1004	46	0	535	56.6
607.40	1.00			Shale	230.7	336.5	1231.7	1232	46	0	662	57.6
606.40	1.00			Shale	230.7	336.5	1462.4	1462	46	0	789	58.6
605.40	1.00			Shale	230.7	336.5	1693.1	1693	46	0	915	59.6
604.40	1.00			Shale	230.7	336.5	1923.9	1924	46	0	1042	60.6
603.40	1.00			Shale	230.7	336.5	2154.6	2155	46	0	1169	61.6
602.40	1.00			Shale	230.7	336.5	2385.3	2385	46	0	1296	62.6
601.40	1.00			Shale	230.7	336.5	2616.0	2616	46	0	1423	63.6
600.40	1.00			Shale	230.7	336.5	2846.8	2847	46	0	1550	64.6
599.40	1.00			Shale	230.7	336.5	3077.5	3077	46	0	1677	65.6
598.40	1.00			Shale	230.7	336.5	3308.2	3308	46	0	1804	66.6
597.40	1.00			Shale	230.7	336.5	3538.9	3539	46	0	1934	67.6
596.40	1.00			Shale	230.7	336.5	3769.7	3770	46	0	2058	68.6
595.40	1.00			Shale	230.7	336.5	4000.4	4000	46	0	2184	69.6
594.40	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>513</b> KIPS	<b>408</b> KIPS	<b>208</b> KIPS	<b>46</b> FT.

PILE TYPE AND SIZE ===== Metal Shell 14" w/.312" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.5		29.6	30	0	0	16	21
641.90	2.50		12	Sandy Gravel	13.0	29.1	67.6	68	7	0	30	23
639.40	2.50		14	Sandy Gravel	15.1	54.1	34.4	34	16	0	3	26
636.90	2.50	0.49	5		5.5	5.7	41.4	41	16	0	7	28
634.40	2.50	0.62	6		6.8	7.3	44.3	44	16	0	9	31
631.90	2.50	0.29	5		3.4	3.4	50.1	50	16	0	12	33
629.40	2.50	0.50	7		5.6	5.9	60.4	60	16	0	17	36
624.40	5.00	0.90	11		18.7	10.6	447.1	447	16	0	230	41
619.40	5.00		75	Hard Till	117.0	378.5	407.6	408	16	0	208	46
614.40	5.00		44	Hard Till	48.6	222.1	738.9	739	16	0	394	54
609.40	5.00		100	Hard Till	199.6	504.7	770.2	770	16	0	408	56
608.40	1.00			Shale	230.7	336.5	1001.0	1004	16	0	535	56.6
607.40	1.00			Shale	230.7	336.5	1231.7	1232	16	0	662	57.6
606.40	1.00			Shale	230.7	336.5	1462.4	1462	16	0	789	58.6
605.40	1.00			Shale	230.7	336.5	1693.1	1693	16	0	915	59.6
604.40	1.00			Shale	230.7	336.5	1923.9	1924	16	0	1042	60.6
603.40	1.00			Shale	230.7	336.5	2154.6	2155	16	0	1169	61.6
602.40	1.00			Shale	230.7	336.5	2385.3	2385	16	0	1296	62.6
601.40	1.00			Shale	230.7	336.5	2616.0	2616	16	0	1423	63.6
600.40	1.00			Shale	230.7	336.5	2846.8	2847	16	0	1550	64.6
599.40	1.00			Shale	230.7	336.5	3077.5	3077	16	0	1677	65.6
598.40	1.00			Shale	230.7	336.5	3308.2	3308	16	0	1804	66.6
597.40	1.00			Shale	230.7	336.5	3538.9	3539	16	0	1934	67.6
596.40	1.00			Shale	230.7	336.5	3769.7	3770	16	0	2058	68.6
595.40	1.00			Shale	230.7	336.5	4000.4	4000	16	0	2184	69.6
594.40	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>335</b> KIPS	<b>301</b> KIPS	<b>163</b> KIPS	<b>59</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Steel HP 10 X 42  
 Plugged Pile Perimeter===== 3.300 FT. Unplugged Pile Perimeter===== 4.858 FT.  
 Plugged Pile End Bearing Area===== 0.680 SQFT. Unplugged Pile End Bearing Area===== 0.086 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.1		10.3	0.1		1.4	1	0	0	1	21
641.90	2.50		12	Sandy Gravel	2.3	10.3	21.5	3.4	1.3	5.9	6	1	0	2	23
639.40	2.50		14	Sandy Gravel	2.7	19.1	9.8	4.0	2.4	8.1	8	3	0	2	26
636.90	2.50	0.49	5		3.2	4.7	14.2	4.6	0.6	12.9	13	3	0	4	28
634.40	2.50	0.62	6		3.9	5.9	14.9	5.7	0.7	18.2	15	3	0	5	31
631.90	2.50	0.29	5		1.9	2.8	18.9	2.8	0.3	21.4	19	3	0	8	33
629.40	2.50	0.50	7		3.2	4.8	25.9	4.7	0.6	26.6	26	3	0	11	36
624.40	5.00	0.90	11		10.8	8.6	123.4	15.8	1.1	53.4	53	3	0	27	41
619.40	5.00		75	Hard Till	20.8	95.3	104.8	30.7	12.1	79.1	79	3	0	41	46
614.40	5.00		44	Hard Till	8.7	55.9	184.7	12.8	7.1	100.9	101	3	0	53	51
609.40	5.00		100	Hard Till	35.6	127.1	177.9	52.4	16.1	147.8	148	3	0	79	56
608.40	1.00			Shale	41.1	84.8	219.0	60.5	10.7	208.4	208	3	0	112	56.6
607.40	1.00			Shale	41.1	84.8	260.1	60.5	10.7	268.9	260	3	0	140	57.6
606.40	1.00			Shale	41.1	84.8	301.2	60.5	10.7	329.4	301	3	0	163	58.6
605.40	1.00			Shale	41.1	84.8	342.3	60.5	10.7	389.9	342	3	0	185	59.6
604.40	1.00			Shale	41.1	84.8	383.4	60.5	10.7	450.5	383	3	0	208	60.6
603.40	1.00			Shale	41.1	84.8	424.5	60.5	10.7	511.0	425	3	0	231	61.6
602.40	1.00			Shale	41.1	84.8	465.7	60.5	10.7	571.5	466	3	0	253	62.6
601.40	1.00			Shale	41.1	84.8	506.8	60.5	10.7	632.0	507	3	0	276	63.6
600.40	1.00			Shale	41.1	84.8	547.9	60.5	10.7	692.5	548	3	0	299	64.6
599.40	1.00			Shale	41.1	84.8	589.0	60.5	10.7	753.1	589	3	0	321	65.6
598.40	1.00			Shale	41.1	84.8	630.1	60.5	10.7	813.6	630	3	0	344	66.6
597.40	1.00			Shale	41.1	84.8	671.2	60.5	10.7	874.1	671	3	0	366	67.6
596.40	1.00			Shale	41.1	84.8	712.3	60.5	10.7	934.6	712	3	0	389	68.6
595.40	1.00			Shale	41.1	84.8	753.4	60.5	10.7	995.1	753	3	0	412	69.6
594.40	1.00			Shale		84.8			10.7						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>418</b> KIPS	<b>383</b> KIPS	<b>207</b> KIPS	<b>59</b> FT.

PILE TYPE AND SIZE ===== Steel HP 12 X 53  
 Plugged Pile Perimeter===== 3.967 FT. Unplugged Pile Perimeter===== 5.800 FT.  
 Plugged Pile End Bearing Area===== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.1		12.5	0.2		1.5	2	0	0	1	21
641.90	2.50		12	Sandy Gravel	2.8	12.3	25.9	4.1	1.4	6.7	7	2	0	2	23
639.40	2.50		14	Sandy Gravel	3.2	23.0	12.9	4.7	2.5	9.7	10	3	0	2	26
636.90	2.50	0.49	5		3.8	6.8	18.5	5.5	0.7	15.4	15	3	0	5	28
634.40	2.50	0.62	6		4.7	8.5	18.6	6.9	0.9	21.8	19	3	0	7	31
631.90	2.50	0.29	5		2.3	4.0	23.8	3.4	0.4	25.5	24	3	0	10	33
629.40	2.50	0.50	7		3.9	6.9	33.2	5.7	0.8	31.8	32	3	0	14	36
624.40	5.00	0.90	11		12.9	12.4	171.5	18.9	1.4	64.4	64	3	0	32	41
619.40	5.00		75	Hard Till	25.1	137.8	139.6	36.6	15.1	94.8	95	3	0	49	46
614.40	5.00		44	Hard Till	10.4	80.8	253.0	15.2	8.8	121.3	121	3	0	63	51
609.40	5.00		100	Hard Till	42.7	183.7	234.5	62.5	20.1	177.1	177	3	0	94	56
608.40	1.00			Shale	49.4	122.5	283.9	72.3	13.4	249.4	249	3	0	134	56.6
607.40	1.00			Shale	49.4	122.5	333.3	72.3	13.4	321.6	322	3	0	174	57.6
606.40	1.00			Shale	49.4	122.5	382.7	72.3	13.4	393.9	383	3	0	207	58.6
605.40	1.00			Shale	49.4	122.5	432.1	72.3	13.4	466.1	432	3	0	234	59.6
604.40	1.00			Shale	49.4	122.5	481.5	72.3	13.4	538.4	482	3	0	264	60.6
603.40	1.00			Shale	49.4	122.5	530.9	72.3	13.4	610.6	534	3	0	289	61.6
602.40	1.00			Shale	49.4	122.5	580.3	72.3	13.4	682.9	580	3	0	316	62.6
601.40	1.00			Shale	49.4	122.5	629.8	72.3	13.4	755.1	630	3	0	343	63.6
600.40	1.00			Shale	49.4	122.5	679.2	72.3	13.4	827.4	679	3	0	370	64.6
599.40	1.00			Shale	49.4	122.5	728.6	72.3	13.4	899.6	729	3	0	397	65.6
598.40	1.00			Shale	49.4	122.5	778.0	72.3	13.4	971.9	778	3	0	425	66.6
597.40	1.00			Shale	49.4	122.5	827.4	72.3	13.4	1044.1	827	3	0	452	67.6
596.40	1.00			Shale	49.4	122.5	876.8	72.3	13.4	1116.4	877	3	0	479	68.6
595.40	1.00			Shale	49.4	122.5	926.2	72.3	13.4	1188.6	926	3	0	506	69.6
594.40	1.00			Shale		122.5									

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>497</b> KIPS	<b>487</b> KIPS	<b>264</b> KIPS	<b>61</b> FT.

PILE TYPE AND SIZE ===== Steel HP 12 X 63  
 Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.1		12.7	0.2		1.8	2	0	0	1	21
641.90	2.50		12	Sandy Gravel	2.8	12.6	26.3	4.1	1.6	7.3	7	2	0	2	23
639.40	2.50		14	Sandy Gravel	3.3	23.4	13.0	4.8	3.0	10.0	10	3	0	2	26
636.90	2.50	0.49	5		3.8	6.9	18.7	5.6	0.9	15.8	16	3	0	5	28
634.40	2.50	0.62	6		4.7	8.7	18.8	7.0	1.1	22.2	19	3	0	7	31
631.90	2.50	0.29	5		2.3	4.1	24.1	3.4	0.5	26.0	24	3	0	10	33
629.40	2.50	0.50	7		3.9	7.0	33.6	5.7	0.9	32.5	32	3	0	14	36
624.40	5.00	0.90	11		13.0	12.6	174.2	19.2	1.6	67.9	68	3	0	34	41
619.40	5.00		75	Hard Till	25.3	140.1	141.5	37.2	17.9	97.7	98	3	0	50	46
614.40	5.00		44	Hard Till	10.5	82.2	256.6	15.4	10.5	126.5	127	3	0	66	51
609.40	5.00		100	Hard Till	43.1	186.8	237.5	63.4	23.9	182.0	182	3	0	97	56
608.40	1.00			Shale	49.8	124.6	287.3	73.3	15.9	255.3	255	3	0	137	56.6
607.40	1.00			Shale	49.8	124.6	337.1	73.3	15.9	328.6	329	3	0	177	57.6
606.40	1.00			Shale	49.8	124.6	386.9	73.3	15.9	401.8	387	3	0	209	58.6
605.40	1.00			Shale	49.8	124.6	436.8	73.3	15.9	475.1	437	3	0	237	59.6
604.40	1.00			Shale	49.8	124.6	486.6	73.3	15.9	548.4	487	3	0	264	60.6
603.40	1.00			Shale	49.8	124.6	536.4	73.3	15.9	621.7	536	3	0	292	61.6
602.40	1.00			Shale	49.8	124.6	586.3	73.3	15.9	695.0	586	3	0	319	62.6
601.40	1.00			Shale	49.8	124.6	636.1	73.3	15.9	768.3	636	3	0	346	63.6
600.40	1.00			Shale	49.8	124.6	685.9	73.3	15.9	841.6	686	3	0	374	64.6
599.40	1.00			Shale	49.8	124.6	735.7	73.3	15.9	914.9	736	3	0	401	65.6
598.40	1.00			Shale	49.8	124.6	785.6	73.3	15.9	988.2	786	3	0	429	66.6
597.40	1.00			Shale	49.8	124.6	835.4	73.3	15.9	1061.4	835	3	0	456	67.6
596.40	1.00			Shale	49.8	124.6	885.2	73.3	15.9	1134.7	885	3	0	483	68.6
595.40	1.00			Shale	49.8	124.6	935.1	73.3	15.9	1208.0	935	3	0	511	69.6
594.40	1.00			Shale		124.6			15.9						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>578</b> KIPS	<b>539</b> KIPS	<b>292</b> KIPS	<b>60</b> FT.

