Illinois Department of Transportation

District 4 • 401 Main Street • Peoria, IL 61602

Structure Geotechnical Report

Bridge Replacement
Illinois Route 8 over West Fork of Kickapoo Creek
Peoria County, Illinois

Region:	Three
District:	Four
Route:	FAS 384 (IL 8)
Section:	(Z-2C-15D)BR
Structure Number:	072-0043 (Existing) 072-0231 (Proposed)
Contract Number:	68862 - PTB 151/33 Work Order #5
Job Number:	P-94-003-09
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IL 8 OVER WEST FORK OF KICKAPOO CREEK
PEORIA COUNTY, ILLINOIS
FAS 384 (IL 8)
SECTION: (Z-2C-15D)BR
CONTRACT NO.: 68862
STRUCTURE NO.: 072-0043(EXISTING)
072-0231(PROPOSED)

SITE INVESTIGATION

A site investigation was done by TERRA Engineering, Ltd. personnel in June 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 FAS 384 (IL 8) over West Fork of Kickapoo Creek at station 480+75.24 in Peoria 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 structure (SN 072-0043) was constructed in 1932 as a single span steel truss set on closed abutments. The steel truss was replaced by PCC deck beams spanning the modified original abutments with a pier added at the mid span in 1979. The structure is 143'-4" back to back of abutments and 31'-0" wide face to face.

The proposed structure will be a three span rolled steel beam structure 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 184 feet, 2 ¼ inches back to back of abutments. The proposed roadway cross-section, curb to curb, for the bridge will measure 32'-0" and will provide one (1) 12 foot wide lane in the westbound direction and one (1) 12 foot wide lane in the eastbound direction with 4 foot wide shoulder on both sides. A Type F parapet is proposed for both sides of the bridge. The horizontal alignment will be maintained as it currently exists, but the vertical alignment will have a slight grade raise over the bridge and a slight grade drop at the south end of the bridge to tie back into the existing pavement.

2.0 SUBSURFACE CONDITIONS

The project site is located approximately a half mile east of Oakhill on IL 8 in Peoria County. Physiographically the project is located in the Galesburg Plain. Four standard penetration test (SPT) borings were proposed, one at each abutment 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 478.1 ft. (B-1), 464.6 ft. (B-2), 464.7 ft. (B-3), and 479.5 ft. (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. SPT's 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 is comprised of Silty Clay Loam, Silty Loam, Sandy Loam, Sand, Sand and Gravel, Silt, and Shale. The uppermost layer in all four tests performed is a combination of Silty Clay Loam and Silty Loam between elevations 531.6 to 560.7. Moisture content ranges from 15 to 32 percent in this layer and has unconfined compressive strengths varying from 0.25 to 2.67 tons per square foot. Blow counts vary from 2 to 23 blows per foot. Boring B-3 has a Sandy Loam layer from elevation 535.2 to 545.2 that follows the top Silty Clay Loam/Silty Loam. The Sandy Loam layer has moisture content ranging from 19 to 26 percent, and blow counts ranging from 0 to 4 blows per foot.

The second layer consists of a combination of Sand and Sand and Gravel. Moisture content varies from 18 to 23 percent in this layer and blow counts ranging from 2 to 31 blows per foot. The layer exists between elevations 521.6 to 535.2. Boring B-1 has a thin Silt layer sandwiched between two Sand layers from elevation 526.1 to 527.1. The moisture content of the Silt layer is 44 percent and the blow count was 3 blows per foot.

The next layer is made up of Sandy Loam, Silty Loam, and Loam and is found between elevations 499.7 and 528.7 with moisture content from 11 to 29 percent. The blow counts range from 10 to 76 blows per foot and the unconfined compressive strength varies between 4.51 to 6.85 tons per square foot. Located between Silty Loam layers in Boring B-2 is a layer of Silt from elevation 513.6 to 514.6 and a layer of Sand from elevation 510.6 to 513.6. Following this layer, boring B-2 has another Silt layer from elevation 502.6 to 207.6 with moisture content of 18 percent and blow count of 25 blows per foot. Boring B-3 has a layer of Silt from elevation 511.7 to 514.7 between Silty Loam layers.

The fourth layer is a Sand and Sand and Gravel layer with moisture content between 13 and 24 percent. The layer occurs between elevations 482.5 and 507.6 and has blow counts varying from 2 to 100 blows per foot.

The final layer of the site is shale. Moisture content of this layer is between 12 and 13 percent with unconfined compressive strengths over 4.5 tons per square foot. Blow counts were all over 100 blows per foot with the highest value at 100 blows per 5 inches.

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 538.9 ft.

The uppermost bedrock in Peoria County consists of Pennsylvanian-aged shales and sandstones belonging to the Carbondale, Shelburn, and Patoka formations.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

The proposed west abutment will sit on top of new embankment due to its placement in front of the existing west abutment. The top 10.0 feet of existing material at the location of the west abutment is predominantly moist silty clay with compressive strengths between 0.41 to 1.93 tons per square feet. Due to the weak, saturated nature of the material between elevations 535.60 and 538.10 ft at this location it is anticipated that 3.17 inches of settlement will occur if no remedial action is taken. One possible solution is to leave the weak material in place and construct the embankment on top of it. If the weak material is left in place, then the embankment will have to sit for approximately 81 days (51 days of settlement plus 30 days to confirm) to allow settlement to occur. Waiting 81 days for settlement to occur would unfavorably lengthen the construction schedule. Wick drains could be utilized to speed the settlement process and shorten the settlement time to approximately 45 days, however wick drains are not a cost effective option for such a small area. It is recommended that the weak material (top 9.0 feet) be removed in areas that will have 5 feet or more of embankment material placed on top. The weak material should be replaced with suitable material prior to the embankment being placed. This solution eliminates the need to wait for settlement to occur and ensures little settlement will take place. There is little to no change to the east abutment profile, therefore detrimental settlement is not anticipated.

3.2 Slope Stability

Slope stability analysis was performed on the side slope for both the west and the east 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 west abutment under static conditions was 2.020 and the minimum for the east abutment was 3.445. Both static values meet the minimum allowable safety factor of 1.5. The minimum safety factor for the west abutment under seismic conditions was 1.808 and the minimum for the east abutment was 3.062. 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 (SD1) of 0.108 g, and a Design Spectral Acceleration (SDs) at 0.2 second of 0.167 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 0.03911 g. The peak seismic ground surface acceleration A_s is 0.071 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

Table 3.4.1 presents the 100 and the 500 year design scour elevations.

Table 3.4.1 – Design Scour Elevation

Abutment/Pier	100 Year Design Scour Elevation (ft)	500 Year Design Scour Elevation (ft)
West Abutment	553.02	553.02
Pier 1	496.85	485.10
Pier 2	496.85	483.84
East Abutment	553.28	553.28

The material down to the scour elevation at the piers is predominantly silty loam and sand (See Appendix C for boring logs). Per Section 2.3.6.3.2 of the IDOT 2012 Bridge Manual this type of material merits a

0% reduction to the scour depth. Scour reduction was considered, however no reduction factor was applied.

3.5 Mining Activity

According to the Directory of Coal Mines in Illinois – Peoria 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 Section 2.3.6.2.1 of the IDOT 2012 Bridge Manual is a single row of vertical H-Piles or Metal Shell piles. Based on the bridge length of 184.2 feet, the abutment foundation is further restricted to only H-Pile and 14 inch Metal Shell pile per the Bridge Design Manual. Due to the depth of scour present at the piers, drilled shafts are being considered for the piers as well.

The Modified IDOT Static Method of Estimating Pile Length spreadsheet (See Appendix G- Part I through Part VI for output) was used to analyze the various pile types and their loading for the west abutment, east abutment, Pier 1, and Pier 2. The analysis run for all substructures for the 14 inch metal shell pile resulted with end bearing resistance values greater than skin friction resistance values. When the end bearing is greater than the skin friction it is not recommended metal shell pile be used. In all four locations metal shell pile becomes overstressed long before the maximum nominal bearing capacity is achieved. The analysis run for Pier 1 and Pier 2 for the 14 inch metal shell pile resulted in scour depths deeper than or equal to pile tip elevation, therefore metal shell should not be used as foundation for either pier. The pile cut off elevation is 555.02 ft for the west abutment, 555.28 ft for the east abutment, and 556.98 ft for the piers. Section 3.1 of this report recommends that the top 9.0 ft of material at the west abutment be removed and replaced with embankment material. Pile lengths for the west abutment were analyzed under the assumption that this recommendation is implemented. The table below summarizes capacities of metal shell for the abutments:

Table 3.6.1 – Metal Shell Pile Capacities

Pile Description	Substructure Description	Nominal Required Bearing (kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
14" w/.25 walls	West Abutment	229	126	37
14" w/.25 walls	West Abutment	257	141	54
14" w/.312 walls	West Abutment	229	126	37
14" w/.312 walls	West Abutment	257	141	54
14" w/.25 walls	East Abutment	341	188	25
14" w/.25 walls	East Abutment	357	196	26
14" w/.312 walls	East Abutment	341	188	25
14" w/.312 walls	East Abutment	357	196	26

Conical tips are recommended if metal shell is selected for the West Abutment due to hard driving conditions (blow counts greater than 30 blows per foot) encountered between 35 feet and 50 feet below the surface. The following tables display H-Pile capacities of frequently rolled pile for both the abutments and the piers.

Table 3.6.2 – H-Pile Capacities (Abutments)

Pile Description	Substructure Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
HP 10x42	West Abutment	231	127	57
HP 10x42	West Abutment	254	140	60
HP 10x42	West Abutment	276	152	69
HP 10x42	East Abutment	233	128	42
HP 10x42	East Abutment	268	147	47
HP 10x42	East Abutment	277	152	54
HP 12x53	West Abutment	277	152	57
HP 12x53	West Abutment	316	174	60
HP 12x53	West Abutment	344	189	69
HP 12x53	East Abutment	292	161	42
HP 12x53	East Abutment	334	184	47
HP 12x53	East Abutment	344	189	54
HP 12x63	West Abutment	319	175	60
HP 12x63	West Abutment	348	191	69
HP 12x63	West Abutment	428	236	70
HP 12x63	East Abutment	347	191	54
HP 12x63	East Abutment	449	247	57
HP 12x63	East Abutment	478	263	58
HP 14x73	West Abutment	415	228	65
HP 14x73	West Abutment	424	233	69
HP 14x73	West Abutment	507	279	70
HP 14x73	East Abutment	421	232	54
HP 14x73	East Abutment	532	311	58
HP 14x73	East Abutment	566	311	58
HP 14x89	West Abutment	393	216	60
HP 14x89	West Abutment	430	236	69
HP 14x89	West Abutment	517	285	70
HP 14x89	East Abutment	611	336	59
HP 14x89	East Abutment	645	355	60
HP 14x89	East Abutment	679	374	61

Table 3.6.2 continued – H-Pile Capacities (Piers)

Pile Description	Substructure Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
HP 10x42	Pier 1	205	44	59
HP 10x42	Pier 1	239	63	60
HP 10x42	Pier 1	272	81	66
HP 10x42	Pier 2	283	98	67
HP 10x42	Pier 2	303	110	68
HP 10x42	Pier 2	323	121	69
HP 12x53	Pier 1	286	75	60
HP 12x53	Pier 1	327	97	61
HP 12x53	Pier 1	339	104	66
HP 12x53	Pier 2	363	131	68
HP 12x53	Pier 2	387	144	69
HP 12x53	Pier 2	404	154	70
HP 12x63	Pier 1	343	106	66
HP 12x63	Pier 1	434	156	68
HP 12x63	Pier 1	475	178	69
HP 12x63	Pier 2	373	136	68
HP 12x63	Pier 2	397	149	69
HP 12x63	Pier 2	414	158	70
HP 14x73	Pier 1	418	132	66
HP 14x73	Pier 1	514	185	68
HP 14x73	Pier 1	563	212	69
HP 14x73	Pier 2	442	161	68
HP 14x73	Pier 2	470	177	69
HP 14x73	Pier 2	490	188	70
HP 14x89	Pier 1	575	218	69
HP 14x89	Pier 1	624	245	70
HP 14x89	Pier 1	674	272	71
HP 14x89	Pier 2	453	167	68
HP 14x89	Pier 2	482	183	69
HP 14x89	Pier 2	500	192	70

The tip elevations for pile driven to bedrock were estimated based on approximately 4.0 feet of embedment in the shale bedrock. It should be noted that 14X117 piles are not readily available and could elongate the construction time. The following table displays H-Pile capacities for 14x117 pile.

Table 3.6.3 – H-Pile Capacities (Piers – uncommon pile size)

Pile Description	Substructure Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
HP 14x117	Pier 1	695	282	71
HP 14x117	Pier 1	745	309	72
HP 14x117	Pier 1	776	326	73
HP 14x117	Pier 2	472	176	68
HP 14x117	Pier 2	502	192	69
HP 14x117	Pier 2	516	200	70

See Appendix G Part I through Part IV for the IDOT pile length spreadsheets. The large depth of scour at the piers was taken into consideration during the analysis of the foundations. Due to the scour, it is recommended that the foundation chosen for the piers be embedded in bedrock to ensure the stability and longevity of the structure. The existing soil conditions at the proposed Pier 1 location require H-Pile size 14X117 in order for bedrock to be reached. H-Pile sizes 12X53 or larger are able to reach bedrock at Pier 2. Since H-Pile 14X117 is not readily available the cost and time required to order this foundation could be a hindrance. In order to reduce the amount of resistance H-Pile receives at Pier 1 as it is being driven, the top 30 feet of material could be loosened with an auger. Disturbing the soil with the auger reduces the unconfined compressive strength and blow counts for the top 30 feet of material to 0 tsf and 0 blows per foot. This allows a smaller and regularly manufactured size H-Pile to be utilized at Pier 1 to reach bedrock. Augering could also be used at Pier 2 to reduce the required pile size. See Appendix G Part V and Part VI for estimated pile lengths after augering to a 30 foot depth at Pier 1 and Pier 2. The table below shows H-Pile capacities at Pier 1 and Pier 2 after the top 30 feet of soil have been disturbed with the auger.

Table 3.6.4 – H-Pile Capacities (Pier 1 and Pier 2 after 30 ft of soil is disturbed)

Pile Description	Substructure Description	Maximum Nominal Required Bearing (kips)	Factored Resistance Available[1] (kips)	Estimated Pile Length (ft)
HP 10x42	Pier 1	257	122	69
HP 10x42	Pier 1	291	140	70
HP 10x42	Pier 1	325	159	71
HP 10x42	Pier 2	160	84	68
HP 10x42	Pier 2	180	95	69
HP 10x42	Pier 2	195	103	70
HP 12x53	Pier 1	308	146	69
HP 12x53	Pier 1	349	168	70
HP 12x53	Pier 1	390	190	71
HP 12x53	Pier 2	192	101	68
HP 12x53	Pier 2	216	114	69
HP 12x53	Pier 2	234	124	70
HP 12x63	Pier 1	400	196	71
HP 12x63	Pier 1	441	219	72
HP 12x63	Pier 1	474	237	73
HP 12x63	Pier 2	200	105	68
HP 12x63	Pier 2	224	119	69
HP 12x63	Pier 2	240	128	70
HP 14x73	Pier 1	473	232	71
HP 14x73	Pier 1	522	259	72
HP 14x73	Pier 1	562	281	73
HP 14x73	Pier 2	236	124	68
HP 14x73	Pier 2	265	140	69
HP 14x73	Pier 2	284	151	70

H-Pile bearing capacity reductions due to negative skin friction, and liquefaction have been considered and are not present at this bridge site. Bearing capacity reductions due to scour have been applied. Hard driving conditions are not anticipated, therefore pile shoes are not recommended for the H-Piles. Since friction H-Piles and H-Piles driven to bedrock are both options, 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.