PILE TYPE AND SIZE ===== Steel HP 14 X 73  
 Plugged Pile Perimeter===== 4.700 FT. Unplugged Pile Perimeter===== 6.975 FT.  
 Plugged Pile End Bearing Area===== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.1		15.0	0.2		1.8	2	0	0	1	21
641.90	2.50		12	Sandy Gravel	3.3	14.8	31.0	4.9	1.6	8.0	8	2	0	3	23
639.40	2.50		14	Sandy Gravel	3.8	27.6	16.7	5.7	3.0	11.8	12	4	0	2	26
636.90	2.50	0.49	5		4.5	9.5	23.7	6.7	1.0	18.7	19	4	0	6	28
634.40	2.50	0.62	6		5.6	12.0	22.9	8.2	1.3	26.3	23	4	0	9	31
631.90	2.50	0.29	5		2.8	5.6	29.7	4.1	0.6	30.8	30	4	0	12	33
629.40	2.50	0.50	7		4.6	9.7	42.0	6.8	1.0	38.5	38	4	0	17	36
624.40	5.00	0.90	11		15.3	17.4	233.2	22.7	1.9	80.1	80	4	0	40	41
619.40	5.00		75	Hard Till	29.7	193.2	183.0	44.1	20.8	115.6	116	4	0	60	46
614.40	5.00		44	Hard Till	12.3	113.4	339.7	18.3	12.2	149.5	149	4	0	78	51
609.40	5.00		100	Hard Till	50.7	257.7	304.4	75.2	27.8	215.4	215	4	0	114	56
608.40	1.00			Shale	58.5	171.8	363.0	86.9	18.5	302.3	302	4	0	162	56.6
607.40	1.00			Shale	58.5	171.8	421.5	86.9	18.5	389.2	389	4	0	210	57.6
606.40	1.00			Shale	58.5	171.8	480.1	86.9	18.5	476.0	476	4	0	258	58.6
605.40	1.00			Shale	58.5	171.8	538.6	86.9	18.5	562.9	539	4	0	292	59.6
604.40	1.00			Shale	58.5	171.8	597.2	86.9	18.5	649.8	597	4	0	324	60.6
603.40	1.00			Shale	58.5	171.8	655.7	86.9	18.5	736.7	656	4	0	357	61.6
602.40	1.00			Shale	58.5	171.8	714.3	86.9	18.5	823.6	744	4	0	389	62.6
601.40	1.00			Shale	58.5	171.8	772.8	86.9	18.5	910.5	773	4	0	421	63.6
600.40	1.00			Shale	58.5	171.8	831.4	86.9	18.5	997.4	831	4	0	453	64.6
599.40	1.00			Shale	58.5	171.8	889.9	86.9	18.5	1084.3	890	4	0	485	65.6
598.40	1.00			Shale	58.5	171.8	948.5	86.9	18.5	1171.2	948	4	0	518	66.6
597.40	1.00			Shale	58.5	171.8	1007.0	86.9	18.5	1258.0	1007	4	0	550	67.6
596.40	1.00			Shale	58.5	171.8	1065.6	86.9	18.5	1344.9	1066	4	0	582	68.6
595.40	1.00			Shale	58.5	171.8	1124.1	86.9	18.5	1431.8	1124	4	0	614	69.6
594.40	1.00			Shale		171.8			18.5						



# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>705</b> KIPS	<b>665</b> KIPS	<b>361</b> KIPS	<b>62</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Steel HP 14 X 89

Plugged Pile Perimeter===== 4.750 FT. Unplugged Pile Perimeter===== 7.033 FT.  
 Plugged Pile End Bearing Area===== 1.409 SQFT. Unplugged Pile End Bearing Area===== 0.181 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.1		15.3	0.2		2.1	2	0	0	1	21
641.90	2.50		12	Sandy Gravel	3.3	15.2	31.7	4.9	2.0	8.7	9	2	0	3	23
639.40	2.50		14	Sandy Gravel	3.9	28.2	17.0	5.7	3.6	12.1	12	4	0	3	26
636.90	2.50	0.49	5		4.5	9.7	24.1	6.7	1.2	19.2	19	4	0	7	28
634.40	2.50	0.62	6		5.6	12.2	23.2	8.3	1.6	26.6	23	4	0	9	31
631.90	2.50	0.29	5		2.8	5.7	30.2	4.1	0.7	31.3	30	4	0	13	33
629.40	2.50	0.50	7		4.6	9.9	42.7	6.9	1.3	39.2	39	4	0	18	36
624.40	5.00	0.90	11		15.5	17.8	237.8	22.9	2.3	85.2	85	4	0	43	41
619.40	5.00		75	Hard Till	30.0	197.4	186.2	44.4	25.4	119.2	119	4	0	61	46
614.40	5.00		44	Hard Till	12.5	115.8	346.1	18.5	14.9	156.6	157	4	0	82	51
609.40	5.00		100	Hard Till	51.2	263.2	309.6	75.8	33.9	221.1	221	4	0	118	56
608.40	1.00			Shale	59.2	175.5	368.7	87.6	22.6	308.7	309	4	0	166	56.6
607.40	1.00			Shale	59.2	175.5	427.9	87.6	22.6	396.3	396	4	0	214	57.6
606.40	1.00			Shale	59.2	175.5	487.1	87.6	22.6	483.9	484	4	0	262	58.6
605.40	1.00			Shale	59.2	175.5	546.2	87.6	22.6	571.6	546	4	0	296	59.6
604.40	1.00			Shale	59.2	175.5	605.4	87.6	22.6	659.2	605	4	0	329	60.6
603.40	1.00			Shale	59.2	175.5	664.6	87.6	22.6	746.8	665	4	0	361	61.6
602.40	1.00			Shale	59.2	175.5	723.8	87.6	22.6	834.4	724	4	0	394	62.6
601.40	1.00			Shale	59.2	175.5	782.9	87.6	22.6	922.0	783	4	0	427	63.6
600.40	1.00			Shale	59.2	175.5	842.1	87.6	22.6	1009.6	842	4	0	459	64.6
599.40	1.00			Shale	59.2	175.5	901.3	87.6	22.6	1097.3	901	4	0	492	65.6
598.40	1.00			Shale	59.2	175.5	960.4	87.6	22.6	1184.9	960	4	0	524	66.6
597.40	1.00			Shale	59.2	175.5	1019.6	87.6	22.6	1272.5	1020	4	0	557	67.6
596.40	1.00			Shale	59.2	175.5	1078.8	87.6	22.6	1360.1	1079	4	0	589	68.6
595.40	1.00			Shale	59.2	175.5	1138.0	87.6	22.6	1447.7	1138	4	0	622	69.6
594.40	1.00			Shale		175.5			22.6						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1  
 REFERENCE BORING ===== B-2  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 637.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>929</b> KIPS	<b>924</b> KIPS	<b>504</b> KIPS	<b>66</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Steel HP 14 X 117  
 Plugged Pile Perimeter===== 4.850 FT. Unplugged Pile Perimeter===== 7.117 FT.  
 Plugged Pile End Bearing Area===== 1.469 SQFT. Unplugged Pile End Bearing Area===== 0.239 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
644.40	1.70		1	Very Fine Silty Sand	0.1		15.9	0.2		2.8	3	0	0	1	21
641.90	2.50		12	Sandy Gravel	3.4	15.8	33.0	5.0	2.6	10.0	10	2	0	4	23
639.40	2.50		14	Sandy Gravel	4.0	29.4	17.6	5.8	4.8	12.6	13	4	0	3	26
636.90	2.50	0.49	5		4.6	10.1	24.9	6.8	1.6	19.9	20	4	0	7	28
634.40	2.50	0.62	6		5.7	12.8	23.8	8.4	2.1	27.2	24	4	0	9	31
631.90	2.50	0.29	5		2.8	6.0	31.0	4.2	1.0	32.1	31	4	0	13	33
629.40	2.50	0.50	7		4.7	10.3	44.0	6.9	1.7	40.3	40	4	0	18	36
624.40	5.00	0.90	11		15.8	18.5	247.2	23.2	3.0	94.0	94	4	0	48	41
619.40	5.00		75	Hard Till	30.6	205.9	192.7	45.0	33.5	125.1	125	4	0	65	46
614.40	5.00		44	Hard Till	12.7	120.8	359.2	18.7	19.6	168.8	169	4	0	89	51
609.40	5.00		100	Hard Till	52.3	274.6	319.9	76.7	44.6	230.6	231	4	0	123	56
608.40	1.00			Shale	60.4	183.0	380.3	88.7	29.8	319.3	319	4	0	171	56.6
607.40	1.00			Shale	60.4	183.0	440.8	88.7	29.8	407.9	408	4	0	220	57.6
606.40	1.00			Shale	60.4	183.0	501.2	88.7	29.8	496.6	497	4	0	269	58.6
605.40	1.00			Shale	60.4	183.0	561.6	88.7	29.8	585.2	562	4	0	305	59.6
604.40	1.00			Shale	60.4	183.0	622.0	88.7	29.8	673.9	622	4	0	338	60.6
603.40	1.00			Shale	60.4	183.0	682.4	88.7	29.8	762.5	682	4	0	371	61.6
602.40	1.00			Shale	60.4	183.0	742.8	88.7	29.8	851.2	743	4	0	404	62.6
601.40	1.00			Shale	60.4	183.0	803.3	88.7	29.8	939.9	803	4	0	438	63.6
600.40	1.00			Shale	60.4	183.0	863.7	88.7	29.8	1028.5	864	4	0	471	64.6
599.40	1.00			Shale	60.4	183.0	924.1	88.7	29.8	1117.2	924	4	0	504	65.6
598.40	1.00			Shale	60.4	183.0	984.5	88.7	29.8	1205.8	985	4	0	537	66.6
597.40	1.00			Shale	60.4	183.0	1044.9	88.7	29.8	1294.5	1045	4	0	571	67.6
596.40	1.00			Shale	60.4	183.0	1105.3	88.7	29.8	1383.1	1105	4	0	604	68.6
595.40	1.00			Shale	60.4	183.0	1165.8	88.7	29.8	1471.8	1166	4	0	637	69.6
594.40	1.00			Shale		183.0			29.8						

**Pile Design Table for Pier 1 utilizing Boring #B-2**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.179" walls</b>			<b>Steel HP 10 X 57</b>			<b>Steel HP 14 X 73</b>		
50	14	36	435	236	62	539	292	60
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 12 X 53</b>			<b>Steel HP 14 X 89</b>		
50	14	36	383	207	59	665	361	62
322	164	46	<b>Steel HP 12 X 63</b>			<b>Steel HP 14 X 102</b>		
<b>Metal Shell 14"Φ w/.25" walls</b>			<b>Steel HP 12 X 63</b>			<b>Steel HP 14 X 102</b>		
60	17	36	487	264	61	793	432	64
<b>Metal Shell 14"Φ w/.312" walls</b>			<b>Steel HP 12 X 74</b>			<b>Steel HP 14 X 117</b>		
60	17	36	545	296	62	924	504	66
408	208	46	<b>Steel HP 12 X 84</b>			<b>Precast 14"x 14"</b>		
<b>Steel HP 8 X 36</b>			<b>Steel HP 12 X 84</b>			<b>Precast 14"x 14"</b>		
267	145	60	655	357	64	77	22	36
<b>Steel HP 10 X 42</b>						<b>Timber Pile</b>		
301	163	59				45      11      36		

# Appendix G

## Part- IV

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft  
  
 TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>413</b> KIPS	<b>77</b> KIPS	<b>37</b> KIPS	<b>37</b> FT.

PILE TYPE AND SIZE ===== Metal Shell 14" w/.25" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		2.4		7.3	7	1	0	3	20
642.70	2.50	0.41	3		4.7	4.8	9.6	10	4	0	1	22
640.20	2.50	0.21	3		2.5	2.5	15.4	15	5	0	3	25
637.70	2.50	0.50	4		5.6	5.9	32.7	33	5	0	13	27
632.70	5.00	1.50	3		27.6	17.6	54.5	54	5	0	25	32
627.70	5.00	1.00	7		20.4	11.7	76.6	77	5	0	37	37
622.70	5.00	1.15	6		22.8	13.5	464.4	464	5	0	250	42
617.70	5.00		75	Hard Till	117.0	378.5	525.9	526	5	0	284	47
612.70	5.00		64	Hard Till	88.4	323.0	796.0	796	5	0	433	52
607.70	5.00		100	Hard Till	199.6	504.7	827.4	827	5	0	450	57
606.70	1.00			Shale	230.7	336.5	1058.1	1058	5	0	577	58.3
605.70	1.00			Shale	230.7	336.5	1288.8	1289	5	0	704	59.3
604.70	1.00			Shale	230.7	336.5	1519.6	1520	5	0	831	60.3
603.70	1.00			Shale	230.7	336.5	1750.3	1750	5	0	957	61.3
602.70	1.00			Shale	230.7	336.5	1981.0	1984	5	0	1084	62.3
601.70	1.00			Shale	230.7	336.5	2211.7	2242	5	0	1244	63.3
600.70	1.00			Shale	230.7	336.5	2442.5	2442	5	0	1338	64.3
599.70	1.00			Shale	230.7	336.5	2673.2	2673	5	0	1465	65.3
598.70	1.00			Shale	230.7	336.5	2903.9	2904	5	0	1592	66.3
597.70	1.00			Shale	230.7	336.5	3134.6	3135	5	0	1719	67.3
596.70	1.00			Shale	230.7	336.5	3365.4	3365	5	0	1846	68.3
595.70	1.00			Shale	230.7	336.5	3596.1	3596	5	0	1973	69.3
594.70	1.00			Shale	230.7	336.5	3826.8	3827	5	0	2099	70.3
593.70	1.00			Shale	230.7	336.5	4057.5	4058	5	0	2226	71.3
592.70	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft  
  
 TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>513</b> KIPS	<b>464</b> KIPS	<b>250</b> KIPS	<b>42</b> FT.

PILE TYPE AND SIZE ===== Metal Shell 14" w/.312" walls  
 Pile Perimeter===== 3.665 FT.  
 Pile End Bearing Area===== 1.069 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		2.4		7.3	7	1	0	3	20
642.70	2.50	0.41	3		4.7	4.8	9.6	10	4	0	1	22
640.20	2.50	0.21	3		2.5	2.5	15.4	15	5	0	3	25
637.70	2.50	0.50	4		5.6	5.9	32.7	33	5	0	13	27
632.70	5.00	1.50	3		27.6	17.6	54.5	54	5	0	25	32
627.70	5.00	1.00	7		20.4	11.7	76.6	77	5	0	37	37
622.70	5.00	1.15	6		22.8	13.5	464.4	464	5	0	250	42
617.70	5.00		75	Hard Till	117.0	378.5	525.9	526	5	0	284	47
612.70	5.00		64	Hard Till	88.4	323.0	796.0	796	5	0	433	52
607.70	5.00		100	Hard Till	199.6	504.7	827.4	827	5	0	450	57
606.70	1.00			Shale	230.7	336.5	1058.1	1058	5	0	577	58.3
605.70	1.00			Shale	230.7	336.5	1288.8	1289	5	0	704	59.3
604.70	1.00			Shale	230.7	336.5	1519.6	1520	5	0	831	60.3
603.70	1.00			Shale	230.7	336.5	1750.3	1750	5	0	957	61.3
602.70	1.00			Shale	230.7	336.5	1981.0	1984	5	0	1084	62.3
601.70	1.00			Shale	230.7	336.5	2211.7	2242	5	0	1244	63.3
600.70	1.00			Shale	230.7	336.5	2442.5	2442	5	0	1338	64.3
599.70	1.00			Shale	230.7	336.5	2673.2	2673	5	0	1465	65.3
598.70	1.00			Shale	230.7	336.5	2903.9	2904	5	0	1592	66.3
597.70	1.00			Shale	230.7	336.5	3134.6	3135	5	0	1719	67.3
596.70	1.00			Shale	230.7	336.5	3365.4	3365	5	0	1846	68.3
595.70	1.00			Shale	230.7	336.5	3596.1	3596	5	0	1973	69.3
594.70	1.00			Shale	230.7	336.5	3826.8	3827	5	0	2099	70.3
593.70	1.00			Shale	230.7	336.5	4057.5	4058	5	0	2226	71.3
592.70	1.00			Shale		336.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>335</b> KIPS	<b>330</b> KIPS	<b>178</b> KIPS	<b>60</b> FT.

PILE TYPE AND SIZE ===== Steel HP 10 X 42  
 Plugged Pile Perimeter===== 3.300 FT. Unplugged Pile Perimeter===== 4.858 FT.  
 Plugged Pile End Bearing Area===== 0.680 SQFT. Unplugged Pile End Bearing Area===== 0.086 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		1.4		5.3	2.1		2.6	3	1	0	1	20
642.70	2.50	0.41	3		2.7	3.9	6.1	3.9	0.5	6.3	6	2	0	1	22
640.20	2.50	0.21	3		1.4	2.0	10.3	2.1	0.3	8.7	9	3	0	2	25
637.70	2.50	0.50	4		3.2	4.8	23.0	4.7	0.6	14.6	15	3	0	5	27
632.70	5.00	1.50	3		15.9	14.3	34.1	23.4	1.8	37.4	34	3	0	16	32
627.70	5.00	1.00	7		11.7	9.5	47.3	17.3	1.2	54.9	47	3	0	23	37
622.70	5.00	1.15	6		13.1	11.0	144.7	19.3	1.4	84.8	85	3	0	44	42
617.70	5.00		75	Hard Till	20.8	95.3	151.6	30.7	12.1	113.7	114	3	0	60	47
612.70	5.00		64	Hard Till	15.8	81.4	213.1	23.2	10.3	142.7	143	3	0	75	52
607.70	5.00		100	Hard Till	35.6	127.1	206.3	52.4	16.1	189.7	190	3	0	101	57
606.70	1.00			Shale	41.1	84.8	247.4	60.5	10.7	250.2	247	3	0	133	58.3
605.70	1.00			Shale	41.1	84.8	288.5	60.5	10.7	310.7	289	3	0	156	59.3
604.70	1.00			Shale	41.1	84.8	329.6	60.5	10.7	371.3	330	3	0	178	60.3
603.70	1.00			Shale	41.1	84.8	370.8	60.5	10.7	431.8	371	3	0	201	61.3
602.70	1.00			Shale	41.1	84.8	411.9	60.5	10.7	492.3	412	3	0	223	62.3
601.70	1.00			Shale	41.1	84.8	453.0	60.5	10.7	552.8	453	3	0	246	63.3
600.70	1.00			Shale	41.1	84.8	494.1	60.5	10.7	613.3	494	3	0	269	64.3
599.70	1.00			Shale	41.1	84.8	535.2	60.5	10.7	673.9	535	3	0	291	65.3
598.70	1.00			Shale	41.1	84.8	576.3	60.5	10.7	734.4	576	3	0	314	66.3
597.70	1.00			Shale	41.1	84.8	617.4	60.5	10.7	794.9	617	3	0	337	67.3
596.70	1.00			Shale	41.1	84.8	658.5	60.5	10.7	855.4	659	3	0	359	68.3
595.70	1.00			Shale	41.1	84.8	699.6	60.5	10.7	916.0	700	3	0	382	69.3
594.70	1.00			Shale	41.1	84.8	740.7	60.5	10.7	976.5	741	3	0	404	70.3
593.70	1.00			Shale	41.1	84.8	781.8	60.5	10.7	1037.0	782	3	0	427	71.3
592.70	1.00			Shale		84.8			10.7						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>418</b> KIPS	<b>417</b> KIPS	<b>226</b> KIPS	<b>60</b> FT.

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 53

Plugged Pile Perimeter===== 3.967 FT. Unplugged Pile Perimeter===== 5.800 FT.  
 Plugged Pile End Bearing Area===== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		1.7		7.3	2.5		3.1	3	1	0	1	20
642.70	2.50	0.41	3		3.2	5.7	7.8	4.7	0.6	7.5	7	3	0	1	22
640.20	2.50	0.21	3		1.7	2.9	13.5	2.5	0.3	10.4	10	4	0	2	25
637.70	2.50	0.50	4		3.9	6.9	31.2	5.7	0.8	17.6	18	4	0	6	27
632.70	5.00	1.50	3		19.1	20.7	43.3	27.9	2.3	44.7	43	4	0	20	32
627.70	5.00	1.00	7		14.1	13.8	59.5	20.6	1.5	65.6	59	4	0	29	37
622.70	5.00	1.15	6		15.7	15.8	197.2	23.0	1.7	101.9	102	4	0	52	42
617.70	5.00		75	Hard Till	25.1	137.8	202.0	36.6	15.1	136.3	136	4	0	71	47
612.70	5.00		64	Hard Till	18.9	117.6	287.1	27.7	12.9	171.3	171	4	0	91	52
607.70	5.00		100	Hard Till	42.7	183.7	268.6	62.5	20.1	227.1	227	4	0	121	57
606.70	1.00			Shale	49.4	122.5	318.0	72.3	13.4	299.3	299	4	0	161	58.3
605.70	1.00			Shale	49.4	122.5	367.5	72.3	13.4	371.6	367	4	0	198	59.3
604.70	1.00			Shale	49.4	122.5	416.9	72.3	13.4	443.8	417	4	0	226	60.3
603.70	1.00			Shale	49.4	122.5	466.3	72.3	13.4	516.1	466	4	0	253	61.3
602.70	1.00			Shale	49.4	122.5	515.7	72.3	13.4	588.3	546	4	0	280	62.3
601.70	1.00			Shale	49.4	122.5	565.1	72.3	13.4	660.6	566	4	0	307	63.3
600.70	1.00			Shale	49.4	122.5	614.5	72.3	13.4	732.8	645	4	0	334	64.3
599.70	1.00			Shale	49.4	122.5	663.9	72.3	13.4	805.1	664	4	0	362	65.3
598.70	1.00			Shale	49.4	122.5	713.3	72.3	13.4	877.3	743	4	0	389	66.3
597.70	1.00			Shale	49.4	122.5	762.8	72.3	13.4	949.6	763	4	0	416	67.3
596.70	1.00			Shale	49.4	122.5	812.2	72.3	13.4	1021.8	842	4	0	443	68.3
595.70	1.00			Shale	49.4	122.5	861.6	72.3	13.4	1094.1	862	4	0	470	69.3
594.70	1.00			Shale	49.4	122.5	911.0	72.3	13.4	1166.3	944	4	0	497	70.3
593.70	1.00			Shale	49.4	122.5	960.4	72.3	13.4	1238.6	960	4	0	525	71.3
592.70	1.00			Shale		122.5			13.4						



# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>497</b> KIPS	<b>471</b> KIPS	<b>256</b> KIPS	<b>61</b> FT.