Drilled shaft foundations at the piers may be economically feasible due to the large scour depths. The drilled shafts would need to be founded in rock; however the rock cores taken at the piers are not deep enough for final design of the drilled shafts. The following recommendations are preliminary pending the results of additional deeper rock cores (See Appendix H for correspondence records with IDOT in regards to additional rock cores).

The preliminary factored loads to the drilled shafts in rock are 1610 kips per pier with a geotechnical resistance factor of 0.5 or 1702 kips per pier with a geotechnical resistance factor of 1.0. This is based on the following:

- Including the dead load of the shaft to the scour depth in the factored load;
- Accounting for the 100 year scour as Strength I limit state and the 500 year scour as an extreme event with reduction factors and load factors of 1.0.

Calculations of tip resistance in accordance with AASHTO LRFD 10.8.3.5.4 result in a nominal tip resistance of 18.8 ksf for pier #1 (B-2) and 31.3 ksf for pier #2 (B-3) founded at elevation 469.7 or lower. However, based on the preliminary factored loads shown above, these end bearing capacities are not sufficient to support the required drilled shaft sizes and numbers.

Calculations of side resistance in accordance with AASHTO LRFD 10.8.3.5.4 result in a nominal side resistance of 9.9 ksf for pier #1 (B-2) and 7.7 ksf for pier #2 (B-3) above elevation 469.7 and 8.5 ksf for pier #2 below elevation 469.7. The following table summarizes the preliminary feasible options for drilled shaft (DS) numbers and sizes:

Table 3.6.5 – Preliminary Drilled Shaft Capacities (Pier 1)

# of Drilled Shafts	Diameter in Rock (inch)	Length in Rock (ft)	Tip Elevation	Nominal Resistance per DS (kips)	Factored Resistance per DS (kips)	Factored Resistance per pier (kips)
2	48	13	466.6	1617	809	1617
3	36	12	467.6	1120	560	1679
4	36	9	470.6	840	420	1679
4	24	13	466.6	809	404	1617

Boring Surface Elevation – 544.6 ft

Top of Rock Elevation – 479.6 ft

Note: Per AASHTO a core to depth of 3 times the diameter below the tip is needed for final design. The IDOT Foundation Geotechnical Unit (FGU) made the decision that additional borings/rock cores are not necessary for further Drilled Shaft design due to the quality of shale shown in the borings (See Appendix H for correspondence records).

Table 3.6.6 – Preliminary Drilled Shaft Capacities (Pier 2)

# of Drilled Shafts	Diameter in Rock (inch)	Length in Rock (ft)	Tip Elevation	Nominal Resistance per DS (kips)	Factored Resistance per DS (kips)	Factored Resistance per pier (kips)
2	48	17	462.7	1715	858	1715
3	36	15	464.7	1126	563	1689
4	24	17	462.7	858	429	1715

Boring Surface Elevation – 560.7 ft

Top of Rock Elevation – 479.7 ft

Note: Per AASHTO a core to depth of 3 times the diameter below the tip is needed for final design. The IDOT Foundation Geotechnical Unit (FGU) made the decision that additional borings/rock cores are not necessary for further Drilled Shaft design due to the quality of shale shown in the borings (See Appendix H for correspondence records).

Preliminary calculations for the drilled shaft are available in Appendix I. In summary, the foundation of the abutments should be either Metal Shell or H-Pile. The piers should utilize either H-Pile or Drilled Shaft foundation. Due to the large quantity of scour, the foundation for the piers needs to be embedded in bedrock.

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.

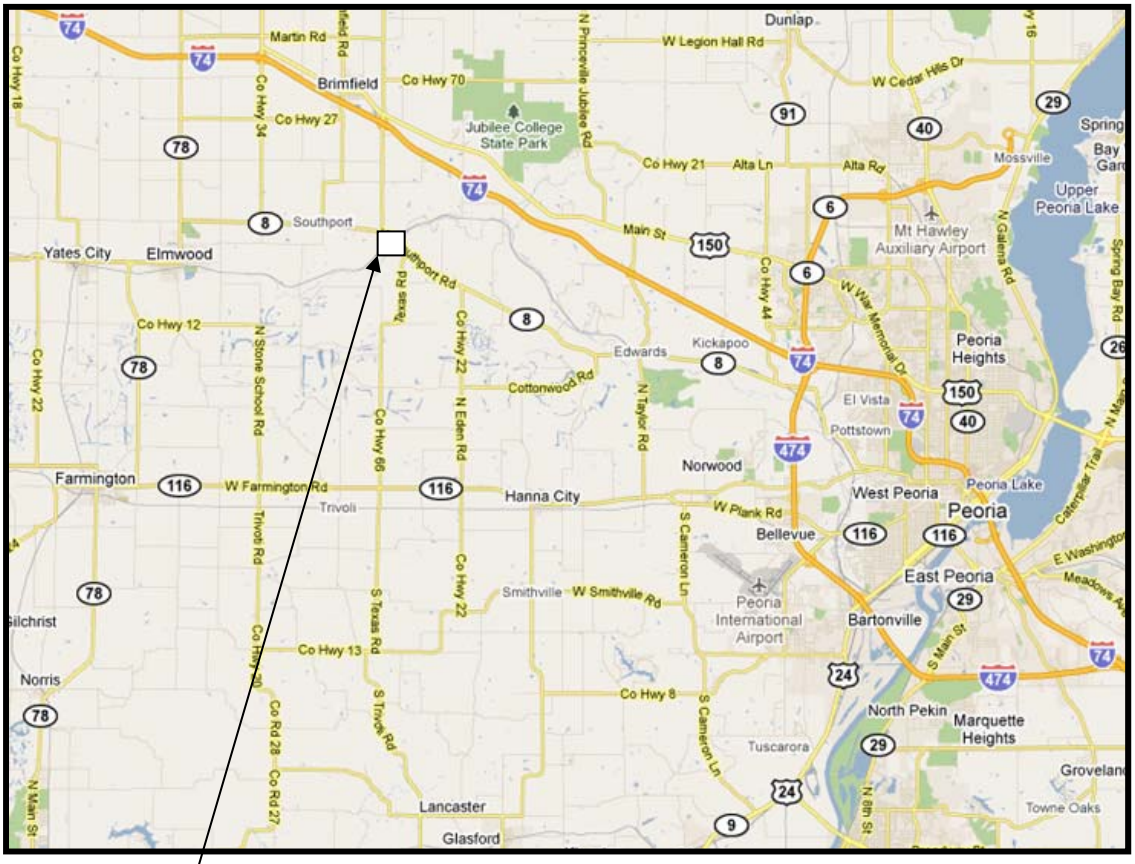
Based on the encountered subsurface conditions, tables for B-1, B-2, B-3, and B-4 summarizing appropriate soil parameters ø, c, γ wet and saturated soil until weights for the LPILE analysis, are included in Appendix J (Reference: LPILE User's Manual, Ensoft, Inc., October 2000). When pile design details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

4.0 CONSTRUCTION CONSIDERATIONS

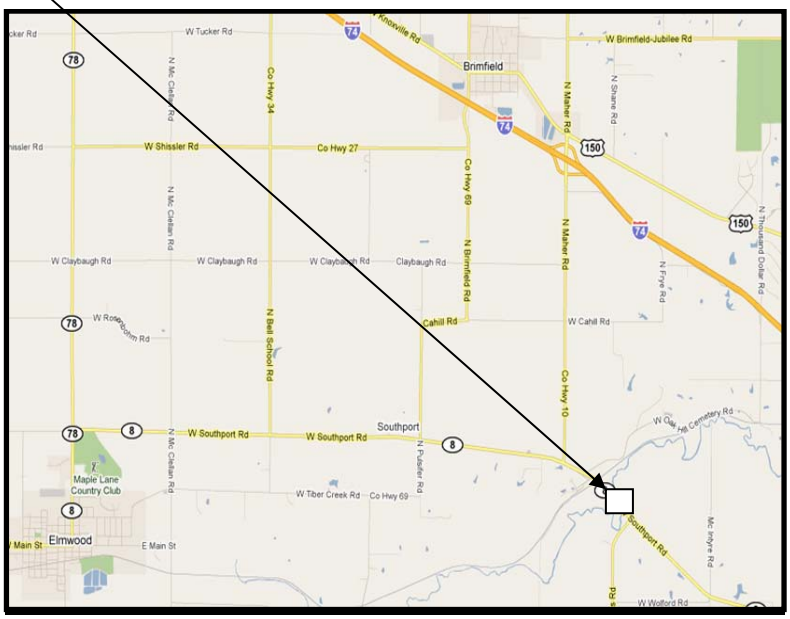
Traffic will be detoured during the removal and replacement of the structure. The Estimated Water Surface Elevation (EWSE) is 536.4 ft. The elevation at the bottom of Pier 1 and Pier 2 is 529.5 ft. The difference between the EWSE elevation and bottom of pier elevation is greater than 6.0 ft., therefore Type 2 cofferdams are necessary for the construction of this structure if H-Pile foundation is used. Due to the sandy nature of the material at the elevation at the bottom of the proposed piers a seal coat should be used for the construction of both piers if a cofferdam is built. If Drilled Shaft foundation is chosen for the piers, a cofferdam is not necessary (see All Bridge Designers Memo 11.2 dated August 8, 2011). 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