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Steel HP 12 X 63

Plugged Pile Perimeter===== 4.000 FT. Unplugged Pile Perimeter===== 5.883 FT.  
 Plugged Pile End Bearing Area===== 1.000 SQFT. Unplugged Pile End Bearing Area===== 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		1.7		7.4	2.5		3.2	3	1	0	1	20
642.70	2.50	0.41	3		3.2	5.7	7.9	4.8	0.7	7.7	8	3	0	1	22
640.20	2.50	0.21	3		1.7	2.9	13.7	2.5	0.4	10.7	11	4	0	2	25
637.70	2.50	0.50	4		3.9	7.0	31.6	5.7	0.9	18.2	18	4	0	6	27
632.70	5.00	1.50	3		19.2	21.0	43.8	28.3	2.7	45.6	44	4	0	20	32
627.70	5.00	1.00	7		14.2	14.0	60.1	20.9	1.8	66.8	60	4	0	29	37
622.70	5.00	1.15	6		15.9	16.1	200.0	23.3	2.1	106.0	106	4	0	55	42
617.70	5.00		75	Hard Till	25.3	140.1	204.7	37.2	17.9	140.5	141	4	0	74	47
612.70	5.00		64	Hard Till	19.1	119.6	291.1	28.1	15.3	177.2	177	4	0	94	52
607.70	5.00		100	Hard Till	43.1	186.8	271.9	63.4	23.9	232.7	233	4	0	124	57
606.70	1.00			Shale	49.8	124.6	321.7	73.3	15.9	305.9	306	4	0	165	58.3
605.70	1.00			Shale	49.8	124.6	371.6	73.3	15.9	379.2	372	4	0	201	59.3
604.70	1.00			Shale	49.8	124.6	421.4	73.3	15.9	452.5	421	4	0	228	60.3
603.70	1.00			Shale	49.8	124.6	471.2	73.3	15.9	525.8	471	4	0	256	61.3
602.70	1.00			Shale	49.8	124.6	521.1	73.3	15.9	599.1	524	4	0	283	62.3
601.70	1.00			Shale	49.8	124.6	570.9	73.3	15.9	672.4	574	4	0	340	63.3
600.70	1.00			Shale	49.8	124.6	620.7	73.3	15.9	745.7	624	4	0	338	64.3
599.70	1.00			Shale	49.8	124.6	670.5	73.3	15.9	819.0	674	4	0	365	65.3
598.70	1.00			Shale	49.8	124.6	720.4	73.3	15.9	892.3	720	4	0	393	66.3
597.70	1.00			Shale	49.8	124.6	770.2	73.3	15.9	965.6	770	4	0	420	67.3
596.70	1.00			Shale	49.8	124.6	820.0	73.3	15.9	1038.8	820	4	0	447	68.3
595.70	1.00			Shale	49.8	124.6	869.9	73.3	15.9	1112.1	870	4	0	475	69.3
594.70	1.00			Shale	49.8	124.6	919.7	73.3	15.9	1185.4	920	4	0	502	70.3
593.70	1.00			Shale	49.8	124.6	969.5	73.3	15.9	1258.7	970	4	0	530	71.3
592.70	1.00			Shale		124.6			15.9						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

### MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>578</b> KIPS	<b>578</b> KIPS	<b>313</b> KIPS	<b>61</b> FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1  
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

PILE TYPE AND SIZE ===== Steel HP 14 X 73  
 Plugged Pile Perimeter===== 4.700 FT. Unplugged Pile Perimeter===== 6.975 FT.  
 Plugged Pile End Bearing Area===== 1.379 SQFT. Unplugged Pile End Bearing Area===== 0.149 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		2.0		9.9	3.0		3.8	4	1	0	1	20
642.70	2.50	0.41	3		3.8	7.9	9.9	5.7	0.9	9.1	9	3	0	2	22
640.20	2.50	0.21	3		2.0	4.1	17.5	3.0	0.4	12.7	13	4	0	3	25
637.70	2.50	0.50	4		4.6	9.7	41.4	6.8	1.0	21.6	22	4	0	8	27
632.70	5.00	1.50	3		22.6	29.0	54.3	33.5	3.1	54.1	54	4	0	25	32
627.70	5.00	1.00	7		16.7	19.3	73.9	24.8	2.1	79.2	74	4	0	36	37
622.70	5.00	1.15	6		18.6	22.2	263.6	27.7	2.4	125.2	125	4	0	65	42
617.70	5.00		75	Hard Till	29.7	193.2	265.0	44.1	20.8	166.3	166	4	0	87	47
612.70	5.00		64	Hard Till	22.4	164.9	380.1	33.3	17.8	209.6	210	4	0	111	52
607.70	5.00		100	Hard Till	50.7	257.7	344.9	75.2	27.8	275.5	275	4	0	147	57
606.70	1.00			Shale	58.5	171.8	403.5	86.9	18.5	362.4	362	4	0	195	58.3
605.70	1.00			Shale	58.5	171.8	462.0	86.9	18.5	449.2	449	4	0	243	59.3
604.70	1.00			Shale	58.5	171.8	520.6	86.9	18.5	536.1	521	4	0	282	60.3
603.70	1.00			Shale	58.5	171.8	579.1	86.9	18.5	623.0	579	4	0	314	61.3
602.70	1.00			Shale	58.5	171.8	637.7	86.9	18.5	709.9	638	4	0	346	62.3
601.70	1.00			Shale	58.5	171.8	696.2	86.9	18.5	796.8	696	4	0	379	63.3
600.70	1.00			Shale	58.5	171.8	754.8	86.9	18.5	883.7	755	4	0	411	64.3
599.70	1.00			Shale	58.5	171.8	813.3	86.9	18.5	970.6	813	4	0	443	65.3
598.70	1.00			Shale	58.5	171.8	871.9	86.9	18.5	1057.5	872	4	0	475	66.3
597.70	1.00			Shale	58.5	171.8	930.4	86.9	18.5	1144.4	930	4	0	507	67.3
596.70	1.00			Shale	58.5	171.8	988.9	86.9	18.5	1231.2	989	4	0	540	68.3
595.70	1.00			Shale	58.5	171.8	1047.5	86.9	18.5	1318.1	1047	4	0	572	69.3
594.70	1.00			Shale	58.5	171.8	1106.0	86.9	18.5	1405.0	1106	4	0	604	70.3
593.70	1.00			Shale	58.5	171.8	1164.6	86.9	18.5	1491.9	1165	4	0	636	71.3
592.70	1.00			Shale		171.8			18.5						

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>705</b> KIPS	<b>705</b> KIPS	<b>383</b> KIPS	<b>63</b> FT.

PILE TYPE AND SIZE ===== Steel HP 14 X 89  
 Plugged Pile Perimeter===== 4.750 FT. Unplugged Pile Perimeter===== 7.033 FT.  
 Plugged Pile End Bearing Area===== 1.409 SQFT. Unplugged Pile End Bearing Area===== 0.181 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		2.0		10.1	3.0		4.0	4	1	0	1	20
642.70	2.50	0.41	3		3.9	8.1	10.0	5.7	1.0	9.2	9	3	0	2	22
640.20	2.50	0.21	3		2.0	4.1	17.8	3.0	0.5	13.0	13	4	0	3	25
637.70	2.50	0.50	4		4.6	9.9	42.2	6.9	1.3	22.4	22	4	0	8	27
632.70	5.00	1.50	3		22.8	29.6	55.1	33.8	3.8	55.0	55	4	0	26	32
627.70	5.00	1.00	7		16.9	19.7	75.0	25.0	2.5	80.3	75	4	0	37	37
622.70	5.00	1.15	6		18.8	22.7	268.5	27.9	2.9	130.7	131	4	0	68	42
617.70	5.00		75	Hard Till	30.0	197.4	269.6	44.4	25.4	171.4	171	4	0	90	47
612.70	5.00		64	Hard Till	22.7	168.5	387.0	33.6	21.7	217.2	217	4	0	115	52
607.70	5.00		100	Hard Till	51.2	263.2	350.5	75.8	33.9	281.7	282	4	0	151	57
606.70	1.00			Shale	59.2	175.5	409.6	87.6	22.6	369.3	369	4	0	199	58.3
605.70	1.00			Shale	59.2	175.5	468.8	87.6	22.6	456.9	457	4	0	247	59.3
604.70	1.00			Shale	59.2	175.5	528.0	87.6	22.6	544.5	528	4	0	286	60.3
603.70	1.00			Shale	59.2	175.5	587.2	87.6	22.6	632.1	587	4	0	319	61.3
602.70	1.00			Shale	59.2	175.5	646.3	87.6	22.6	719.8	646	4	0	351	62.3
601.70	1.00			Shale	59.2	175.5	705.5	87.6	22.6	807.4	706	4	0	384	63.3
600.70	1.00			Shale	59.2	175.5	764.7	87.6	22.6	895.0	765	4	0	416	64.3
599.70	1.00			Shale	59.2	175.5	823.8	87.6	22.6	982.6	824	4	0	449	65.3
598.70	1.00			Shale	59.2	175.5	883.0	87.6	22.6	1070.2	883	4	0	481	66.3
597.70	1.00			Shale	59.2	175.5	942.2	87.6	22.6	1157.8	942	4	0	514	67.3
596.70	1.00			Shale	59.2	175.5	1001.4	87.6	22.6	1245.5	1001	4	0	546	68.3
595.70	1.00			Shale	59.2	175.5	1060.5	87.6	22.6	1333.1	1061	4	0	579	69.3
594.70	1.00			Shale	59.2	175.5	1119.7	87.6	22.6	1420.7	1120	4	0	611	70.3
593.70	1.00			Shale	59.2	175.5	1178.9	87.6	22.6	1508.3	1179	4	0	644	71.3
592.70	1.00			Shale		175.5			22.6			4	0		

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE===== Pier 2  
 REFERENCE BORING ===== B-3  
 LRFD or ASD or SEISMIC ===== LRFD  
 PILE CUTOFF ELEV. ===== 664.96 ft  
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 646.10 ft  
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour  
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 639.00 ft  
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1555 kips  
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 35.17 ft  
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 353.71 KIPS  
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 132.64 KIPS

## MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req'd Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
<b>929</b> KIPS	<b>929</b> KIPS	<b>506</b> KIPS	<b>67</b> FT.

PILE TYPE AND SIZE ===== Steel HP 14 X 117  
 Plugged Pile Perimeter===== 4.850 FT. Unplugged Pile Perimeter===== 7.117 FT.  
 Plugged Pile End Bearing Area===== 1.469 SQFT. Unplugged Pile End Bearing Area===== 0.239 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
645.20	0.90	0.62	5		2.1		10.5	3.0		4.4	4	1	0	1	20
642.70	2.50	0.41	3		3.9	8.4	10.3	5.8	1.4	9.5	10	3	0	2	22
640.20	2.50	0.21	3		2.1	4.3	18.4	3.1	0.7	13.5	14	4	0	3	25
637.70	2.50	0.50	4		4.7	10.3	43.7	6.9	1.7	23.8	24	4	0	9	27
632.70	5.00	1.50	3		23.3	30.9	56.7	34.2	5.0	56.4	56	4	0	27	32
627.70	5.00	1.00	7		17.2	20.6	77.1	25.3	3.3	82.2	77	4	0	38	37
622.70	5.00	1.15	6		19.2	23.7	278.5	28.2	3.9	140.0	140	4	0	73	42
617.70	5.00		75	Hard Till	30.6	205.9	279.0	45.0	33.5	180.1	180	4	0	95	47
612.70	5.00		64	Hard Till	23.2	175.7	401.0	34.0	28.6	230.1	230	4	0	122	52
607.70	5.00		100	Hard Till	52.3	274.6	361.7	76.7	44.6	291.9	292	4	0	156	57
606.70	1.00			Shale	60.4	183.0	422.1	88.7	29.8	380.6	381	4	0	205	58.3
605.70	1.00			Shale	60.4	183.0	482.5	88.7	29.8	469.2	469	4	0	254	59.3
604.70	1.00			Shale	60.4	183.0	543.0	88.7	29.8	557.9	543	4	0	294	60.3
603.70	1.00			Shale	60.4	183.0	603.4	88.7	29.8	646.5	603	4	0	327	61.3
602.70	1.00			Shale	60.4	183.0	663.8	88.7	29.8	735.2	664	4	0	361	62.3
601.70	1.00			Shale	60.4	183.0	724.2	88.7	29.8	823.9	724	4	0	394	63.3
600.70	1.00			Shale	60.4	183.0	784.6	88.7	29.8	912.5	785	4	0	427	64.3
599.70	1.00			Shale	60.4	183.0	845.0	88.7	29.8	1001.2	845	4	0	460	65.3
598.70	1.00			Shale	60.4	183.0	905.5	88.7	29.8	1089.8	905	4	0	494	66.3
597.70	1.00			Shale	60.4	183.0	965.9	88.7	29.8	1178.5	966	4	0	527	67.3
596.70	1.00			Shale	60.4	183.0	1026.3	88.7	29.8	1267.1	1026	4	0	560	68.3
595.70	1.00			Shale	60.4	183.0	1086.7	88.7	29.8	1355.8	1087	4	0	593	69.3
594.70	1.00			Shale	60.4	183.0	1147.1	88.7	29.8	1444.4	1147	4	0	626	70.3
593.70	1.00			Shale	60.4	183.0	1207.5	88.7	29.8	1533.1	1208	4	0	660	71.3
592.70	1.00			Shale		183.0			29.8						

**Pile Design Table for Pier 2 utilizing Boring #B-3**

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
<b>Metal Shell 12"Φ w/.179" walls</b>			<b>Steel HP 10 X 57</b>			<b>Steel HP 14 X 73</b>		
64	31	37	422	229	62	210	111	52
<b>Metal Shell 12"Φ w/.25" walls</b>			<b>Steel HP 12 X 53</b>			275 147 57		
64	31	37	417	226	60	578 313 61		
352	189	42	<b>Steel HP 12 X 63</b>			<b>Steel HP 14 X 89</b>		
<b>Metal Shell 14"Φ w/.25" walls</b>			471 256 61			217 115 52		
77	37	37	<b>Steel HP 12 X 74</b>			282 151 57		
<b>Metal Shell 14"Φ w/.312" walls</b>			580 315 63			705 383 63		
77	37	37	<b>Steel HP 12 X 84</b>			<b>Steel HP 14 X 102</b>		
464	250	42	639 348 64			223 118 52		
<b>Steel HP 8 X 36</b>						286 153 57		
257	139	60				810 441 65		
<b>Steel HP 10 X 42</b>						<b>Steel HP 14 X 117</b>		
330	178	60				230 122 52		
						292 156 57		
						929 506 67		
						<b>Precast 14"x 14"</b>		
						98 47 37		
						<b>Timber Pile</b>		
						57 27 37		

## Appendix H

L-pile Input for Boring B-1  
 STA. 863+57  
 Offset 30 Ft LT  
 Water Table Elevation 649.6 Ft

Depth (Ft)	Elevation (Ft)		Abbreviated Soil Description	Friction ( $\phi$ ) °	Cohesion (c) tsf	Unit Weight (pcf)	
						$\gamma_{wet}$	$\gamma_{sat}$
3.0	658.6	to 655.6	Silty Clay Loam		0.75		127.3
5.5	655.6	to 653.1	Silty Clay Loam		0.25		134.3
11.0	653.1	to 647.6	Silty Clay Loam		0.23		128.3
13.0	647.6	to 645.6	Sand and Gravel	31			121.0
16.0	645.6	to 642.6	Sandy Loam	29			140.4
21.0	642.6	to 637.6	Sand	32			121.0
32.0	637.6	to 626.6	Silty Loam		0.54		120.0
45.0	626.6	to 613.6	Silty Clay Loam- Weathered Shale		1.27	143.4	
60.0	613.6	to 598.6	Shale		2.50	149.0	

L-pile Input for Boring B-2  
 STA. 863+92  
 Offset 30.0 Ft LT

Depth (Ft)	Elevation (Ft)	Abbreviated Soil Description	Friction ( $\phi$ ) °	Cohesion (c) tsf	Unit Weight (pcf)	
					$\gamma_{wet}$	$\gamma_{sat}$
3.0	658.4 to 655.4	Silty Clay Loam		0.50		131.3
6.0	655.4 to 652.4	Silty Clay Loam		1.25		119.2
11.0	652.4 to 647.4	Silty Clay Loam		0.25		132.3
16.0	647.4 to 642.4	Sandy Loam	27			152.4
21.0	642.4 to 637.4	Sand and Gravel	32			126.2
37.0	637.4 to 621.4	Silty Loam		0.28		121.2
55.0	621.4 to 603.4	Silty Clay Loam- Weathered Shale		2.50	141.1	
71.0	603.4 to 587.4	Shale		2.50	149.0	



L-pile Input for Boring B-3  
 STA. 864+50  
 Offset 27.0 Ft RT

Depth (Ft)	Elevation (Ft)		Abbreviated Soil Description	Friction ( $\phi$ ) °	Cohesion (c) tsf	Unit Weight (pcf)	
						$\gamma_{wet}$	$\gamma_{sat}$
6.0	666.7	to 660.7	Silty Clay Loam		0.71	118.68	
11.0	660.7	to 655.7	Silty Clay Loam		0.84	122.21	
16.0	655.7	to 650.7	Silty Clay Loam		1.21	124.23	
18.0	650.7	to 648.7	Silty Clay Loam		0.64	123.22	
23.0	648.7	to 643.7	Silty Clay Loam		0.28		129.3
29.0	643.7	to 637.7	Silty Clay Loam		0.18		126.3
33.0	637.7	to 633.7	Sand	28			121.0
46.0	633.7	to 620.7	Silty Loam		0.61		125.57
65.0	620.7	to 601.7	Silty Clay Loam- Weathered Shale		2.50	139.5	
80.0	601.7	to 586.7	Shale		2.50	149	

L-pile Input for Boring B-4  
 STA. 865+30  
 Offset 27.0 Ft RT

Depth (Ft)	Elevation (Ft)		Abbreviated Soil Description	Friction ( $\phi$ ) °	Cohesion (c) tsf	Unit Weight (pcf)	
						$\gamma_{wet}$	$\gamma_{sat}$
3.0	667.0	to 664.0	Silty Clay Loam		0.53	120.2	
6.0	664.0	to 661.0	Silty Loam		0.58	122.2	
8.0	661.0	to 659.0	Silty Clay Loam		1.00	124.2	
10.0	659.0	to 657.0	Silty Clay Loam		0.75	126.3	
18.0	657.0	to 649.0	Silty Clay Loam		1.03	125.9	
23.0	649.0	to 644.0	Silty Clay Loam		0.25		128.3
26.0	644.0	to 641.0	Silt	27			113.2
29.0	641.0	to 638.0	Sandy Loam/ Sand	28			144.0
32.0	638.0	to 635.0	Sandy Loam	30			147.6
38.0	635.0	to 629.0	Silty Loam		0.75	125.6	
45.0	629.0	to 622.0	Silty Loam		0.88	125.2	
52.0	622.0	to 615.0	Silty Clay Loam- Weathered Clay		2.50	136.4	
60.0	615.0	to 607.0	Shale		2.50	149	

# Geotechnical Design Memorandum

(In-House)

## US Route 67 over Pope Creek Bridge Replacement

Structure Number: 066-0019  
Route: FAP 310 (US 67)  
Section: 103-BR  
County: Mercer  
Project Number: D-94-042-08

Prepared For: Jeffery S. Burke  
Prepared By: Foundations & Geotechnical Unit  
Lindsey N. Jones  
Reviewed By: Bradley L. Hessing

Report Date: April 9, 2015  
Revised Report Date: June 29, 2016

## Table of Contents

1.0 Project Description.....	1
3.4 Scour [Updated].....	1
3.6 Bridge Foundations [Updated].....	1-3
Driven Pile Recommendations [Updated].....	2
Drilled Shaft Recommendations [New].....	2-3
4.0 Construction Considerations [Updated].....	4

### Appendix

Boring Logs.....	5-22
Updated Raw Scour Values.....	23-26
Approved TSL.....	27

## 1.0 Project Description

This memorandum provides additional geotechnical data and recommendations for the proposed bridge for US 67 over Pope Creek.

This memorandum was prepared to incorporate the updated Hydraulic Report scour results that reflect 1 pier (rather than 2 piers) and to provide drilled shaft recommendation for the proposed pier. This Geotechnical Design Memorandum (GDM) supplements the approved SGR with a revised date of June 6, 2012. Geotechnical evaluation and design recommendations in the SGR are still valid, except as specifically referenced in this document.

## 3.4 Scour [Updated]

The scour analysis was revised to reflect 1 pier rather than 2. Per the Hydraulic Report with an approval letter dated July 1, 2014, the raw Q100 scour is 35.27 ft, and the raw Q200 scour is 40.98 ft. The streambed elevation is 648.60 ft and due to the pier's proximity to the streambed the scour was taken from this elevation. The Q100 and Q200 pier scour elevations in the table below have been adjusted according to Bridge Manual Section 2.3.6.3.2 and the soil profile of Boring B-2. Scour elevation Table 3.4.1 was revised to conform to All Bridge Designers (ABD) Memorandum 14.2. The Item 113 rating for the abutments was 8 and the rating for the drilled shaft bent pier is 5. Per ABD 14.2 the lowest rating of the individual substructures should be shown in the chart. The scour information shown below supersedes the scour elevations shown in the approved SGR. This information is for a 2 span structure with spill-thru abutments and a drilled shaft bent pier. If the structure changes from the aforementioned, the scour table will need to be re-evaluated.

**Revised Table 3.4.1 – Scour Elevation**

Event/Limit State	Design Scour Elevations (ft.)			Item 113
	N. Abut	Pier	S. Abut	
Q100	661.92	620.59	662.11	5
Q200	661.92	620.02	662.11	
Design	661.92	620.59	662.11	
Check	661.92	620.02	662.11	

## 3.6 Bridge Foundations [Updated]

The TSL designer was contacted for updated factored substructure loads for the proposed 2 span structure. The preliminary factored loads, in kips, are estimated as follows:

N. Abut	Pier	S. Abut.
835	1350	953

## Driven Pile Recommendations [Updated]

The values presented for the north and south abutments in Tables 3.6.1 and 3.6.2 of the approved SGR are still applicable. Due to the revised scour evaluations, the pile resistance values for the piers are no longer accurate and need to be re-evaluated if it is desirable to use driven piles at the pier. The use of driven piles at the pier would likely require a Type I Cofferdam.

The approved SGR was written prior to ABD Memo 12.3, which changed the integral abutment design policy. Per ABD Memo 12.3, all metal shell and H-pile sizes are feasible at the abutments with the use of integral abutments. Metal shell piles would reach maximum nominal bearing at approximately 45 ft in length. H-piles would reach maximum nominal bearing at approximately 60 ft in length. H-piles are still an acceptable foundation at the abutments.

## Drilled Shafts Recommendations [New]

The following drilled shaft recommendations are based on boring B-2 and only apply to the proposed Pier. The Top of Rock elevation at the Pier is 621.40 ft. Silty Clay Loam-Weathered Shale starts at elevation 621.40 and extends to 603.40. Boring B-2 describes shale bedrock starting at 603.40 and the boring extends to elevation 587.40 ft (16 ft rock core). The top of the drilled shaft is estimated to be 664.5 ft.

The top of rock elevation is 621.40 ft, however Q100 scour elevation extends to 620.96 so resistance in rock above this elevation should be neglected. Rock from elevation 621.40 to 603.40 ft is described as Silty Clay Loam – Weathered Shale. This material can be considered clayey shale, weak shale, or an Intermediate Geo Material (IGM). It is recommended that the side and tip resistance between these elevations be designed using the Illinois Center for Transportation (ICT) research recommendations from the “Improvement for Determining Axial Capacity of Drilled Shafts in Shale in Illinois” report (Research Report No. FHWA-ICT-13-017). This method allows for the design of drilled shaft to use the side resistance in combination with the tip resistance. The table below provides recommended unit side and unit tip resistance values between elevation 621.40 and 603.40 ft. A resistance factor of 0.5 was applied to the total resistance as per the ICT report. The ICT method should not be used below elevation 603.40 ft, since the rock strength exceeds the definition of “weak shale” provided in the ICT report.

### ICT Drilled Shaft Design – Elev. 621.40 to 603.40 ft.

Bottom of Layer & Tip Bearing Elev.	Layer Thickness (ft)	Nominal Unit Side Resistance (ksf)	Factored Unit Side Resistance (ksf)	Socket Length at Bottom of Layer (ft)	Nominal Unit Tip Resistance (ksf)	Factored Unit Tip Resistance (ksf)
616.40	*5.0	2.7	1.35	*5.0	30.6	15.3
608.90	7.5			12.5	51.3	25.6
606.40	2.5			15.0	127.4	63.7
603.40	3.0			18.0	322.5	161.2

\*Neglect resistance above the Q100 scour elevation.

With the use of the AASHTO equations to design drilled shafts in shale, IDOT permits the design to combine side resistance and tip resistance for a total shaft resistance. Side resistance in rock can be accumulated along the length of the shaft using the following values starting at elevation 621.40 ft.