Location Map



Project Location



Quadrangle Map

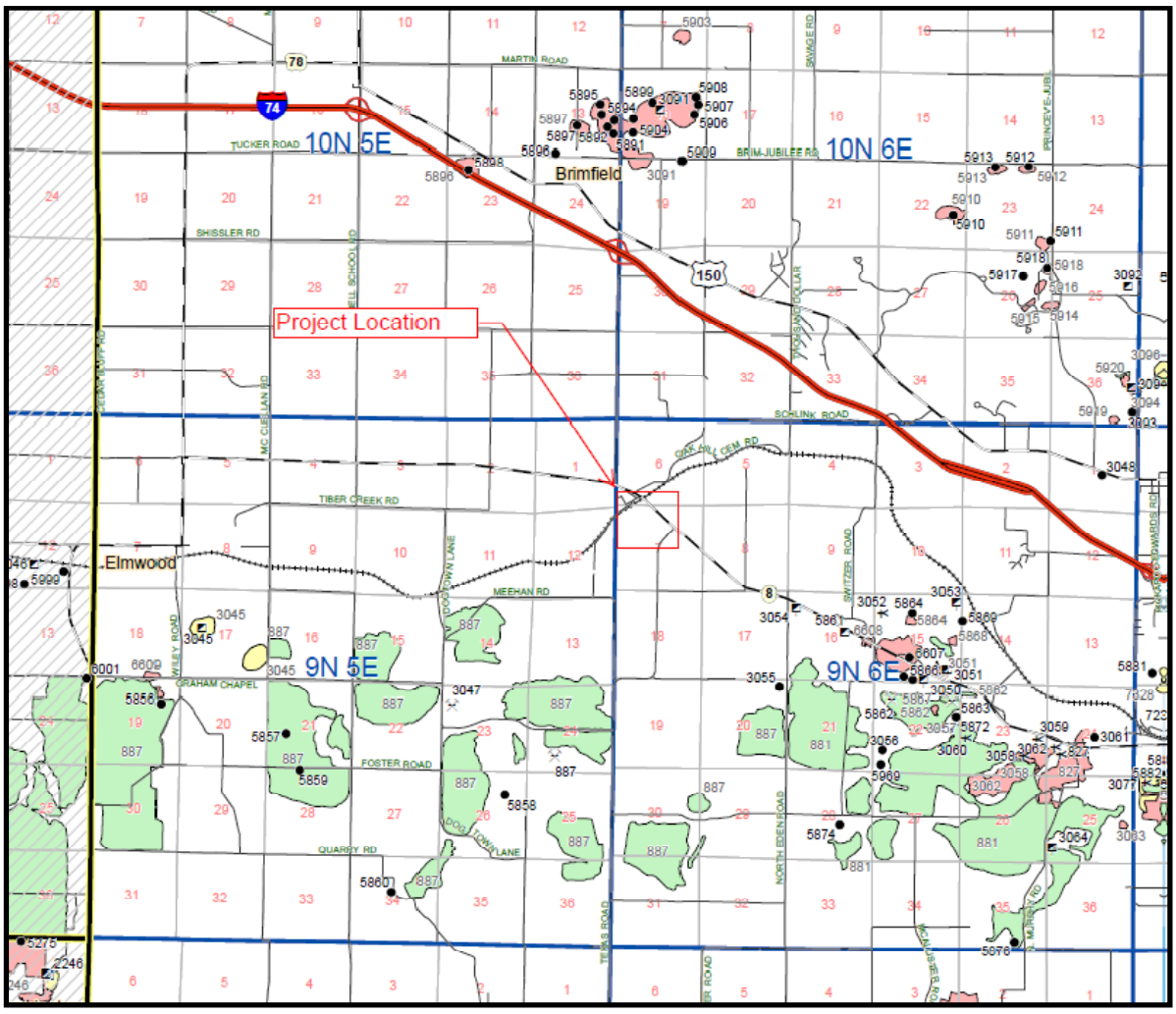


Photo 1
South West Ditch

Photo 2
South East Ditch

Photo 3
South East Wing Wall

Photo 4
North West Ditch

Photo 5
Erosion on North West Ditch Showing Erosion and Exposed Fabric

Photo 6
North West Wing Wall with Reinforcement Exposed

Photo 7
North West Creek Bank

Photo 8
North East Ditch

Photo 9
Erosion above North East Wing Wall Showing Exposed Fabric

Photo 10
North East Creek Bank

Photo 11
East Bridge Joint

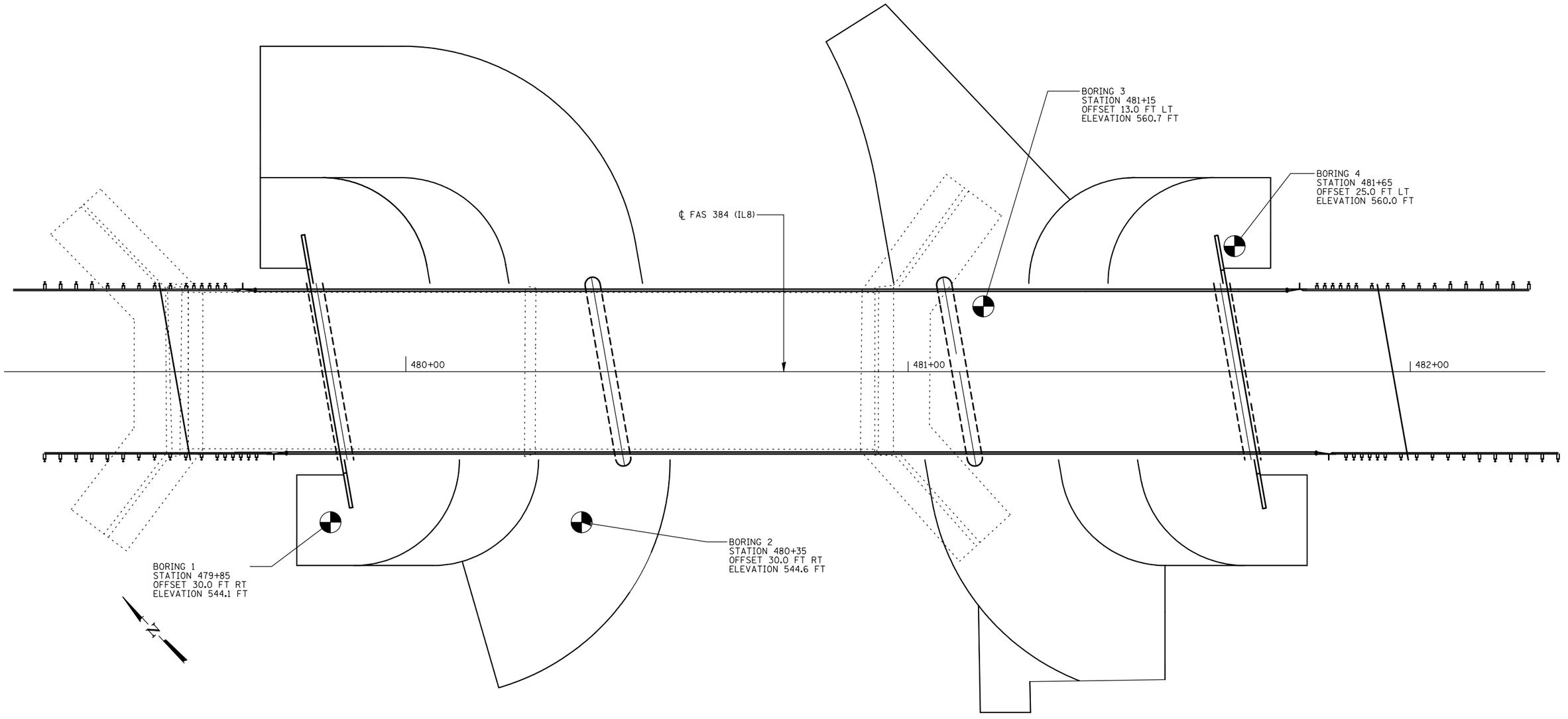
Photo 12
Center Joint

Photo 13
West Bridge Joint

Photo 14
Exposed Substructure near Center of Bridge

Appendix B

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION



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FEET

BORING LOCATION PLAN VIEW
IL 8 OVER WEST FORK OF KICKAPOO CREEK
F.A.S. 384 - SECTION (Z-2C-15D)BR
PEORIA COUNTY
STATION 480+75.24
STRUCTURE NO. 072-0231

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
1 SHEETS

F.A.S RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
384	(Z-2C-15D)BR	PEORIA		
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

Date 3/16/11

ROUTE IL 8 DESCRIPTION Bridge Over Kickapoo Creek

SECT. (Z-2C-15D)BR STRUCT. NO. 072-0231 DRILLED BY B. Williamson

COUNTY Peoria LOCATION Rosefield Township S. 7 , TWP. 9N , RNG. 6E

Boring No. B-1 W. Abutment
Station 479+85
Offset 30.00ft RT
Surface Elev. 544.10 ft

Surface Water Elev. 534.5
Groundwater Elev.:
when drilling 533.1
at Completion 534.1
after ____ Hrs. ____

	DEPTH	BLOWS	Qu tsf	W %
Stiff dark brown SILTY CLAY LOAM, moist				
		2 3 4	B 1.93	18
541.10				
Medium stiff dark brown SILTY LOAM, moist				
		2 2 2	B 0.53	23
	-5			
538.60				
Soft to medium stiff dark brown SILTY LOAM, very moist				
		1 1 1	B 0.41	32
		1 2 2	B 0.74	27
	-10			
533.60				
Very loose brown fine to coarse SAND, saturated				
		2 2 2		
		2 2 2		
	-15			
		3 2 1		44
527.10				
Very loose dark brown organic SILT, very moist				
526.10				
Loose brown fine to coarse SAND, saturated				
		1 2 6		
	-20			
523.60				
Medium dense gray SANDY LOAM, moist				
		4 9 15		12
521.10				
Hard gray SILTY LOAM, moist				
		4 10 16	B 4.63	15
	-25			

	DEPTH	BLOWS	Qu tsf	W %
Hard gray SILTY LOAM, moist				
		5 10 26	B 4.72	17
516.10				
Hard dark brown SILTY LOAM, moist				
		4 9 16	B 6.15	29
	-30			
512.10				
Hard gray SILTY LOAM, moist				
		7 14 20	B 5.54	14
	-35			
507.10				
Loose gray fine SAND, saturated				
		3 5 7		18
504.60				
Loose gray SANDY LOAM, moist	-40			
502.10				
Very loose gray fine to medium SAND, saturated				
		2 1 1		
	-45			
496.10				
Very dense brown fine to coase SAND and small GRAVEL, saturated				
		9 30 50/5"		
	-50			

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

STRUCTURE NO. 072-0231
ROUTE IL 8
SECTION (Z-2C-15D)BR
COUNTY Peoria

Boring No. B-1 W. Abutment
Station 479+85
Offset 30.00ft RT
Elevation 494.10 ft

	DEPTH	BLOWS	Qu tsf	W %
Very dense brown fine to coarse SAND and small GRAVEL, saturated				
492.10				
Medium dense gray fine to medium SAND, some clay binder, saturated		7 11 14		24
	-55			
487.10				
Hard gray SILTY LOAM, moist		15 20 20	P 4.5+	9
	-60			
483.10				
Very dense black SHALE		75 50/4"	P 4.5+	13
	-65			
478.10				
End of Boring at 66' - Auger Refusal				
	-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
Testing Service Corporation
STRUCTURE BORING LOG

Date 3/15/11

ROUTE IL 8 DESCRIPTION Bridge Over Kickapoo Creek

SECT. (Z-2C-15D)BR STRUCT. NO. 072-0231 DRILLED BY B. Williamson

COUNTY Peoria LOCATION Rosefield Township S. 7 , TWP. 9N , RNG. 6E

Boring No. B-2 Pier 1
Station 480+35
Offset 30.00ft RT
Surface Elev. 544.60 ft

Surface Water Elev. 534.5
Groundwater Elev.:
when drilling 533.6
at Completion
after Hrs.

DEPTH	BLOWS	Qu tsf	W %
	Medium stiff dark brown SILTY LOAM, moist		
	1 1 3	P 0.75	20
541.60			
	Stiff dark brown SILTY LOAM, moist		
	2 2 3	B 1.85	20
-5			
539.10			
	Medium stiff dark brown SILTY LOAM, very moist to moist		
	1 1 2	B 0.53	32
	0 1 2	P 0.49	23
-10			
534.10			
	Soft gray SILTY LOAM, moist		
	0 1 1	B 0.25	27
531.60			
	Very loose to loose gray fine to medium SAND, saturated		
	0 1 1		23
-15			
	3 4 4		
	2 3 3		
-20			
	2 2 3		
521.60			
	Hard gray SILTY LOAM, moist		
	4 5 5	P 4.5+	13
-25			

DEPTH	BLOWS	Qu tsf	W %
	Hard gray silty LOAM, moist		
	8 13 16	B 6.36	15
	5 8 10	B 4.51	21
514.60			
-30			
	Medium dense dark brown SILT, moist		
513.60			
	Medium dense gray fine to medium SAND, saturated		
510.60			
	5 10 19	B 6.85	16
	Hard gray SILTY LOAM, moist		
-35			
507.60			
	Medium dense gray SILT, moist		
	5 12 13		18
-40			
502.60			
	Medium dense gray fine SAND, saturated		
	5 9 13		19
-45			
496.60			
	Very dense brown fine to coarse SAND and small GRAVEL, saturated		
	6 50/5"		
-50			

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

Date 3/15/11

STRUCTURE NO. 072-0231
ROUTE IL 8
SECTION (Z-2C-15D)BR
COUNTY Peoria

Boring No. B-2 Pier 1
Station 480+35
Offset 30.00ft RT
Elevation 494.60 ft

DEPTH	BLOWS	Qu tsf	W %
Very dense brown fine to coarse SAND and small GRAVEL, saturated			
492.60			
Medium dense gray fine SAND, saturated			
	10 12 18		
-55			
487.60			
Very dense brown fine to coarse SAND and small GRAVEL, saturated			
	13 44 50/3"		24
485.10			
Very dense gray SHALE			
-60			
Boring continued with rock core			
	31 50/3"		13
-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

Date 3/15/11

ROUTE IL 8 DESCRIPTION Bridge Over Kickapoo Creek

SECT. (Z-2C-15D)BR STRUCT. NO. 072-0231 DRILLED BY B. Williamson

COUNTY Peoria

Boring No. B-2 Pier 1 Core Type NX
Station 480+35 Core Diameter 2 in
Offset 30.00ft RT Core Length 15 ft

Surface Elev. 544.60 ft

Top Elev. ft	Coring Notes and Rock Description	Core Run (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (Min/ft)	COMP. STRNGTH (tsf)
	Very dense gray SHALE	1	95	75		
477.60						
	Very dense black SHALE					
	Moisture Content = 6%					206.1
	-70.0					
	Moisture Content = 6%					154.8
	-75.0					
		2	100	80		
464.60	-80.0					
	End of Boring at 80.0'					
	-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

8 ft to 10 ft

10 ft to 12 ft

12 ft to 14 ft

14 ft to 15 ft

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Date 3/17/11

ROUTE IL 8 DESCRIPTION Bridge Over Kickapoo Creek

SECT. (Z-2C-15D)BR STRUCT. NO. 072-0231 DRILLED BY B. Williamson

COUNTY Peoria LOCATION Rosefield Township S. 7 , TWP. 9N , RNG. 6E

Boring No. B-3 Pier 2
Station 481+15
Offset 13.00ft LT
Surface Elev. 560.70 ft

Surface Water Elev. 534.5
Groundwater Elev.:
when drilling 539.7
at Completion 542.7
after ____ Hrs. ____

DEPTH	BLOWS	Qu tsf	W %
Pavment and aggregate base			
559.20			
Medium stiff to stiff brown SILTY CLAY LOAM, moist	1 2 3	P 1.0	22
	2 3 3	B 1.44	26
-5			
	1 2 2	B 0.57	27
	1 2 2	P 1.0	24
-10			
550.20			
Stiff brown-gray SILTY LOAM, moist	1 3 5	B 1.56	23
547.70			
Stiff gray SILTY LOAM, moist	1 2 4	B 1.48	25
-15			
545.20			
Very loose brown SANDY LOAM, moist	1 2 2		19
	1 1 2		24
-20			
	0 0 0		24
537.70			
Very loose gray-brown SANDY LOAM, moist	0 0 1		26
-25			

DEPTH	BLOWS	Qu tsf	W %
535.20			
Loose gray fine SAND, saturated	1 3 4		18
	0 3 5		
-30			
528.70			
Hard gray SILTY LOAM, moist			
	10 15 15	P 4.5+	13
-35			
	11 16 21	B 6.85	11
-40			
	6 9 18	P 4.5+	20
-45			
514.70			
Medium dense dark brown SILT, moist			
511.70			
Hard gray SILTY LOAM, moist	3 11 19	B 5.13	16
-50			

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

STRUCTURE NO. 072-0231
ROUTE IL 8
SECTION (Z-2C-15D)BR
COUNTY Peoria

Boring No. B-3 Pier 2
Station 481+15
Offset 13.00ft LT
Elevation 510.70 ft

	DEPTH	BLOWS	Qu tsf	W %
Hard gray SILTY LOAM, moist				
508.70				
Medium dense gray SANDY LOAM, moist		4 4 11		21
	-55			
		3 5 6		22
	-60			
499.70				
Medium dense gray fine SAND, saturated		3 5 7		19
	-65			
493.70				
Very dense brown fine to coarse SAND and small GRAVEL, saturated		5 16 38		
	-70			
488.70				
Very dense brown fine to medium SAND, saturated		21 44 50/4"		
	-75			

STRUCTURE NO. 072-0231
ROUTE IL 8
SECTION (Z-2C-15D)BR
COUNTY Peoria

Elevation 485.70 ft

	DEPTH	BLOWS	Qu tsf	W %
Very dense brown fine to medium SAND, saturated				
482.70				
Very dense gray SHALE		16 100/5"		13
Boring continued with rock core	-80			
	-85			
	-90			
	-95			
	-100			

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

Date 3/17/11

ROUTE IL 8 DESCRIPTION Bridge Over Kickapoo Creek

SECT. (Z-2C-15D)BR STRUCT. NO. 072-0231 DRILLED BY B. Williamson

COUNTY Peoria

Boring No. B-3 Pier 2 Core Type NX
Station 481+15 Core Diameter 2 in
Offset 13.00ft LT Core Length 15 ft

Surface Elev. 560.70 ft

Top Elev. ft	Coring Notes and Rock Description	Core Run (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (Min/ft)	COMP. STRNGTH (tsf)
	Very dense gray SHALE	1	98	88		
	-85.0					
	Moisture Content = 2%					95.2
	-90.0					
	Moisture Content = 9%					38.9
		2	100	100		
	Moisture Content = 8%					74.9
	-95.0					
	Moisture Content = 10%					40.3
464.70						
	End of Boring at 96'					
	-100.0					

Color pictures of the cores Yes

Cores will be stored for examination until _____

0 ft to 2.5 ft

2.5 ft to 4.5 ft

4.5 ft to 7.5 ft

7.5 ft to 9.5 ft

9.5 ft to 10 ft

10 ft to 12 ft

12 ft to 14 ft

14 ft to 15 ft

ILLINOIS DEPARTMENT OF TRANSPORTATION
Testing Service Corporation
STRUCTURE BORING LOG

Date 3/16/11

ROUTE IL 8 DESCRIPTION Bridge Over Kicakpoo Creek

SECT. (Z-2C-15D)BR STRUCT. NO. 072-0231 DRILLED BY B. Williamson

COUNTY Peoria LOCATION Rosefield Township S. 7 , TWP. 9N , RNG. 6E

Boring No. B-4 E. Abutment
Station 481+65
Offset 25.00ft LT
Surface Elev. 560.00 ft

Surface Water Elev. 534.5
Groundwater Elev.:
when drilling 534.0
at Completion 540.0
after ____ Hrs. ____

DEPTH	BLOWS	Qu tsf	W %
Stiff brown SILTY LOAM, moist			
	1 2 3	B 1.44	23
557.00			
Medium stiff gray-brown SILTY LOAM, moist			
	1 2 2	B 0.62	26
-5			
554.50			
Medium dense brown SAND and GRAVEL, moist			
	6 7 7		15
552.00			
Very stiff brown-dark brown SILTY LOAM, moist			
	2 2 5	B 2.67	23
-10			
	10 11 12	P 2.5	24
547.00			
Very stiff to stiff brown SILTY LOAM, very moist			
	6 6 8	P 2.0	31
-15			
	3 5 4	B 2.05	32
	2 2 4	B 1.44	32
-20			
539.50			
Soft gray SILTY LOAM, moist			
	0 2 2	B 0.45	26
537.00			
Stiff gray SILTY LOAM, moist			
	1 2 3	B 1.03	18
-25			