**AASHTO Drilled Shaft Side Resistance Design – Elev. 621.40 to 587.40 ft.**

Bottom of Layer & Tip Bearing Elev.	Layer Thickness (ft)	Nominal Unit Side Resistance (ksf)	Factored Unit Side Resistance (ksf)	Socket Length at Bottom of Layer (ft)	Nominal Unit Tip Resistance (ksf)	Factored Unit Tip Resistance (ksf)
619.40	*2.0	<sup>1</sup> 2.2	<sup>1</sup> 1.0	*2.0	<sup>3</sup> 17.8	<sup>3</sup> 9.8
615.40	4.0			6.0	<sup>3</sup> 51.5	<sup>3</sup> 28.3
612.40	3.0			9.0	<sup>3</sup> 31.0	<sup>3</sup> 17.1
611.40	1.0			10.0	<sup>3</sup> 42.7	<sup>3</sup> 23.5
603.40	8.0			18.0		
601.90	1.5	<sup>2</sup> 8.3	<sup>2</sup> 4.6	19.5	<sup>4</sup> 200.9	<sup>4</sup> 100.4
599.90	2.0			21.5	<sup>4</sup> 245.6	<sup>4</sup> 122.8
598.40	1.5			23.0	<sup>4</sup> 275.3	<sup>4</sup> 137.6
597.40	1.0	<sup>2</sup> 15.9	<sup>2</sup> 8.7	24.0		
593.40	4.0			28.0	<sup>4</sup> 270.3	<sup>4</sup> 135.2
590.40	3.0	<sup>2</sup> 20.9	<sup>2</sup> 11.5	31.0	--	--
587.40	3.0	<sup>2</sup> 26.3	<sup>2</sup> 14.5	34.0	--	--

\*Neglect resistance above the Q100 scour elevation.

-- Not enough boring data below the bearing elevation to calculate tip resistance.

<sup>1</sup>Side resistance was calculated using AASHTO's equation for drilled shaft in clay with a resistance factor of 0.45.

<sup>2</sup>Side resistance was calculated using AASHTO's equation for drilled shaft in rock with a resistance factor of 0.55.

<sup>3</sup>Tip resistance was calculated using AASHTO's equation for drilled shaft in IGM with a resistance factor of 0.55.

<sup>4</sup>Tip resistance was calculated using Zhang and Einstein equation for drilled shaft in rock with a resistance factor of 0.50.

The two methods provided above should not be combined together for a total shaft resistance. In other words, the shaft should be design using the ICT method for the weak shale from 621.40 to 603.40 ft. or using the AASHTO LRFD method from elevation 621.40 to 587.40 ft.

Embedment into rock to achieve fixity for the lateral load will need to be considered during the final design. Both lateral load and axial load need to be satisfied with the final design embedment depth. The deeper embedment as required per the lateral load design or axial load design should be used. The soil parameters from the approved SGR can be used for the lateral analysis.

#### **4.0 Construction Considerations [Updated]**

Boring log (B-2) recorded blow-ins of the sand and gravel layer between 16 and 21 ft below the ground surface. Casing or slurry will likely need to extend through this layer for the construction of the drilled shaft. Permanent casing does not appear necessary.

The cofferdam recommendations in the approved report are no longer valid due to the revised pier location and type. With the use of a drilled shaft bent with webwall at the pier, a cofferdam is not needed. If the pier type is changed, then the need for a cofferdam should be revisited.



**ILLINOIS DEPARTMENT OF TRANSPORTATION**  
**Testing Service Corporation**  
**STRUCTURE BORING LOG**

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek  
 SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson  
 COUNTY Mercer LOCATION Greene Township S.34/35, TWP. 14N, RNG. 2W

Boring No.	Station	Offset	Surface Elev.	DEPTH	BLOW	Qu	W	Surface Water Elev.	Groundwater Elev.:	DEPTH	BLOW	Qu	W
			ft	H	S	tsf	%		when drilling	H	S	tsf	%
B-1 N. Abutment	863+57	30.00ft LT	658.60					650.1					
									647.6				
									649.6				
Stiff dark brown SILTY CLAY LOAM, moist			655.60		3	P	26				2	P	28
					4	1.5					4	1.0	
					5						5		
Soft dark brown SILTY CLAY LOAM, very moist			653.10		2	P	33				2	B	23
					2	0.5					3	0.78	
				-5	3					-30	5		
Soft brown-gray SILTY CLAY LOAM, moist					0	B	26						
					2	0.45		626.60					
					3								
					2	P	28				4	B	16
					3	0.5					8	3.08	
				-10	4					-35	15		
Medium dense brown coarse SAND and small GRAVEL, saturated			647.60		4								
					6								
					5								
Loose brown SANDY LOAM, saturated			645.60		2		17				8	B	14
					4						19	2.53	
				-15	4					-40	28		
Medium dense brown fine SAND, saturated			642.60		4								
					10								
					5								
					10						12	S	17
					7						28	2.03	
				-20	3					-45	30		
Stiff gray SILTY LOAM, moist			637.60		3	B	29						
					5	1.35							
					7								
					3	B	20				13	P	16
					5	1.15					46	4.5+	
				-25	8			608.60		-50	50		



**ILLINOIS DEPARTMENT OF TRANSPORTATION**  
**Testing Service Corporation**  
**STRUCTURE BORING LOG**

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek  
 SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson  
 COUNTY Mercer LOCATION Greene Township S.34/35, TWP. 14N , RNG. 2W

Boring No.	Station	Offset	Surface Elev.	DEPTH	BLOW	Qu	W	Surface Water Elev.	Groundwater Elev.:	DEPTH	BLOW	Qu	W
			ft	H	S	tsf	%		when drilling	H	S	tsf	%
B-2 Pier 1	863+92	30.00ft LT	658.40					650.1					
								647.4					
Medium stiff dark brown SILTY CLAY LOAM, very moist			655.40		2 2 3	P 1.0	30				3 2 3	B 0.29	26
Very stiff dark brown-brown SILTY CLAY LOAM, moist			652.40		4 8 -5	P 2.5	18				3 3 4	P 0.5	27
Soft dark brown SILTY CLAY LOAM, very moist			647.40		1 1 2	P 0.5	31						
					0 1 -10	P 0.5	31				3 4 7	B 0.90	31
Very loose brown-gray SANDY LOAM, wet			642.40		0 0 0		30						
18" Blow-in at 15'			642.40		1 0 -15		24				9 26 49	P 4.5+	11
Medium dense brown coarse SAND and small GRAVEL, saturated			637.40		8 8 4		22						
24" Blow-in at 17.5' Sample 8 - No Recovery					8 9 -20						5 17 27	P 4.5+	16
24" Blow-in at 20'													
Soft to medium stiff gray SILTY LOAM, moist					2 2 3	B 0.49	24						
					3 3 -25	B 0.62	23				14 48	P 4.5+	15

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test Stations. Depths. Offset. and Elevations are in Feet



# Testing Service Corporation

## STRUCTURE ROCK CORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek

SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson

COUNTY Mercer

Boring No. B-2 Pier 1 Core Type NX  
 Station 863+92 Core Diameter 2 in  
 Offset 30.00ft LT Core Length 16 ft  
 Surface Elev. 658.40 ft

RECOVER Y (%)	R . Q . D . (%)	CORE TIME (Min/ft)	COMP. STRNGTH (tsf)
75	51		47.5
			172.1
97	83		121.7
			192.2

Top Elev. ft	Coring Notes and Rock Description	Core Run (#)
603.40	Hard gray to dark gray SHALE  Moisture Content = 7%  Moisture Content = 6%	1
	-60.0	
		2
	-65.0	
	Moisture Content = 1%  Moisture Content = 1%	
	-70.0	
587.40	End of Boring at 71.0'	
	-75.0	

Color pictures of the cores Yes

Cores will be stored for examination until \_\_\_\_\_



0 ft to 2 ft



2 ft to 4 ft



4 ft to 6 ft



6 ft to 8 ft



10 ft to 12 ft



12 ft to 14 ft





14 ft to 16 ft

ILLINOIS DEPARTMENT OF TRANSPORTATION  
Testing Service Corporation  
STRUCTURE BORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek  
 SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson  
 COUNTY Mercer LOCATION Greene Township S.34/35, TWP. 14N , RNG. 2W

Boring No.	Station	Offset	Surface Elev.	DEPTH	BLOW S	Qu tsf	W %	Surface Water Elev.	Groundwater Elev.:	DEPTH	BLOW S	Qu tsf	W %
B-3 Pier 2	864+50	27.00ft RT	666.70 ft					650.1					
								640.7					
Stiff brown SILTY CLAY LOAM, moist													
					1	P	16				0	B	24
					1	1.0					1	0.21	
					2						2		
					2	B	19	637.70			1	P	28
					2	1.85					2	0.5	
					4						2		
				-5									
660.70													
Stiff dark brown SILTY CLAY LOAM, moist													
					2	B	23						
					4	1.93							
					4								
								633.70					
					1	B	19				1	P	20
					3	1.44					2	1.5	
					4						3		
				-10									
655.70													
Very stiff brown-gray SILTY CLAY LOAM, moist													
					1	B	25						
					3	2.21							
					6								
					1	B	21				1	P	27
					3	2.62					3	1.0	
					6						4		
				-15									
650.70													
Stiff gray-brown SILTY CLAY LOAM, moist													
					1	B	22						
					3	1.27							
					4								
648.70													
Soft to medium stiff gray-brown SILTY CLAY LOAM, moist													
					0	B	27				1	B	26
					2	0.49					2	1.15	
					2						4		
				-20									
					1	B	29	620.70					
					2	0.62							
					3								
643.70													
Soft gray SILTY CLAY LOAM, moist													
					0	B	26				5	P	11
					1	0.41					40	4.5+	
					2						39		
				-25									

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test Stations. Depths. Offset. and Elevations are in Feet



# Testing Service Corporation

## STRUCTURE ROCK CORING LOG

ROUTE U. S. 67 DESCRIPTION Bridge Over Pope Creek

SECT. 103-BR STRUCT. NO. 066-0019 DRILLED BY B. Williamson

COUNTY Mercer

Boring No. B-3 Pier 2 Core Type NX  
 Station 864+50 Core Diameter 2 in  
 Offset 27.00ft RT Core Length 15 ft  
 Surface Elev. 666.70 ft

R E C O V E R Y	R · Q · D ·	C O R E T I M E	C O M P. S T R U C T I O N G T H
(%)	(%)	(Min/ ft)	(tsf)
97	82		
			132.5
			162.7
93	77		227.5
			160.6

Top Elev. ft	Coring Notes and Rock Description	Core Run (#)
601.70	Hard gray to dark gray SHALE	1
	-70.0	
	Moisture Content = 1%	
	-75.0	
	Moisture Content = 1%	
	Moisture Content = 1%	2
	-80.0	
586.70	End of Boring at 80'	
	-85.0	

Color pictures of the cores Yes

Cores will be stored for examination until \_\_\_\_\_



0 ft to 2 ft



2 ft to 4 ft



4 ft to 6 ft



6 ft to 8 ft



10 ft to 12 ft



10 ft to 12 ft



12 ft to 14 ft



14 ft to 16 ft





ILLINOIS DEPARTMENT OF TRANSPORTATION  
Testing Service Corporation  
STRUCTURE BORING LOG

STRUCTURE NO. 066-0019  
 ROUTE U. S. 67  
 SECTION 103-BR  
 COUNTY Mercer

Boring No. <u>B-4 S. Abutment</u>	D E P T H	B L O W S	Qu tsf	W %
Station <u>865+30</u>				
Offset <u>27.00ft RT</u>				
Elevation <u>617.00</u> ft				
Hard gray SILTY CLAY LOAM - WEATHERED SHALE	615.00			
Hard gray SHALE				
		20 100/5"	P 4.5+	9
	-55			
		60 100/3"	9 4.5+	9
	607.00 -60			
End of Boring at 60' - Auger Refusal				
	-65			
	-70			
	-75			

SPT. (N) = Sum of last two blow values in sample. (Qu) B=Bulge S=Shear P=Penetration Test  
 Stations, Depths, Offset, and Elevations are in Feet



# Illinois Department of Transportation

## Memorandum

---

To: Kensil A. Garnett, District 4                      Attn: Maureen M. Addis  
From: D. Carl Puzey  
Subject: Hydraulic Report  
Date: July 1, 2014

---

FAP Route 310  
Section (103)BR-1  
Mercer County

D-94-013-08  
SN 066-0003 (exist.)  
066-0019 (prop.)