DEPTH	BLOWS	Qu tsf	W %
534.50			
Loose gray fine to coarse SAND and small GRAVEL, saturated			
	2 3 5		
532.00			
Dense gray fine to coarse SAND and small GRAVEL, saturated			
	14 15 16		
-30			
528.00			
Very dense gray SANDY LOAM, moist			
	15 36 40		13
-35			
523.00			
Hard gray SILTY LOAM, moist			
	8 14 8	B 6.56	13
-40			
	5 10 18	B 5.86	24
-45			
	8 12 15	B 5.13	16
-50			

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

STRUCTURE NO. 072-0231
ROUTE IL 8
SECTION (Z-2C-15D)BR
COUNTY Peoria

Boring No. B-4 E. Abutment
Station 481+65
Offset 25.00ft LT
Elevation 510.00 ft

DEPTH	BLOWS	Qu tsf	W %
Hard gray SILTY LOAM, moist			
508.00			
Medium dense gray SANDY LOAM, moist			
	5		17
	11		
-55	18		
503.00			
Medium dense gray fine to coarse SAND and small GRAVEL, saturated			
	9		
	11		
-60	15		
497.00			
Very dense to dense gray fine to coarse SAND and small GRAVEL, saturated			
	14		
	32		
-65	45		
	11		
	13		
-70	63		
	5		
	16		
-75	29		

STRUCTURE NO. 072-0231
ROUTE IL 8
SECTION (Z-2C-15D)BR
COUNTY Peoria

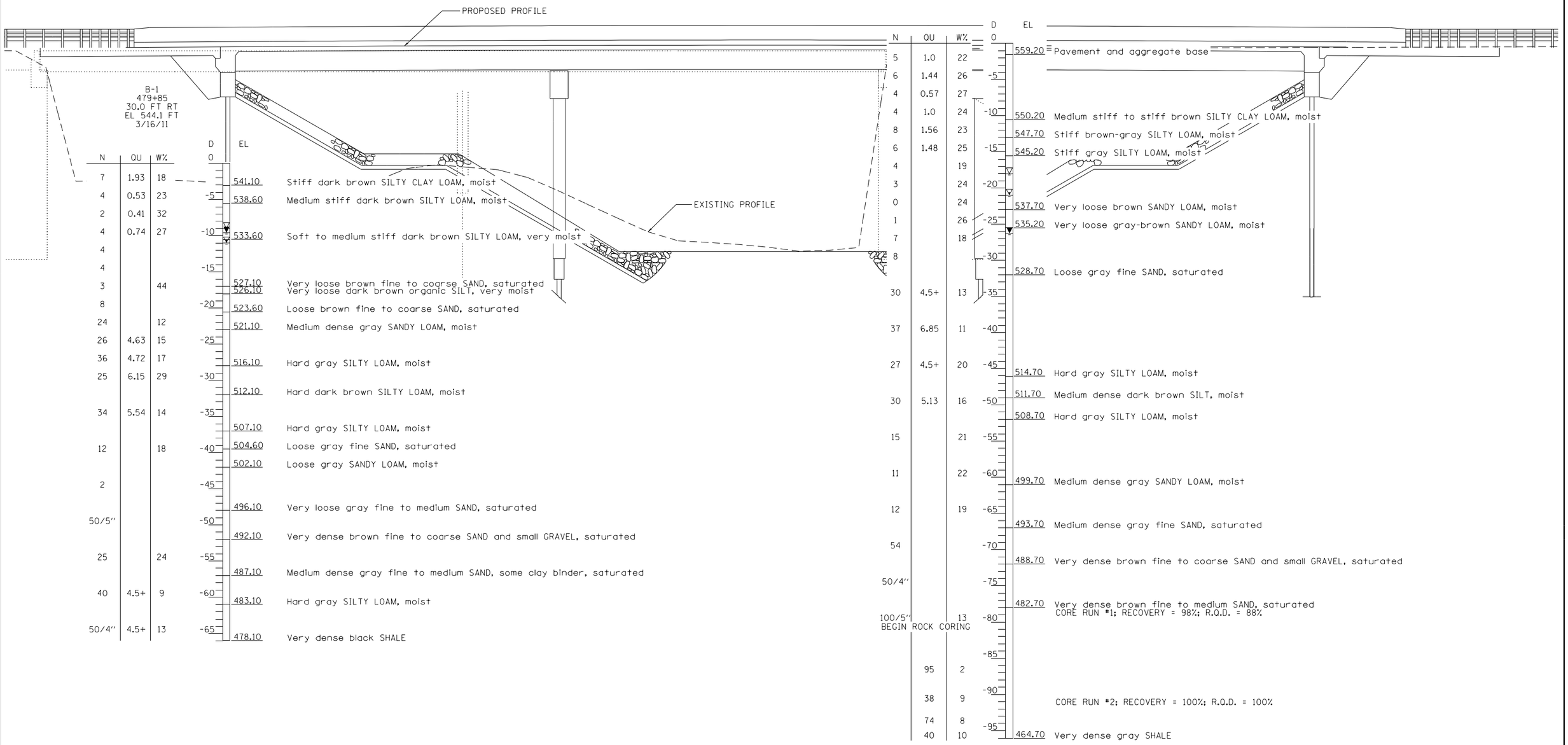
Elevation 485.00 ft

DEPTH	BLOWS	Qu tsf	W %
Dense gray fine to coarse SAND and small GRAVEL, saturated			
482.50			
Very dense gray SHALE			
	15		12
	100/6"		
-80			
479.50			
End of Boring at 80.5' - Auger Refusal			
-85			
-90			
-95			
-100			

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



B-1
479+85
30.0 FT RT
EL 544.1 FT
3/16/11

N	QU	W%	D	EL	
			0		
7	1.93	18		541.10	Stiff dark brown SILTY CLAY LOAM, moist
4	0.53	23	-5	538.60	Medium stiff dark brown SILTY LOAM, moist
2	0.41	32			
4	0.74	27	-10	533.60	Soft to medium stiff dark brown SILTY LOAM, very moist
4					
4			-15		
3		44		527.10	Very loose brown fine to coarse SAND, saturated
				526.10	Very loose dark brown organic SILT, very moist
8			-20	523.60	Loose brown fine to coarse SAND, saturated
24		12		521.10	Medium dense gray SANDY LOAM, moist
26	4.63	15	-25		
36	4.72	17		516.10	Hard gray SILTY LOAM, moist
25	6.15	29	-30		
				512.10	Hard dark brown SILTY LOAM, moist
34	5.54	14	-35		
				507.10	Hard gray SILTY LOAM, moist
12		18	-40	504.60	Loose gray fine SAND, saturated
				502.10	Loose gray SANDY LOAM, moist
2			-45		
				496.10	Very loose gray fine to medium SAND, saturated
50/5"			-50		
				492.10	Very dense brown fine to coarse SAND and small GRAVEL, saturated
25		24	-55		
				487.10	Medium dense gray fine to medium SAND, some clay binder, saturated
40	4.5+	9	-60	483.10	Hard gray SILTY LOAM, moist
50/4"	4.5+	13	-65	478.10	Very dense black SHALE

B-3
481+15
13.0 FT LT
EL 560.7 FT
3/17/11

N	QU	W%	D	EL	
			0		
5	1.0	22		559.20	Pavement and aggregate base
6	1.44	26	-5		
4	0.57	27			
4	1.0	24	-10	550.20	Medium stiff to stiff brown SILTY CLAY LOAM, moist
8	1.56	23		547.70	Stiff brown-gray SILTY LOAM, moist
6	1.48	25	-15	545.20	Stiff gray SILTY LOAM, moist
4		19			
3		24	-20		
0		24		537.70	Very loose brown SANDY LOAM, moist
1		26	-25	535.20	Very loose gray-brown SANDY LOAM, moist
7		18			
8			-30		
				528.70	Loose gray fine SAND, saturated
30	4.5+	13	-35		
37	6.85	11	-40		
27	4.5+	20	-45	514.70	Hard gray SILTY LOAM, moist
				511.70	Medium dense dark brown SILT, moist
30	5.13	16	-50	508.70	Hard gray SILTY LOAM, moist
15		21	-55		
11		22	-60	499.70	Medium dense gray SANDY LOAM, moist
12		19	-65	493.70	Medium dense gray fine SAND, saturated
54			-70	488.70	Very dense brown fine to coarse SAND and small GRAVEL, saturated
50/4"			-75		
				482.70	Very dense brown fine to medium SAND, saturated
100/5"		13	-80		CORE RUN #1; RECOVERY = 98%; R.Q.D. = 88%
BEGIN ROCK CORING					
			-85		
95	2				
			-90		
38	9				CORE RUN #2; RECOVERY = 100%; R.Q.D. = 100%
74	8				
40	10		-95	464.70	Very dense gray SHALE

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

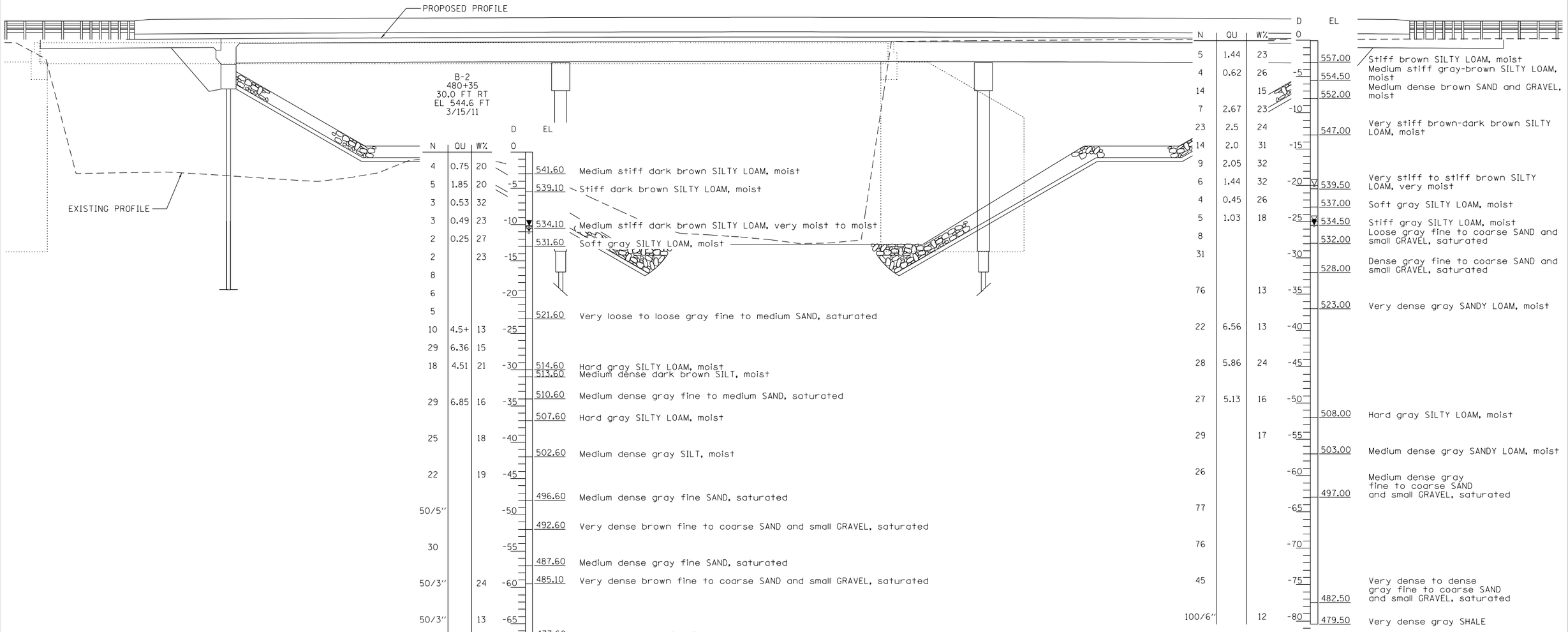
SUBSURFACE DATA PROFILE
IL 8 OVER WEST FORK OF KICKAPOO CREEK
F.A.S. 384 - SECTION (Z-2C-15D)BR
PEORIA COUNTY
STATION 480+75.24
STRUCTURE NO. 072-0231

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
2 SHEETS

F.A.S RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
384	(Z-2C-15D)BR	PEORIA		
	BORINGS 1 AND 3	CONTRACT NO.		
FED. ROAD DIST. NO.	ILLINOIS	FED. AID PROJECT		

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION



B-2
480+35
30.0 FT RT
EL 544.6 FT
3/15/11

N	QU	W%	D	EL	
			0		
4	0.75	20		541.60	Medium stiff dark brown SILTY LOAM, moist
5	1.85	20	-5	539.10	Stiff dark brown SILTY LOAM, moist
3	0.53	32			
3	0.49	23	-10	534.10	Medium stiff dark brown SILTY LOAM, very moist to moist
2	0.25	27		531.60	Soft gray SILTY LOAM, moist
2		23	-15		
8					
6			-20		
5				521.60	Very loose to loose gray fine to medium SAND, saturated
10	4.5+	13	-25		
29	6.36	15			
18	4.51	21	-30	514.60	Hard gray SILTY LOAM, moist
				513.60	Medium dense dark brown SILT, moist
29	6.85	16	-35	510.60	Medium dense gray fine to medium SAND, saturated
				507.60	Hard gray SILTY LOAM, moist
25		18	-40		
				502.60	Medium dense gray SILT, moist
22		19	-45		
				496.60	Medium dense gray fine SAND, saturated
50/5"			-50		
				492.60	Very dense brown fine to coarse SAND and small GRAVEL, saturated
30			-55		
				487.60	Medium dense gray fine SAND, saturated
50/3"		24	-60	485.10	Very dense brown fine to coarse SAND and small GRAVEL, saturated
50/3"		13	-65		
				477.60	Very dense gray SHALE
BEGIN ROCK CORING					CORE RUN #1; RECOVERY = 95%; R.Q.D. = 75%
	206	6	-70		
	154	6			
			-75		CORE RUN #2; RECOVERY = 100%; R.Q.D. = 80%
			-80	464.60	Very dense black SHALE

B-4
481+65
25.0 FT LT
EL 560.0 FT
3/16/11

N	QU	W%	D	EL	
			0		
5	1.44	23		557.00	Stiff brown SILTY LOAM, moist
4	0.62	26	-5	554.50	Medium stiff gray-brown SILTY LOAM, moist
14		15		552.00	Medium dense brown SAND and GRAVEL, moist
7	2.67	23	-10		
23	2.5	24		547.00	Very stiff brown-dark brown SILTY LOAM, moist
14	2.0	31	-15		
9	2.05	32			
6	1.44	32	-20	539.50	Very stiff to stiff brown SILTY LOAM, very moist
4	0.45	26		537.00	Soft gray SILTY LOAM, moist
5	1.03	18	-25	534.50	Stiff gray SILTY LOAM, moist
8				532.00	Loose gray fine to coarse SAND and small GRAVEL, saturated
31			-30		
				528.00	Dense gray fine to coarse SAND and small GRAVEL, saturated
76		13	-35		
				523.00	Very dense gray SANDY LOAM, moist
22	6.56	13	-40		
28	5.86	24	-45		
27	5.13	16	-50		
				508.00	Hard gray SILTY LOAM, moist
29		17	-55		
				503.00	Medium dense gray SANDY LOAM, moist
26			-60		
				497.00	Medium dense gray fine to coarse SAND and small GRAVEL, saturated
77			-65		
76			-70		
45			-75		Very dense to dense gray fine to coarse SAND and small GRAVEL, saturated
				482.50	
100/6"		12	-80	479.50	Very dense gray SHALE