US Route 67 over Pope Creek

Reply is made to the memorandum and revised hydraulic report for the above location, submitted for our review and approval on June 23, 2014 via email by the consultant Thouvenot, Wade and Moerchen, Inc. The hydraulic report was originally approved on March 6, 2014 but a change in project scope prompted this resubmittal. The change of project scope occurred because the submitted scour computations were revised based on our review comments dated May 22, 2013 and resulted in deeper anticipated scour. The revised anticipated scour depths, adjusted for soil type, are below the bottom tip elevation of the existing pier. Therefore this hydraulic report submittal reflects the change in the proposed scope of work from replacement with reuse of the existing pier to complete structure replacement.

We approve the revised hydraulic report, waterway information table and scour computations. We noticed, however, that the pier shape used in the proposed pier scour computations has been changed to "group of cylinders" from the previous submittal entry of "round nose". While both pier types produce the same resulting scour depths based on the conditions at this site, please note a solid wall pier type should be utilized for this bridge replacement due to the debris prone location of the project.

The IDOT clearance and freeboard policies are met with the proposed opening. A Statewide Permit #12 will be issued for this project, due to the greater than 10 square mile watershed, once the TS&L drawing has been stamped approved. We have received your Professional Engineer's certifications stating the existing structure has not caused flood damages or complaints. Please note the proposed structure configuration and waterway information table may be subject to revision during the TS&L stage of the project.

Any question or concerns may be directed to Gina Kramer at (217)558-4536 or Gina.Kramer@illinois.gov.



**WATERWAY INFORMATION TABLE**

Route: FAP 310 (US 67) Existing SN: 066-0003  
 Section: (103) BR-1 Proposed SN: 066-0019  
 County: Mercer Waterway: Pope Creek  
 Prepared by: S. Goldak Date: 06-23-2014  
 Checked by: CGB Date: 06-23-2014

Flood Event	Freq. Yr.	Discharge Ft <sup>3</sup> /s	Waterway Opening - ft <sup>2</sup>		Existing Overtopping Elev. = 668.0		Proposed Overtopping Elev. = 668.0		Head - ft.		Headwater Elevation ft.	
			Existing	Proposed	Natural H.W.E. ft.	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing
Design	10	4670	816	892	661.3	1.3	1.2	662.6	662.5			
Base	50	6940	914	1007	662.3	2.2	2.0	664.5	664.3			
Scour Design Check	100	7960	944	1042	662.6	2.5	2.3	665.1	664.9			
Overtop Existing	200	8980	983	1090	663.0	2.9	2.7	665.9	665.7			
Overtop Proposed	NA											
Max. Calc.	500	10300	1022	1138	663.4	3.5	3.2	666.9	666.6			

10 YEAR VELOCITY THROUGH EXISTING BRIDGE = 5.8 ft/s  
 10 YEAR VELOCITY THROUGH PROPOSED BRIDGE = 5.5 ft/s  
 ALL-TIME H.W.E. & DATE: 662.6 +/- Spring 2013

Scope of Work: Structure Replacement

**EXISTING STRUCTURE**

TYPE: Deck Beam on Closed Abutments  
 LENGTH: 103'4" (Bk- to-Bk Abut)  
 # SPANS: 2  
 LOW BEAM: 665.6'  
 SKEW: 0 degree  
 LOW E.O.P.: 668.0'

**PROPOSED STRUCTURE**

TYPE: W33 I-Beam on Open Abutments  
 LENGTH: 140'1" (Bk-to-Bk)  
 # SPANS: 2  
 LOW BEAM: 665.6'  
 SKEW: 0 degree  
 LOW E.O.P.: 668.0'

NOTE: PROPOSED STRUCTURE DETAILS ARE PRELIMINARY; SUBJECT TO REFINEMENT IN TSL STAGE.

6-18-2014  
 PIER MOVED RIGHT  
 (NORTH)  
 100 YR

Contraction Scour

	Left	Channel	Right
<b>Input Data</b>			
Average Depth (ft):	6.06	12.51	5.80
Approach Velocity (ft/s):	0.89	2.04	0.86
Br Average Depth (ft):	4.05	14.01	6.46
BR Opening Flow (cfs):	156.86	6790.92	1012.22
BR Top WD (ft):	16.19	62.67	45.58
Grain Size D50 (mm):	0.03	0.03	0.03
Approach Flow (cfs):	2786.13	2014.54	3159.34
Approach Top WD (ft):	518.05	79.05	832.42
K1 Coefficient:	0.690	0.690	0.690
<b>Results</b>			
Scour Depth Ys (ft):	1.58	27.59	6.97
Critical Velocity (ft/s):	0.70	0.79	0.69
Equation:	Live	Live	Live

Pier Scour

All piers have the same scour depth

Input Data

Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.03000
Depth Upstream (ft):	16.40
Velocity Upstream (ft/s):	6.49
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	35.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.05000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	7.68
Froude #:	0.28
Equation:	CSU equation

Abutment Scour

	Left	Right
<b>Input Data</b>		
Station at Toe (ft):	-48.02	85.24
Toe Sta at appr (ft):	-52.37	86.36
Abutment Length (ft):	500.24	586.97
Depth at Toe (ft):	8.54	7.54
K1 Shape Coef:	0.55 - Spill-through abutment	
Degree of Skew (degrees):	90.00	90.00
K2 Skew Coef:	1.00	1.00
Projected Length L' (ft):	500.24	586.97
Avg Depth Obstructed Ya (ft):	6.07	5.81
Flow Obstructed Qe (cfs):	2697.80	2935.64
Area Obstructed Ae (sq ft):	3036.73	3408.48
<b>Results</b>		
Scour Depth Ys (ft):	18.00	16.64
Froude #:	0.14	0.16

6-18-2014  
 PIER MOVED RIGHT  
 (NORTH)  
 200 YR

Contraction Scour

	Left	Channel	Right
<b>Input Data</b>			
Average Depth (ft):	6.73	13.23	6.40
Approach Velocity (ft/s):	0.91	2.03	0.88
Br Average Depth (ft):	4.29	14.45	6.28
BR Opening Flow (cfs):	132.16	7846.04	1001.80
BR Top WD (ft):	17.00	62.67	50.23
Grain Size D50 (mm):	0.03	0.03	0.03
Approach Flow (cfs):	3210.22	2123.53	3646.24
Approach Top WD (ft):	522.42	79.05	645.06
K1 Coefficient:	0.690	0.690	0.690
<b>Results</b>			
Scour Depth Ys (ft):	0.36	33.15	6.03
Critical Velocity (ft/s):	0.71	0.80	0.71
Equation:	Live	Live	Live

Pier Scour

All piers have the same scour depth

Input Data

Pier Shape:	Group of Cylinders
Pier Width (ft):	3.50
Grain Size D50 (mm):	0.03000
Depth Upstream (ft):	17.11
Velocity Upstream (ft/s):	6.70
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	35.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.05000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	7.83
Froude #:	0.29
Equation:	CSU equation

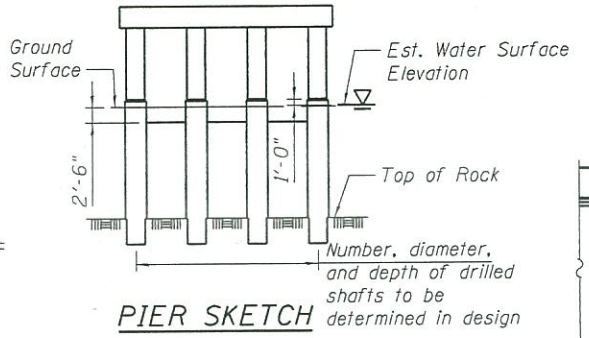
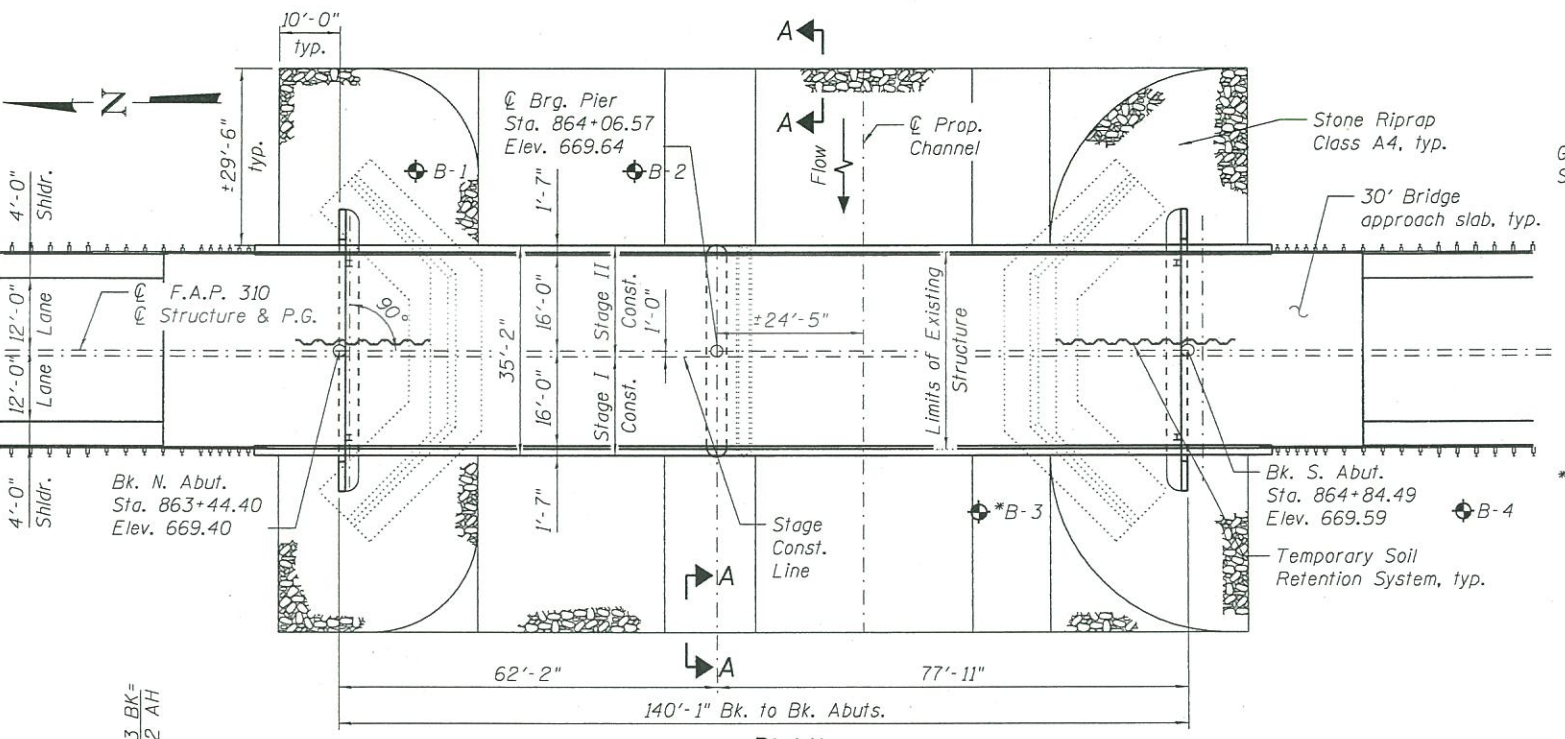
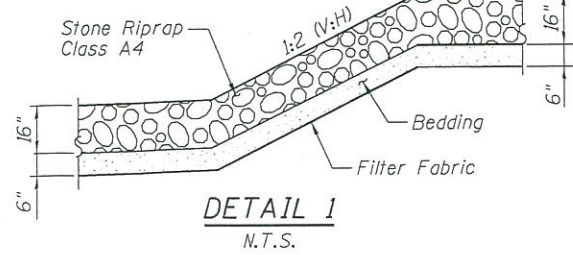
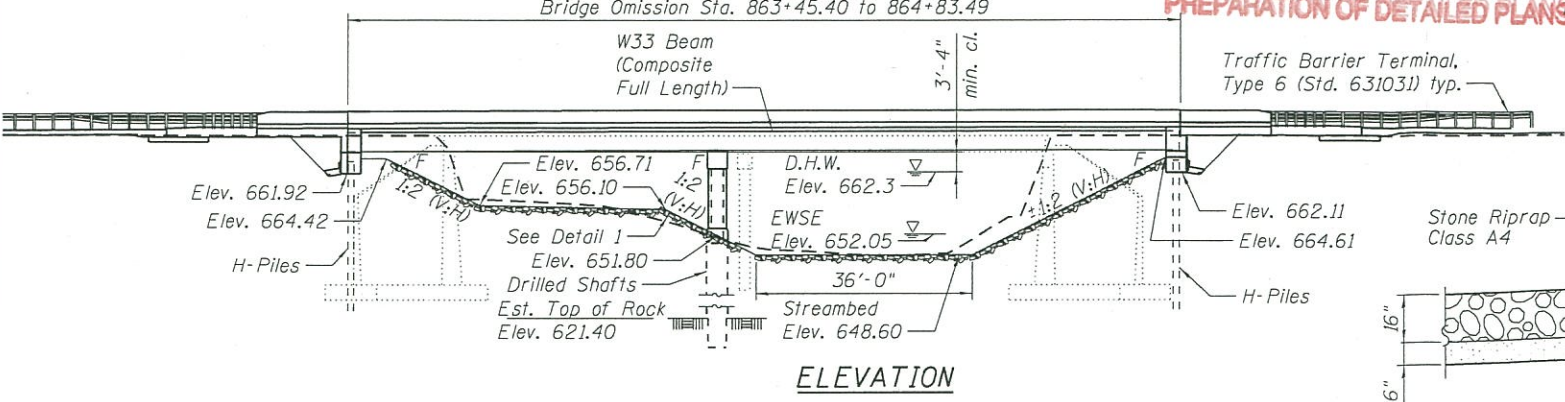
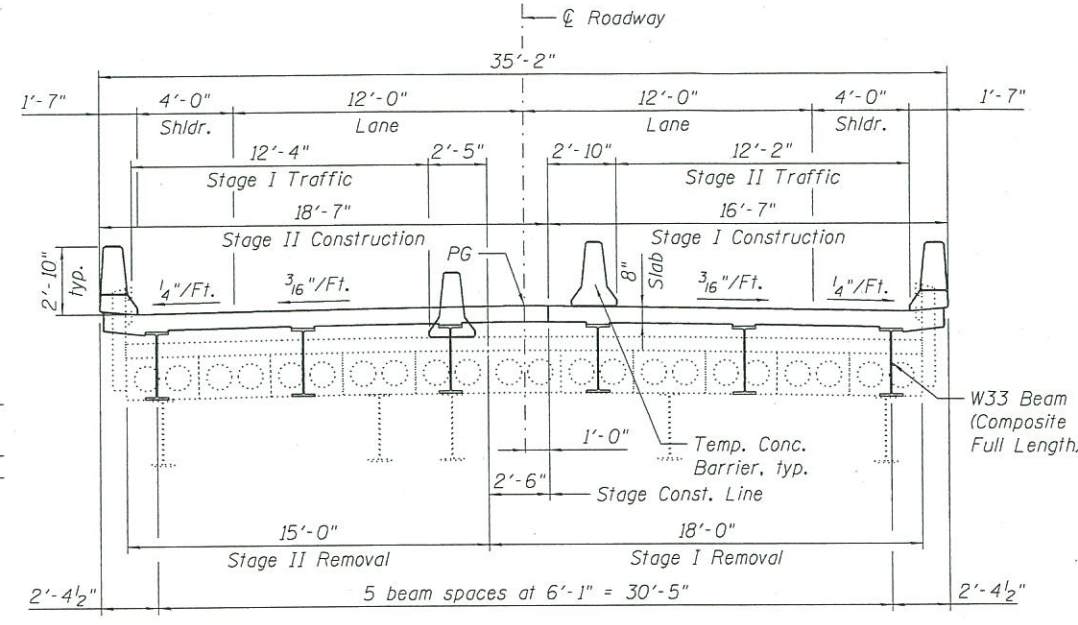
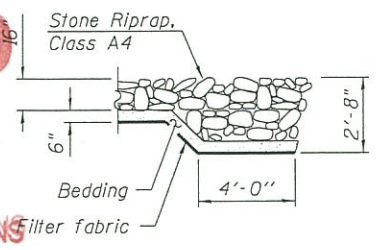
Abutment Scour