DESIGNED -	
CHECKED -	
DRAWN -	
CHECKED -	

\- 200

EXAMINED

ENGINEER OF BRIDGE DESIGN

PASSED

ENGINEER OF BRIDGES AND STRUCTURES

SUBSURFACE DATA PROFILE
IL 8 OVER WEST FORK OF KICKAPOO CREEK
F.A.S. 384 - SECTION (Z-2C-15D)BR
PEORIA COUNTY
STATION 480+75.24
STRUCTURE NO. 072-0231

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

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

SHEET NO. 2
2 SHEETS

F.A.S RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
384	(Z-2C-15D)BR	PEORIA		
	BORINGS 2 AND 4	CONTRACT NO.		
FED. ROAD DIST. NO.	ILLINOIS	FED. AID PROJECT		

Appendix E

Slide Analysis Information

Document Name

File Name: WF Kickapoo_West Abutment_Seismic.sli

Project Settings

Project Title: WF Kickapoo_West Abutment_Seismic
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
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): 0.03911

Material Properties

Material: 1- Embankment
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 2- Silty Clay Loam
Strength Type: Mohr-Coulomb
Unit Weight: 119.18 lb/ft3
Cohesion: 1940 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 3- Silty Loam
Strength Type: Mohr-Coulomb
Unit Weight: 118.08 lb/ft3
Cohesion: 540 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 4- Silty Loam
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 118.08 lb/ft3
Saturated Unit Weight: 124.32 lb/ft3
Cohesion: 580 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 5- Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 110.21 lb/ft3
Saturated Unit Weight: 120.51 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 6- Silt
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 109.48 lb/ft3
Saturated Unit Weight: 132.48 lb/ft3
Cohesion: 0 psf
Friction Angle: 27 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 7- Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 110.21 lb/ft3
Saturated Unit Weight: 120.51 lb/ft3
Cohesion: 0 psf
Friction Angle: 32 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 8- Sandy Loam
Strength Type: Mohr-Coulomb
Unit Weight: 134.4 lb/ft3
Cohesion: 0 psf

Friction Angle: 37 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 9- Silty Loam
Strength Type: Mohr-Coulomb
Unit Weight: 114.88 lb/ft3
Cohesion: 5480 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 10- Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 110.21 lb/ft3
Saturated Unit Weight: 121.03 lb/ft3
Cohesion: 0 psf
Friction Angle: 29.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 11- Sand and Gravel
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 113.42 lb/ft3
Saturated Unit Weight: 124.02 lb/ft3
Cohesion: 0 psf
Friction Angle: 50 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 12- Sand
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 110.21 lb/ft3
Saturated Unit Weight: 127.72 lb/ft3
Cohesion: 0 psf
Friction Angle: 38 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 13- Silty Loam
Strength Type: Mohr-Coulomb
Unit Weight: 104.64 lb/ft3
Cohesion: 5000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 14- Shale
Strength Type: Mohr-Coulomb
Unit Weight: 149 lb/ft3
Cohesion: 5000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

List of All Coordinates

Material Boundary
0.000 544.100
133.660 544.100

Material Boundary
0.000 541.100
139.460 541.100

Material Boundary
0.000 533.600
154.460 533.600

Material Boundary
0.000 527.100
257.660 527.100

Material Boundary
0.000 526.100
257.660 526.100

Material Boundary
0.000 523.600
257.660 523.600

Material Boundary
0.000 521.100
257.660 521.100

Material Boundary
0.000 507.100
257.660 507.100

Material Boundary
0.000 496.100
257.660 496.100

Material Boundary
0.000 492.100
257.660 492.100

Material Boundary
0.000 487.100
257.660 487.100

Material Boundary
0.000 483.100
257.660 483.100

Material Boundary
0.000 538.900
143.860 538.900

External Boundary

0.000	544.100
0.000	541.100
0.000	538.900
0.000	533.600
0.000	527.100
0.000	526.100
0.000	523.600
0.000	521.100
0.000	507.100
0.000	496.100
0.000	492.100
0.000	487.100
0.000	483.100
0.000	450.000
257.660	450.000
257.660	483.100
257.660	487.100
257.660	492.100
257.660	496.100
257.660	507.100
257.660	521.100
257.660	523.600
257.660	526.100
257.660	527.100
257.660	532.000
157.660	532.000
154.460	533.600
143.860	538.900
139.460	541.100
133.660	544.100
100.000	560.830
0.000	560.830

Water Table

0.000	538.900
143.860	538.900

Search Grid

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266.019	609.479
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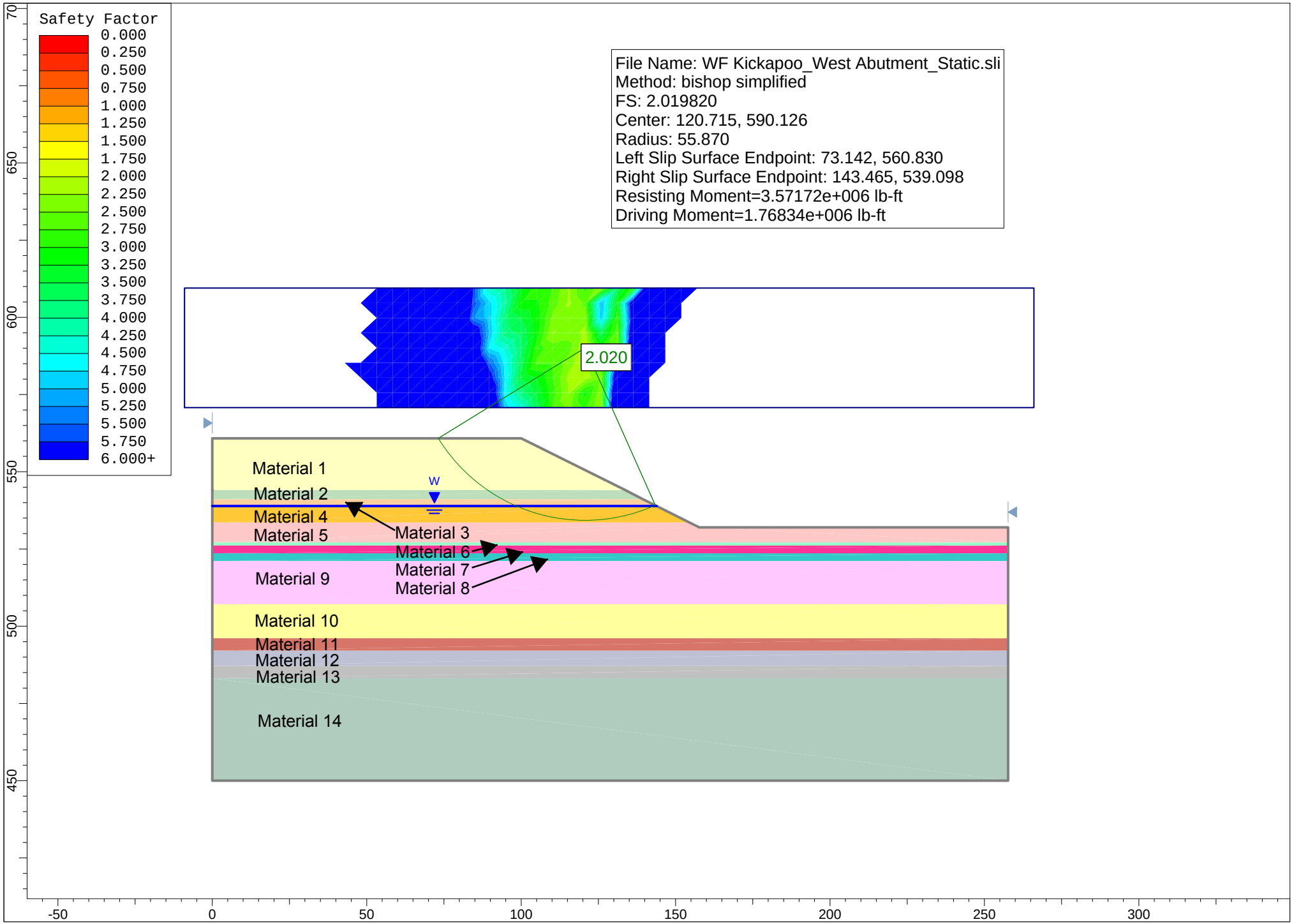
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4.000
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4.500
4.750
5.000
5.250
5.500
5.750
6.000+
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Method: bishop simplified
FS: 2.019820
Center: 120.715, 590.126
Radius: 55.870
Left Slip Surface Endpoint: 73.142, 560.830
Right Slip Surface Endpoint: 143.465, 539.098
Resisting Moment=3.57172e+006 lb-ft
Driving Moment=1.76834e+006 lb-ft
2.020
w
Material 1
Material 2
Material 4
Material 5
Material 3
Material 6
Material 7
Material 8
Material 9
Material 10
Material 11
Material 12
Material 13
Material 14
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600
550
500
450
-50
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50
100
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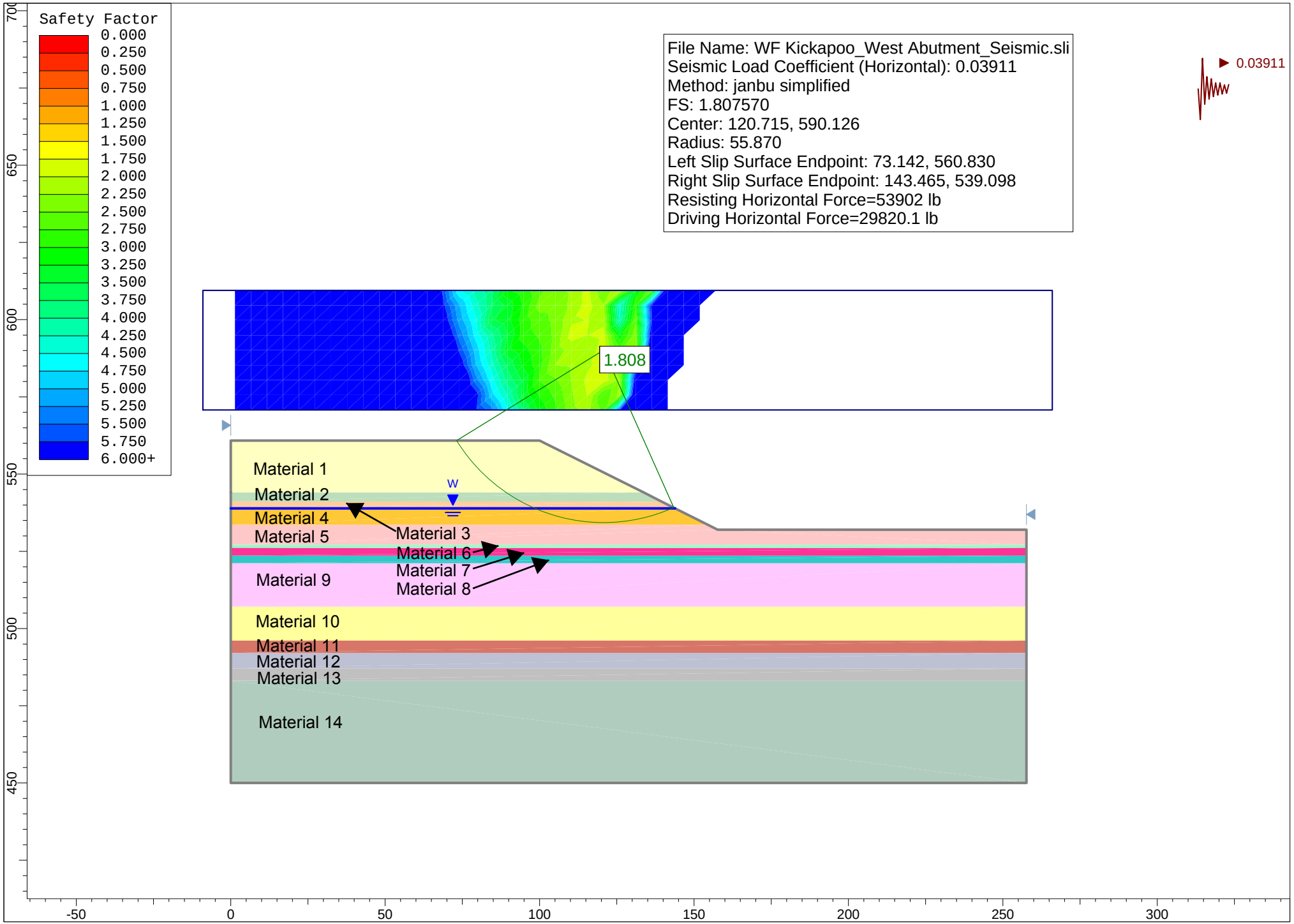
200
250
300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4.750
5.000
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5.500
5.750
6.000+
File Name: WF Kickapoo_West Abutment_Seismic.sli
Seismic Load Coefficient (Horizontal): 0.03911
Method: janbu simplified
FS: 1.807570
Center: 120.715, 590.126
Radius: 55.870
Left Slip Surface Endpoint: 73.142, 560.830
Right Slip Surface Endpoint: 143.465, 539.098
Resisting Horizontal Force=53902 lb
Driving Horizontal Force=29820.1 lb
0.03911
1.808
W
Material 1
Material 2
Material 4
Material 5
Material 3
Material 6
Material 7
Material 8
Material 9
Material 10
Material 11
Material 12
Material 13
Material 14
700
650
600
550
500
450
-50
0
50
100
150
200
250
300

Slide Analysis Information

Document Name

File Name: WF Kickapoo_East Abut_Seismic.sli

Project Settings

Project Title: WF Kickapoo_East Abutment_Static
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
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): 0.03911

Material Properties

Material: 1- Silty Loam
Strength Type: Mohr-Coulomb
Unit Weight: 118.08 lb/ft3
Cohesion: 1440 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 2- Sand and Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 121.9 lb/ft3
Cohesion: 0 psf
Friction Angle: 32 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 3- Silty Loam
Strength Type: Mohr-Coulomb
Unit Weight: 122.48 lb/ft3
Cohesion: 2210 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 4- Silty Loam
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 114.24 lb/ft3
Saturated Unit Weight: 120.96 lb/ft3
Cohesion: 450 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 5- Silty Loam
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 109.44 lb/ft3
Saturated Unit Weight: 113.28 lb/ft3
Cohesion: 1040 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 6- Sand and Gravel
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 118.72 lb/ft3
Saturated Unit Weight: 124.02 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 7- Sand and Gravel
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 118.72 lb/ft3
Saturated Unit Weight: 124.02 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 8- Sandy Loam
Strength Type: Mohr-Coulomb
Unit Weight: 135.6 lb/ft3
Cohesion: 0 psf

Friction Angle: 50 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 9- Silty Loam
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 112.96 lb/ft3
Saturated Unit Weight: 124.02 lb/ft3
Cohesion: 5850 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 10- Sandy Loam
Strength Type: Mohr-Coulomb
Unit Weight: 140.4 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 11- Sand and Gravel
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 113.42 lb/ft3
Saturated Unit Weight: 124.02 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: 12- Shale
Strength Type: Mohr-Coulomb
Unit Weight: 149 lb/ft3
Cohesion: 5000 psf
Friction Angle: 0 degrees
Water Surface: Water Table
Custom Hu value: 1