	Left	Right
<b>Input Data</b>		
Station at Toe (ft):	-48.02	85.24
Toe Sta at appr (ft):	-52.37	86.36
Abutment Length (ft):	504.61	586.97
Depth at Toe (ft):	9.25	8.25
K1 Shape Coef:	0.55 - Spill-through abutment	
Degree of Skew (degrees):	90.00	90.00
K2 Skew Coef:	1.00	1.00
Projected Length L' (ft):	504.61	586.97
Avg Depth Obstructed Ya (ft):	6.74	6.53
Flow Obstructed Qe (cfs):	3107.31	3387.68
Area Obstructed Ae (sq ft):	3399.26	3832.01
<b>Results</b>		
Scour Depth Ys (ft):	19.71	18.32
Froude #:	0.15	0.17

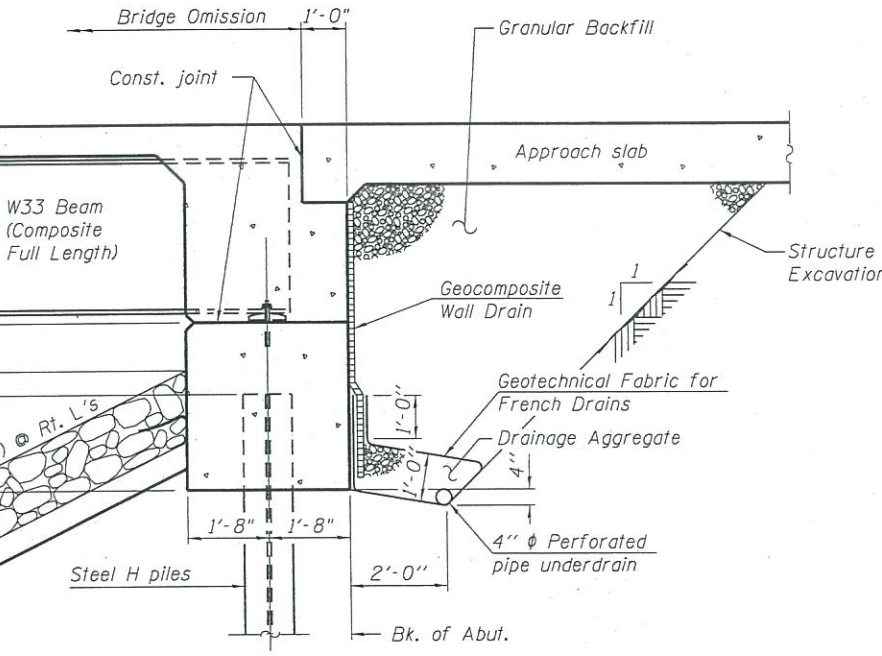
Bench Mark: Railroad Spike in first utility pole north of Structure No. 066-0003, East side of roadway. Elev. 659.74 (NAVD 88).

Existing Structure: S.N. 066-0003, built in 1931, under construction Route SBI-85, US Rt. 67, Sec. 103-BR. The structure is a two span precast prestressed concrete structure that replaced the original steel truss. The total length of the structure is 103'-4" from back to back of abutments, and it has a width of 33'-0". In 1971, the original superstructure was removed, the abutments were modified and a center pier was added to support the PPC deck beams. In 2001, the deck beams and substructures were repaired and 7" reinforced concrete overlay was placed over the deck beams. In 2008, temporary support beams were installed in both spans. Existing temporary steel beams and supports to be delivered to the E. Peoria Yard. Existing structure to be removed. Traffic to be maintained using staged construction.

**APPROVED**  
**AUG 05 2015**  
 AS A BASIS FOR  
 PREPARATION OF DETAILED PLANS



\* The location of this boring is uncertain. The surveyed ground elevation at the location shown on the boring log is approximately 16' below the ground surface elevation shown in the boring. The geotechnical engineer and drilling contractor were contacted but were unable to clear up this discrepancy. The boring is shown in the location noted on the boring log.



SECTION THRU INTEGRAL ABUTMENT  
 (Horiz. dim. @ Rt. L's)

PLAN  
 LOADING HL 93

Allow 50#/sq. ft. for future wearing surface.  
 2014 AASHTO LRFD Bridge Design Specifications, with 2015 Interims

**DESIGN SPECIFICATIONS**

**DESIGN STRESSES**

**FIELD UNITS**

$f'_c = 3,500$  psi  
 $f'_c = 4,000$  psi (superstructure concrete)  
 $f_y = 60,000$  psi (Reinforcement)  
 $f_y = 50,000$  psi (M270 Grade 50W)

**SEISMIC DATA**

Seismic Performance Zone (SPZ) = 1  
 Design Spectral Acceleration at 1.0 sec. ( $S_{D1}$ ) = 0.094g  
 Design Spectral Acceleration at 0.2 sec. ( $S_{D5}$ ) = 0.137g  
 Soil Site Class = D

**HIGHWAY CLASSIFICATION**

F.A.P. Rte. 310 - US 67  
 Functional Class: Other Principal Arterial-NHS  
 AADT: 2750 (2013); 2550 (2033)  
 ADTT: 470 (2013); 434 (2033)  
 DHV: 128

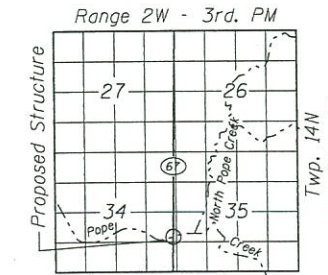
Speed: 55 m.p.h. (posted); 55 m.p.h. (design)  
 Two-way traffic Directional Dist. 50:50

**DESIGN SCOUR ELEVATION TABLE**

Event / Limit	Design Scour Elevations (ft.)			
	N. Abut.	Pier	S. Abut.	Item 113
Q100	661.92	620.59	662.11	5
Q200	661.92	620.02	662.11	
Design	661.92	620.59	662.11	
Check	661.92	620.02	662.11	

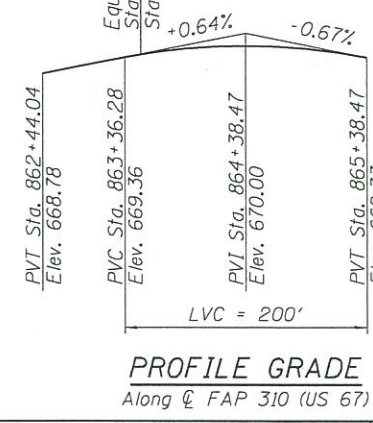
**WATERWAY INFORMATION**

		Drainage Area = 88.8 Sq. Mi.		Low Grade Elev. 668.0 @ Sta. 867+00					
Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft.		Head - Ft.		Headwater El.		
			Exist.	Prop.	Exist.	Prop.	Exist.	Prop.	
Design	10	4670	816	892	661.3	1.3	1.2	662.6	662.5
	50	6940	914	1007	662.3	2.2	2.0	664.5	664.3
Base	100	7960	944	1042	662.6	2.5	2.3	665.1	664.9
	200	8980	983	1090	663.0	2.9	2.7	665.9	665.7
Overtop Existing	NA								
Overtop Proposed	NA								
Max. Calc.	500	10300	1022	1138	663.4	3.5	3.2	666.9	666.6



LOCATION SKETCH

GENERAL PLAN & ELEVATION  
 US 67 OVER POPE CREEK  
 F.A.P. RTE 310 - SECTION (103)BR-1  
 MERCER COUNTY  
 STATION 864+14.45  
 STRUCTURE NO. 066-0019



PROFILE GRADE  
 Along Q FAP 310 (US 67)

THOUVENOT, WADE & MOERCHEN, INC.  
 SWANSEA • WATERLOO • EDWARDSVILLE • ST. LOUIS • ST. CHARLES

USER NAME	DESIGNED	REVISIONS
m_joost	MJJ	
	ALN	
	MJJ/TJP	
	ALN/MJJ	

STATE OF ILLINOIS  
 DEPARTMENT OF TRANSPORTATION

GENERAL PLAN & ELEVATION  
 STRUCTURE NO. 066-0019  
 SHEET NO. 1 OF 1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
310	(103)BR-1	MERCER	1	1

CONTRACT NO. 68804  
 ILL. Page 2 of 27