List of All Coordinates

Material Boundary

0.000	554.500
112.660	554.500

Material Boundary

0.000	552.000
117.660	552.000

Material Boundary

0.000	534.500
152.660	534.500

Material Boundary

0.000	528.000
257.660	528.000

Material Boundary
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257.660 523.000

Material Boundary
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257.660 508.000

Material Boundary
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257.660 503.000

Material Boundary
0.000 482.500
257.660 482.500

Material Boundary
0.000 538.900
143.860 538.900

Material Boundary
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147.660 537.000

Material Boundary
0.000 532.000
157.660 532.000

External Boundary
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0.000 552.000
0.000 538.900
0.000 537.000
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257.660 532.000
157.660 532.000
152.660 534.500
147.660 537.000
143.860 538.900
117.660 552.000
112.660 554.500

100.000	560.830
0.000	560.830

Water Table

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Search Grid

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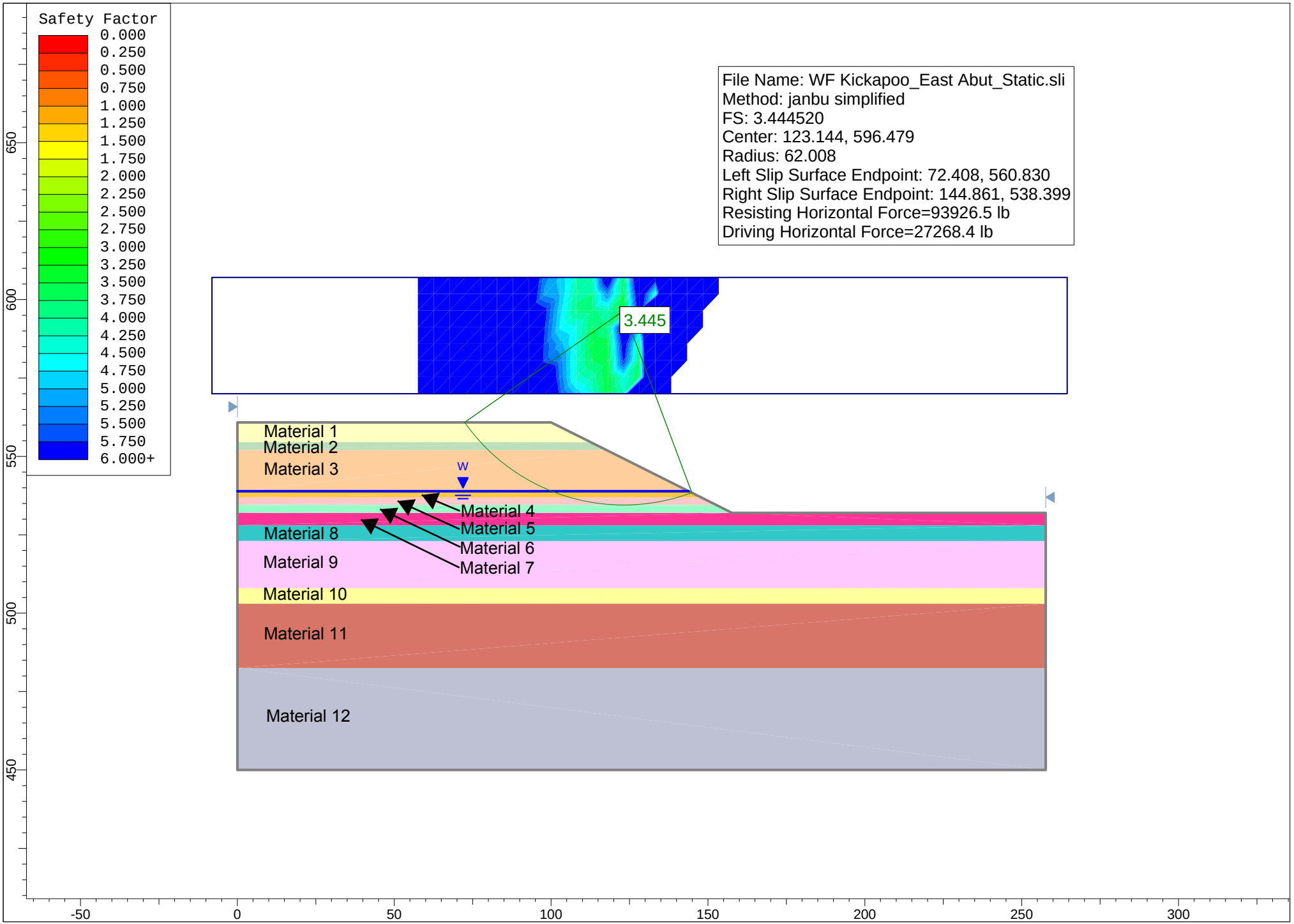
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5.750
6.000+
File Name: WF Kickapoo_East Abut_Static.sli
Method: janbu simplified
FS: 3.444520
Center: 123.144, 596.479
Radius: 62.008
Left Slip Surface Endpoint: 72.408, 560.830
Right Slip Surface Endpoint: 144.861, 538.399
Resisting Horizontal Force=93926.5 lb
Driving Horizontal Force=27268.4 lb
3.445
Material 1
Material 2
Material 3
W
Material 4
Material 5
Material 6
Material 7
Material 8
Material 9
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Material 11
Material 12
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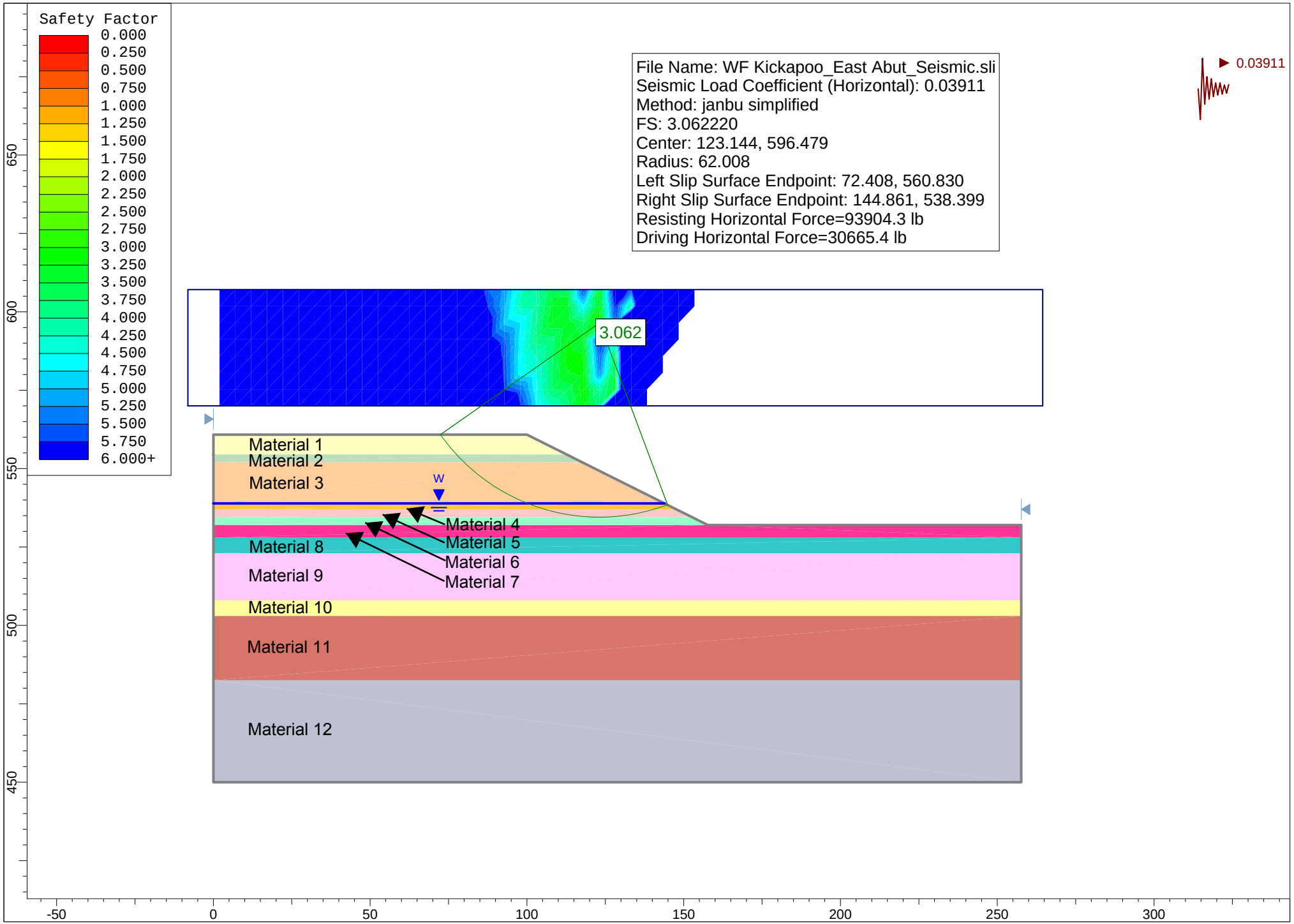
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4.500
4.750
5.000
5.250
5.500
5.750
6.000+
File Name: WF Kickapoo_East Abut_Seismic.sli
Seismic Load Coefficient (Horizontal): 0.03911
Method: janbu simplified
FS: 3.062220
Center: 123.144, 596.479
Radius: 62.008
Left Slip Surface Endpoint: 72.408, 560.830
Right Slip Surface Endpoint: 144.861, 538.399
Resisting Horizontal Force=93904.3 lb
Driving Horizontal Force=30665.4 lb
0.03911
3.062
Material 1
Material 2
Material 3
w
Material 4
Material 5
Material 6
Material 7
Material 8
Material 9
Material 10
Material 11
Material 12
650
600
550
500
450
-50
0
50
100
150
200
250
300

Appendix F

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====IL 8 over West Fork of Kickapoo Creek

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	553.32	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1	
Top of Boring Elev.	553.32	ft.
Approximate Fixity Elev.	547.32	ft.

Individual Site Class Definition:

N (bar): 15 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 53 (Blows/ft.) Soil Site Class C <----Controls
s_u (bar): 2.7 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
3.2	544.1	9.22	5	1.00	
4.7	542.6	1.50	7	1.93	
7.2	540.1	2.50	4	0.53	
9.7	537.6	2.50	2	0.41	
12.2	535.1	2.50	4	0.74	
14.7	532.6	2.50	4		
17.2	530.1	2.50	4		
19.7	527.6	2.50	3		B
22.2	525.1	2.50	8		
24.7	522.6	2.50	24		
27.2	520.1	2.50	26	4.63	
29.7	517.6	2.50	36	4.72	
32.2	515.1	2.50	25	6.15	
37.2	510.1	5.00	34	5.54	
42.2	505.1	5.00	12		B
47.2	500.1	5.00	2		
52.2	495.1	5.00	100		
57.2	490.1	5.00	25		
62.2	485.1	5.00	40	5.00	
103.2	444.1	41.00	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	536.4	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2	
Top of Boring Elev.	544.6	ft.
Approximate Fixity Elev.	530.4	ft.

Individual Site Class Definition:

N (bar): 39 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 76 (Blows/ft.) Soil Site Class C <----Controls
s_u (bar): 4.96 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	543.1	1.50	4	0.75	
	540.6	2.50	5	1.85	
	538.1	2.50	3	0.53	
	535.6	2.50	3	0.49	
	533.1	2.50	2	0.25	
	530.6	2.50	2		
2.3	528.1	2.50	8		
4.8	525.6	2.50	6		
7.3	523.1	2.50	5		
9.8	520.6	2.50	10	5.00	
12.3	518.1	2.50	29	6.36	
14.8	515.6	2.50	18	4.51	B
19.8	510.6	5.00	29	6.85	B
24.8	505.6	5.00	25		
29.8	500.6	5.00	22		
34.8	495.6	5.00	100		
39.8	490.6	5.00	30		
44.8	485.6	5.00	100		B
85.8	444.6	41.00	100	5.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)	536.4	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-3	
Top of Boring Elev.	560.7	ft.
Approximate Fixity Elev.	530.4	ft.

Individual Site Class Definition:

N (bar): 42 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 43 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 5 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	559.2	1.50	5	1.00	B
	556.7	2.50	6	1.44	
	554.2	2.50	4	0.57	
	551.7	2.50	4	1.00	
	549.2	2.50	8	1.56	
	546.7	2.50	6	1.48	
	544.2	2.50	4		
	541.7	2.50	3		
	539.2	2.50	0		
	536.7	2.50	1		
	534.2	2.50	7		
	531.7	2.50	8		
3.7	526.7	5.00	30	5.00	B
8.7	521.7	5.00	37	6.85	
13.7	516.7	5.00	27	5.00	
18.7	511.7	5.00	30	5.13	
23.7	506.7	5.00	15		
28.7	501.7	5.00	11		
33.7	496.7	5.00	12		
38.7	491.7	5.00	54		
43.7	486.7	5.00	100		
69.7	460.7	26.00	100	5.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)	553.32	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-4	
Top of Boring Elev.	560	ft.
Approximate Fixity Elev.	547.32	ft.

Individual Site Class Definition:

N (bar): 34 (Blows/ft.) Soil Site Class D <----Controls
N_{ch} (bar): 34 (Blows/ft.) Soil Site Class D
s_u (bar): 1.93 (ksf) Soil Site Class D

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	558.5	1.50	5	1.44	
	556.0	2.50	4	0.62	
	553.5	2.50	14		
	551.0	2.50	7	2.67	
	548.5	2.50	23	2.50	
1.3	546.0	2.50	14	2.00	
3.8	543.5	2.50	9	2.05	
6.3	541.0	2.50	6	1.44	
8.8	538.5	2.50	4	0.45	
11.3	536.0	2.50	5	1.03	
13.8	533.5	2.50	8		
16.3	531.0	2.50	31		
21.3	526.0	5.00	76		
26.3	521.0	5.00	22	6.56	
31.3	516.0	5.00	28	5.86	
36.3	511.0	5.00	27	5.13	
41.3	506.0	5.00	29		
46.3	501.0	5.00	26		
51.3	496.0	5.00	77		
56.3	491.0	5.00	76		
61.3	486.0	5.00	45		
87.3	460.0	26.00	100	5.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar): 33 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 50 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 3.42 (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========== West Abut w/ Embank. Materia
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 KIPS

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

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
413 KIPS	**257** KIPS	**141** KIPS	**54** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				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.)
544.10	8.92	1.00	6		36.4		48.1				48	0	0	26	11
542.60	1.50	1.00	7		6.1	11.7	54.2				54	0	0	30	12
540.10	2.50	1.00	4		10.2	11.7	64.4				64	0	0	35	15
537.60	2.50	1.00	2		10.2	11.7	74.6				75	0	0	41	17
535.10	2.50	1.00	4		10.2	11.7	100.0				100	0	0	55	20
532.60	2.50		4	Medium Sand	3.4	26.9	103.3				103	0	0	57	22
530.10	2.50		4	Medium Sand	3.4	26.9	94.9				95	0	0	52	25
527.60	2.50		3	Very Fine Silty Sand	2.2	15.1	135.8				136	0	0	75	27
525.10	2.50		8	Medium Sand	6.7	53.8	250.2				250	0	0	138	30
522.60	2.50		24	Medium Sand	20.2	161.5	163.2				163	0	0	90	32
520.10	2.50	4.63	26		29.8	54.3	320.5				320	0	0	176	35
517.60	2.50		36	Hard Till	18.6	181.7	229.4				229	0	0	126	37
515.10	2.50	6.15	25		29.8	72.1	358.7				359	0	0	197	40
510.10	5.00		34	Hard Till	34.6	171.6	302.5				303	0	0	166	45
507.60	2.50		12	Fine Sand	9.5	80.8	312.0				312	0	0	172	47
505.10	2.50		12	Fine Sand	9.5	80.8	254.2				254	0	0	140	50
504.10	1.00		2	Medium Sand	0.7	13.5	254.9				255	0	0	140	51
503.10	1.00		2	Medium Sand	0.7	13.5	255.6				256	0	0	141	52
502.10	1.00		2	Medium Sand	0.7	13.5	256.3				256	0	0	141	53
501.10	1.00		2	Medium Sand	0.7	13.5	256.9				257	0	0	141	54
500.10	1.00		2	Medium Sand	0.7	13.5	917.1				~~917~~	~~0~~	~~0~~	~~504~~	~~55~~
499.10	1.00		100	Sandy Gravel	129.8	672.9	1046.9				~~1047~~	~~0~~	~~0~~	~~576~~	~~56~~
498.10	1.00		100	Sandy Gravel	129.8	672.9	1176.7				~~1177~~	~~0~~	~~0~~	~~647~~	~~57~~
497.10	1.00		100	Sandy Gravel	129.8	672.9	1306.4				~~1306~~	~~0~~	~~0~~	~~719~~	~~58~~
496.10	1.00		100	Sandy Gravel	129.8	672.9	1436.2				~~1436~~	~~0~~	~~0~~	~~790~~	~~59~~
495.10	1.00		100	Sandy Gravel	129.8	672.9	1061.3				~~1061~~	~~0~~	~~0~~	~~584~~	~~60~~
490.10	5.00		25	Medium Sand	42.2	168.2	1137.1				~~1137~~	~~0~~	~~0~~	~~625~~	~~65~~
489.10	1.00		40	Hard Till	8.5	201.9	1145.6				~~1146~~	~~0~~	~~0~~	~~630~~	~~66~~
488.10	1.00		40	Hard Till	8.5	201.9	1154.2				~~1154~~	~~0~~	~~0~~	~~635~~	~~67~~
487.10	1.00		40	Hard Till	8.5	201.9	1162.7				~~1163~~	~~0~~	~~0~~	~~639~~	~~68~~
486.10	1.00		40	Hard Till	8.5	201.9	1171.2				~~1171~~	~~0~~	~~0~~	~~644~~	~~69~~
485.10	1.00		40	Hard Till	8.5	201.9	1482.5				~~1483~~	~~0~~	~~0~~	~~815~~	~~70~~
484.10	1.00		100	Hard Till		504.7									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Abut w/ Embank. Materia
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 KIPS

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

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
513 KIPS	**257** KIPS	**141** KIPS	**54** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				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.)
544.10	8.92	1.00	6		36.4		48.1				48	0	0	26	11
542.60	1.50	1.00	7		6.1	11.7	54.2				54	0	0	30	12
540.10	2.50	1.00	4		10.2	11.7	64.4				64	0	0	35	15
537.60	2.50	1.00	2		10.2	11.7	74.6				75	0	0	41	17
535.10	2.50	1.00	4		10.2	11.7	100.0				100	0	0	55	20
532.60	2.50		4	Medium Sand	3.4	26.9	103.3				103	0	0	57	22
530.10	2.50		4	Medium Sand	3.4	26.9	94.9				95	0	0	52	25
527.60	2.50		3	Very Fine Silty Sand	2.2	15.1	135.8				136	0	0	75	27
525.10	2.50		8	Medium Sand	6.7	53.8	250.2				250	0	0	138	30
522.60	2.50		24	Medium Sand	20.2	161.5	163.2				163	0	0	90	32
520.10	2.50	4.63	26		29.8	54.3	320.5				320	0	0	176	35
517.60	2.50		36	Hard Till	18.6	181.7	229.4				229	0	0	126	37
515.10	2.50	6.15	25		29.8	72.1	358.7				359	0	0	197	40
510.10	5.00		34	Hard Till	34.6	171.6	302.5				303	0	0	166	45
507.60	2.50		12	Fine Sand	9.5	80.8	312.0				312	0	0	172	47
505.10	2.50		12	Fine Sand	9.5	80.8	254.2				254	0	0	140	50
504.10	1.00		2	Medium Sand	0.7	13.5	254.9				255	0	0	140	51
503.10	1.00		2	Medium Sand	0.7	13.5	255.6				256	0	0	141	52
502.10	1.00		2	Medium Sand	0.7	13.5	256.3				256	0	0	141	53
501.10	1.00		2	Medium Sand	0.7	13.5	256.9				257	0	0	141	54
500.10	1.00		2	Medium Sand	0.7	13.5	917.1				~~917~~	~~0~~	~~0~~	~~504~~	~~55~~
499.10	1.00		100	Sandy Gravel	129.8	672.9	1046.9				~~1047~~	~~0~~	~~0~~	~~576~~	~~56~~
498.10	1.00		100	Sandy Gravel	129.8	672.9	1176.7				~~1177~~	~~0~~	~~0~~	~~647~~	~~57~~
497.10	1.00		100	Sandy Gravel	129.8	672.9	1306.4				~~1306~~	~~0~~	~~0~~	~~719~~	~~58~~
496.10	1.00		100	Sandy Gravel	129.8	672.9	1436.2				~~1436~~	~~0~~	~~0~~	~~790~~	~~59~~
495.10	1.00		100	Sandy Gravel	129.8	672.9	1061.3				~~1061~~	~~0~~	~~0~~	~~584~~	~~60~~
490.10	5.00		25	Medium Sand	42.2	168.2	1137.1				~~1137~~	~~0~~	~~0~~	~~625~~	~~65~~
489.10	1.00		40	Hard Till	8.5	201.9	1145.6				~~1146~~	~~0~~	~~0~~	~~630~~	~~66~~
488.10	1.00		40	Hard Till	8.5	201.9	1154.2				~~1154~~	~~0~~	~~0~~	~~635~~	~~67~~
487.10	1.00		40	Hard Till	8.5	201.9	1162.7				~~1163~~	~~0~~	~~0~~	~~639~~	~~68~~
486.10	1.00		40	Hard Till	8.5	201.9	1171.2				~~1171~~	~~0~~	~~0~~	~~644~~	~~69~~
485.10	1.00		40	Hard Till	8.5	201.9	1482.5				~~1483~~	~~0~~	~~0~~	~~815~~	~~70~~
484.10	1.00		100	Hard Till		504.7									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Abut w/ Embank. Materia
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
335 KIPS	**276** KIPS	**152** KIPS	**69** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
544.10	8.92	1.00	6		20.9		***30.4***	30.8		32.0	30	0	0	17	11
542.60	1.50	1.00	7		3.5	9.5	***34.0***	5.2	1.2	37.2	34	0	0	19	12
540.10	2.50	1.00	4		5.9	9.5	***39.8***	8.6	1.2	45.8	40	0	0	22	15
537.60	2.50	1.00	2		5.9	9.5	***45.7***	8.6	1.2	54.4	46	0	0	25	17
535.10	2.50	1.00	4		5.9	9.5	***48.8***	8.6	1.2	62.7	49	0	0	27	20
532.60	2.50		4	Medium Sand	0.6	6.8	***49.4***	0.9	0.9	63.6	49	0	0	27	22
530.10	2.50		4	Medium Sand	0.6	6.8	***47.0***	0.9	0.9	64.1	47	0	0	26	25
527.60	2.50		3	Very Fine Silty Sand	0.4	3.8	***57.2***	0.6	0.5	65.9	57	0	0	31	27
525.10	2.50		8	Medium Sand	1.2	13.6	85.5	1.8	1.7	***71.1***	71	0	0	39	30
522.60	2.50		24	Medium Sand	3.6	40.7	92.6	5.3	5.1	***76.9***	77	0	0	42	32
520.10	2.50	4.63	26		17.1	44.1	111.3	25.2	5.6	***102.3***	102	0	0	56	35
517.60	2.50		36	Hard Till	3.3	45.8	127.5	4.9	5.8	***108.8***	109	0	0	60	37
515.10	2.50	6.15	25		17.1	58.6	***129.2***	25.2	7.4	132.1	129	0	0	71	40
510.10	5.00		34	Hard Till	6.2	43.2	***112.5***	9.1	5.5	138.3	113	0	0	62	45
507.60	2.50		12	Fine Sand	1.7	20.3	***114.2***	2.5	2.6	140.8	114	0	0	63	47
505.10	2.50		12	Fine Sand	1.7	20.3	***99.0***	2.5	2.6	141.1	99	0	0	54	50
504.10	1.00		2	Medium Sand	0.1	3.4	***99.1***	0.2	0.4	141.3	99	0	0	54	51
503.10	1.00		2	Medium Sand	0.1	3.4	***99.2***	0.2	0.4	141.5	99	0	0	55	52
502.10	1.00		2	Medium Sand	0.1	3.4	***99.3***	0.2	0.4	141.7	99	0	0	55	53
501.10	1.00		2	Medium Sand	0.1	3.4	***99.4***	0.2	0.4	141.9	99	0	0	55	54
500.10	1.00		2	Medium Sand	0.1	3.4	265.7	0.2	0.4	***163.0***	163	0	0	90	55
499.10	1.00		100	Sandy Gravel	23.1	169.5	288.8	34.0	21.5	***197.1***	197	0	0	108	56
498.10	1.00		100	Sandy Gravel	23.1	169.5	311.9	34.0	21.5	***231.1***	231	0	0	127	57
497.10	1.00		100	Sandy Gravel	23.1	169.5	335.1	34.0	21.5	***265.2***	265	0	0	146	58
496.10	1.00		100	Sandy Gravel	23.1	169.5	358.2	34.0	21.5	***299.2***	299	0	0	165	59
495.10	1.00		100	Sandy Gravel	23.1	169.5	***254.2***	34.0	21.5	317.2	254	0	0	140	60
490.10	5.00		25	Medium Sand	7.5	42.4	***270.2***	11.1	5.4	329.3	270	0	0	149	65
489.10	1.00		40	Hard Till	1.5	50.9	***271.7***	2.2	6.4	331.5	272	0	0	149	66
488.10	1.00		40	Hard Till	1.5	50.9	***273.2***	2.2	6.4	333.8	273	0	0	150	67
487.10	1.00		40	Hard Till	1.5	50.9	***274.7***	2.2	6.4	336.0	275	0	0	151	68
486.10	1.00		40	Hard Till	1.5	50.9	***276.2***	2.2	6.4	338.2	276	0	0	152	69
485.10	1.00		40	Hard Till	1.5	50.9	354.0	2.2	6.4	***350.1***	~~350~~	~~0~~	~~0~~	~~193~~	~~70~~
484.10	1.00		100	Hard Till		127.1			16.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Abut w/ Embank. Materia
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
418 KIPS	**344** KIPS	**189** KIPS	**69** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
544.10	8.92	1.00	6		25.1		38.9	36.8		***38.3***	38	0	0	21	11
542.60	1.50	1.00	7		4.2	13.8	***43.1***	6.2	1.5	44.4	43	0	0	24	12
540.10	2.50	1.00	4		7.0	13.8	***50.2***	10.3	1.5	54.8	50	0	0	28	15
537.60	2.50	1.00	2		7.0	13.8	***57.2***	10.3	1.5	65.1	57	0	0	31	17
535.10	2.50	1.00	4		7.0	13.8	***60.3***	10.3	1.5	74.9	60	0	0	33	20
532.60	2.50		4	Medium Sand	0.7	9.8	***61.0***	1.1	1.1	76.0	61	0	0	34	22
530.10	2.50		4	Medium Sand	0.7	9.8	***57.5***	1.1	1.1	76.6	57	0	0	32	25
527.60	2.50		3	Very Fine Silty Sand	0.5	5.5	***72.0***	0.7	0.6	78.8	72	0	0	40	27
525.10	2.50		8	Medium Sand	1.4	19.6	112.7	2.1	2.1	***85.2***	85	0	0	47	30
522.60	2.50		24	Medium Sand	4.3	58.8	122.0	6.3	6.4	***92.1***	92	0	0	51	32
520.10	2.50	4.63	26		20.6	63.8	145.0	30.1	7.0	***122.5***	122	0	0	67	35
517.60	2.50		36	Hard Till	4.0	66.1	167.5	5.8	7.2	***130.3***	130	0	0	72	37
515.10	2.50	6.15	25		20.6	84.8	165.9	30.1	9.3	***158.0***	158	0	0	87	40
510.10	5.00		34	Hard Till	7.4	62.5	***140.2***	10.8	6.8	165.2	140	0	0	77	45
507.60	2.50		12	Fine Sand	2.0	29.4	***142.2***	3.0	3.2	168.2	142	0	0	78	47
505.10	2.50		12	Fine Sand	2.0	29.4	***119.8***	3.0	3.2	168.5	120	0	0	66	50
504.10	1.00		2	Medium Sand	0.1	4.9	***119.9***	0.2	0.5	168.7	120	0	0	66	51
503.10	1.00		2	Medium Sand	0.1	4.9	***120.1***	0.2	0.5	168.9	120	0	0	66	52
502.10	1.00		2	Medium Sand	0.1	4.9	***120.2***	0.2	0.5	169.2	120	0	0	66	53
501.10	1.00		2	Medium Sand	0.1	4.9	***120.4***	0.2	0.5	169.4	120	0	0	66	54
500.10	1.00		2	Medium Sand	0.1	4.9	360.6	0.2	0.5	***195.9***	196	0	0	108	55
499.10	1.00		100	Sandy Gravel	27.8	245.0	388.4	40.6	26.8	***236.5***	236	0	0	130	56
498.10	1.00		100	Sandy Gravel	27.8	245.0	416.2	40.6	26.8	***277.1***	277	0	0	152	57
497.10	1.00		100	Sandy Gravel	27.8	245.0	444.0	40.6	26.8	***317.8***	318	0	0	175	58
496.10	1.00		100	Sandy Gravel	27.8	245.0	471.8	40.6	26.8	***358.4***	358	0	0	197	59
495.10	1.00		100	Sandy Gravel	27.8	245.0	***315.8***	40.6	26.8	379.0	316	0	0	174	60
490.10	5.00		25	Medium Sand	9.0	61.2	***337.1***	13.2	6.7	393.5	337	0	0	185	65
489.10	1.00		40	Hard Till	1.8	73.5	***338.9***	2.7	8.0	396.2	339	0	0	186	66
488.10	1.00		40	Hard Till	1.8	73.5	***340.8***	2.7	8.0	398.8	341	0	0	187	67
487.10	1.00		40	Hard Till	1.8	73.5	***342.6***	2.7	8.0	401.5	343	0	0	188	68
486.10	1.00		40	Hard Till	1.8	73.5	***344.4***	2.7	8.0	404.2	344	0	0	189	69
485.10	1.00		40	Hard Till	1.8	73.5	456.5	2.7	8.0	***418.9***	~~419~~	~~0~~	~~0~~	~~230~~	~~70~~
484.10	1.00		100	Hard Till		183.7			20.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Abut w/ Embank. Materia
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
497 KIPS	**428** KIPS	**236** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
544.10	8.92	1.00	6		25.4		39.4	37.3		***39.1***	39	0	0	21	11
542.60	1.50	1.00	7		4.3	14.0	***43.6***	6.3	1.8	45.3	44	0	0	24	12
540.10	2.50	1.00	4		7.1	14.0	***50.7***	10.5	1.8	55.8	51	0	0	28	15
537.60	2.50	1.00	2		7.1	14.0	***57.8***	10.5	1.8	66.3	58	0	0	32	17
535.10	2.50	1.00	4		7.1	14.0	***60.9***	10.5	1.8	76.2	61	0	0	33	20
532.60	2.50		4	Medium Sand	0.7	10.0	***61.6***	1.1	1.3	77.3	62	0	0	34	22
530.10	2.50		4	Medium Sand	0.7	10.0	***58.0***	1.1	1.3	77.8	58	0	0	32	25
527.60	2.50		3	Very Fine Silty Sand	0.5	5.6	***72.8***	0.7	0.7	80.3	73	0	0	40	27
525.10	2.50		8	Medium Sand	1.5	19.9	114.1	2.1	2.5	***87.5***	88	0	0	48	30
522.60	2.50		24	Medium Sand	4.4	59.8	123.6	6.4	7.6	***94.6***	95	0	0	52	32
520.10	2.50	4.63	26		20.8	64.9	146.7	30.6	8.3	***125.5***	125	0	0	69	35
517.60	2.50		36	Hard Till	4.0	67.3	169.7	5.9	8.6	***133.8***	134	0	0	74	37
515.10	2.50	6.15	25		20.8	86.2	167.8	30.6	11.0	***161.5***	161	0	0	89	40
510.10	5.00		34	Hard Till	7.5	63.5	***141.6***	11.0	8.1	168.2	142	0	0	78	45
507.60	2.50		12	Fine Sand	2.1	29.9	***143.7***	3.0	3.8	171.2	144	0	0	79	47
505.10	2.50		12	Fine Sand	2.1	29.9	***120.8***	3.0	3.8	171.0	121	0	0	66	50
504.10	1.00		2	Medium Sand	0.1	5.0	***121.0***	0.2	0.6	171.3	121	0	0	67	51
503.10	1.00		2	Medium Sand	0.1	5.0	***121.1***	0.2	0.6	171.5	121	0	0	67	52
502.10	1.00		2	Medium Sand	0.1	5.0	***121.3***	0.2	0.6	171.7	121	0	0	67	53
501.10	1.00		2	Medium Sand	0.1	5.0	***121.4***	0.2	0.6	171.9	121	0	0	67	54
500.10	1.00		2	Medium Sand	0.1	5.0	365.7	0.2	0.6	***203.3***	203	0	0	112	55
499.10	1.00		100	Sandy Gravel	28.0	249.1	393.7	41.2	31.8	***244.5***	245	0	0	134	56
498.10	1.00		100	Sandy Gravel	28.0	249.1	421.8	41.2	31.8	***285.8***	286	0	0	157	57
497.10	1.00		100	Sandy Gravel	28.0	249.1	449.8	41.2	31.8	***327.0***	327	0	0	180	58
496.10	1.00		100	Sandy Gravel	28.0	249.1	477.8	41.2	31.8	***368.2***	368	0	0	203	59
495.10	1.00		100	Sandy Gravel	28.0	249.1	***319.0***	41.2	31.8	385.6	319	0	0	175	60
490.10	5.00		25	Medium Sand	9.1	62.3	***340.6***	13.4	8.0	400.5	341	0	0	187	65
489.10	1.00		40	Hard Till	1.8	74.7	***342.4***	2.7	9.6	403.3	342	0	0	188	66
488.10	1.00		40	Hard Till	1.8	74.7	***344.2***	2.7	9.6	406.0	344	0	0	189	67
487.10	1.00		40	Hard Till	1.8	74.7	***346.1***	2.7	9.6	408.7	346	0	0	190	68
486.10	1.00		40	Hard Till	1.8	74.7	***347.9***	2.7	9.6	411.4	348	0	0	191	69
485.10	1.00		40	Hard Till	1.8	74.7	461.9	2.7	9.6	***428.4***	428	0	0	236	70
484.10	1.00		100	Hard Till		186.8			23.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== West Abut w/ Embank. Materia
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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
578 KIPS	**507** KIPS	**279** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
544.10	8.92	1.00	6		29.8		49.1	44.2		***46.3***	46	0	0	25	11
542.60	1.50	1.00	7		5.0	19.3	54.1	7.4	2.1	***53.7***	54	0	0	30	12
540.10	2.50	1.00	4		8.3	19.3	***62.5***	12.4	2.1	66.1	62	0	0	34	15
537.60	2.50	1.00	2		8.3	19.3	***70.8***	12.4	2.1	78.5	71	0	0	39	17
535.10	2.50	1.00	4		8.3	19.3	***73.6***	12.4	2.1	90.3	74	0	0	40	20
532.60	2.50		4	Medium Sand	0.9	13.7	***74.4***	1.3	1.5	91.6	74	0	0	41	22
530.10	2.50		4	Medium Sand	0.9	13.7	***69.3***	1.3	1.5	92.2	69	0	0	38	25
527.60	2.50		3	Very Fine Silty Sand	0.5	7.7	***89.6***	0.8	0.8	95.1	90	0	0	49	27
525.10	2.50		8	Medium Sand	1.7	27.5	146.3	2.5	3.0	***103.6***	104	0	0	57	30
522.60	2.50		24	Medium Sand	5.1	82.4	158.4	7.6	8.9	***112.0***	112	0	0	62	32
520.10	2.50	4.63	26		24.4	89.5	186.1	36.2	9.6	***148.6***	149	0	0	82	35
517.60	2.50		36	Hard Till	4.7	92.8	216.9	7.0	10.0	***158.4***	158	0	0	87	37
515.10	2.50	6.15	25		24.4	118.8	210.1	36.2	12.8	***191.3***	191	0	0	105	40
510.10	5.00		34	Hard Till	8.8	87.6	***172.5***	13.0	9.4	199.3	173	0	0	95	45
507.60	2.50		12	Fine Sand	2.4	41.2	***174.9***	3.6	4.4	202.9	175	0	0	96	47
505.10	2.50		12	Fine Sand	2.4	41.2	***143.0***	3.6	4.4	202.8	143	0	0	79	50
504.10	1.00		2	Medium Sand	0.2	6.9	***143.2***	0.3	0.7	203.0	143	0	0	79	51
503.10	1.00		2	Medium Sand	0.2	6.9	***143.3***	0.3	0.7	203.3	143	0	0	79	52
502.10	1.00		2	Medium Sand	0.2	6.9	***143.5***	0.3	0.7	203.5	144	0	0	79	53
501.10	1.00		2	Medium Sand	0.2	6.9	***143.7***	0.3	0.7	203.8	144	0	0	79	54
500.10	1.00		2	Medium Sand	0.2	6.9	480.5	0.3	0.7	***240.3***	240	0	0	132	55
499.10	1.00		100	Sandy Gravel	32.9	343.5	513.5	48.9	37.0	***289.2***	289	0	0	159	56
498.10	1.00		100	Sandy Gravel	32.9	343.5	546.4	48.9	37.0	***338.1***	338	0	0	186	57
497.10	1.00		100	Sandy Gravel	32.9	343.5	579.3	48.9	37.0	***386.9***	387	0	0	213	58
496.10	1.00		100	Sandy Gravel	32.9	343.5	612.3	48.9	37.0	***435.8***	436	0	0	240	59
495.10	1.00		100	Sandy Gravel	32.9	343.5	***387.5***	48.9	37.0	456.9	388	0	0	213	60
490.10	5.00		25	Medium Sand	10.7	85.9	***415.4***	15.9	9.3	474.7	415	0	0	228	65
489.10	1.00		40	Hard Till	2.2	103.1	***417.6***	3.2	11.1	477.9	418	0	0	230	66
488.10	1.00		40	Hard Till	2.2	103.1	***419.7***	3.2	11.1	481.1	420	0	0	231	67
487.10	1.00		40	Hard Till	2.2	103.1	***421.9***	3.2	11.1	484.3	422	0	0	232	68
486.10	1.00		40	Hard Till	2.2	103.1	***424.1***	3.2	11.1	487.5	424	0	0	233	69
485.10	1.00		40	Hard Till	2.2	103.1	580.8	3.2	11.1	***507.3***	507	0	0	279	70
484.10	1.00		100	Hard Till		257.7			27.8						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE==========West Abut w/ Embank. Materia
REFERENCE BORING ==========B-1
LRFD or ASD or SEISMIC ==========LRFD
PILE CUTOFF ELEV. ==========555.02 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.02 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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
705 KIPS	**517** KIPS	**285** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
544.10	8.92	1.00	6		30.1		49.8	44.6		***47.1***	47	0	0	26	11
542.60	1.50	1.00	7		5.1	19.7	54.9	7.5	2.5	***54.6***	55	0	0	30	12
540.10	2.50	1.00	4		8.4	19.7	***63.3***	12.5	2.5	67.1	63	0	0	35	15
537.60	2.50	1.00	2		8.4	19.7	***71.8***	12.5	2.5	79.6	72	0	0	39	17
535.10	2.50	1.00	4		8.4	19.7	***74.5***	12.5	2.5	91.4	75	0	0	41	20
532.60	2.50		4	Medium Sand	0.9	14.0	***75.4***	1.3	1.8	92.6	75	0	0	41	22
530.10	2.50		4	Medium Sand	0.9	14.0	***70.1***	1.3	1.8	93.1	70	0	0	39	25
527.60	2.50		3	Very Fine Silty Sand	0.6	7.9	***90.8***	0.8	1.0	96.6	91	0	0	50	27
525.10	2.50		8	Medium Sand	1.7	28.1	148.7	2.6	3.6	***106.3***	106	0	0	58	30
522.60	2.50		24	Medium Sand	5.2	84.2	161.1	7.7	10.8	***115.0***	115	0	0	63	32
520.10	2.50	4.63	26		24.7	91.4	189.1	36.6	11.8	***151.9***	152	0	0	84	35
517.60	2.50		36	Hard Till	4.8	94.8	220.5	7.0	12.2	***162.4***	162	0	0	89	37
515.10	2.50	6.15	25		24.7	121.4	213.3	36.6	15.6	***194.9***	195	0	0	107	40
510.10	5.00		34	Hard Till	8.9	89.5	***174.8***	13.1	11.5	201.9	175	0	0	96	45
507.60	2.50		12	Fine Sand	2.4	42.1	***177.3***	3.6	5.4	205.5	177	0	0	97	47
505.10	2.50		12	Fine Sand	2.4	42.1	***144.6***	3.6	5.4	204.6	145	0	0	80	50
504.10	1.00		2	Medium Sand	0.2	7.0	***144.8***	0.3	0.9	204.9	145	0	0	80	51
503.10	1.00		2	Medium Sand	0.2	7.0	***144.9***	0.3	0.9	205.1	145	0	0	80	52
502.10	1.00		2	Medium Sand	0.2	7.0	***145.1***	0.3	0.9	205.4	145	0	0	80	53
501.10	1.00		2	Medium Sand	0.2	7.0	***145.3***	0.3	0.9	205.6	145	0	0	80	54
500.10	1.00		2	Medium Sand	0.2	7.0	489.4	0.3	0.9	***250.2***	250	0	0	138	55
499.10	1.00		100	Sandy Gravel	33.3	351.0	522.7	49.3	45.2	***299.4***	299	0	0	165	56
498.10	1.00		100	Sandy Gravel	33.3	351.0	556.0	49.3	45.2	***348.7***	349	0	0	192	57
497.10	1.00		100	Sandy Gravel	33.3	351.0	589.3	49.3	45.2	***398.0***	398	0	0	219	58
496.10	1.00		100	Sandy Gravel	33.3	351.0	622.6	49.3	45.2	***447.3***	447	0	0	246	59
495.10	1.00		100	Sandy Gravel	33.3	351.0	***392.6***	49.3	45.2	462.7	393	0	0	216	60
490.10	5.00		25	Medium Sand	10.8	87.7	***421.0***	16.0	11.3	481.0	421	0	0	232	65
489.10	1.00		40	Hard Till	2.2	105.3	***423.2***	3.2	13.6	484.2	423	0	0	233	66
488.10	1.00		40	Hard Till	2.2	105.3	***425.3***	3.2	13.6	487.4	425	0	0	234	67
487.10	1.00		40	Hard Till	2.2	105.3	***427.5***	3.2	13.6	490.7	428	0	0	235	68
486.10	1.00		40	Hard Till	2.2	105.3	***429.7***	3.2	13.6	493.9	430	0	0	236	69
485.10	1.00		40	Hard Till	2.2	105.3	589.8	3.2	13.6	***517.5***	517	0	0	285	70
484.10	1.00		100	Hard Till		263.2			33.9						

Pile Design Table for West Abut w/ Embank. Material utilizing Boring #B-1

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
80	44	25
110	60	27
133	73	32
188	103	37
Metal Shell 12"Φ w/.25" walls		
80	44	25
110	60	27
133	73	32
188	103	37
216	119	50
217	119	51
217	120	52
218	120	53
219	120	54
Metal Shell 14"Φ w/.25" walls		
75	41	17
95	52	25
136	75	27
163	90	32
229	126	37
254	140	50
255	140	51
256	141	52
256	141	53
257	141	54
Metal Shell 14"Φ w/.312" walls		
75	41	17
95	52	25
136	75	27
163	90	32
229	126	37
254	140	50
255	140	51
256	141	52
256	141	53
257	141	54
Steel HP 8 X 36		
81	44	54
132	72	55
159	87	56
186	102	57
201	111	60
213	117	65
214	118	66
216	119	67
217	119	68
218	120	69
270	149	70
Steel HP 10 X 42		
77	42	32
99	54	50
99	54	51
99	55	52
99	55	53
99	55	54
163	90	55
197	108	56
231	127	57
254	140	60
270	149	65
272	149	66
273	150	67
275	151	68
276	152	69

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
79	44	32
101	56	50
101	56	51
101	56	52
101	56	53
101	56	54
171	94	55
206	113	56
240	132	57
260	143	60
277	152	65
278	153	66
280	154	67
281	155	68
283	155	69
358	197	70
Steel HP 12 X 53		
85	47	30
92	51	32
120	66	50
120	66	51
120	66	52
120	66	53
120	66	54
196	108	55
236	130	56
277	152	57
316	174	60
337	185	65
339	186	66
341	187	67
343	188	68
344	189	69
Steel HP 12 X 63		
88	48	30
95	52	32
121	66	50
121	67	51
121	67	52
121	67	53
121	67	54
203	112	55
245	134	56
286	157	57
319	175	60
341	187	65
342	188	66
344	189	67
346	190	68
348	191	69
428	236	70
Steel HP 12 X 74		
74	41	27
89	49	30
97	53	32
122	67	50
123	67	51
123	67	52
123	68	53
123	68	54
210	115	55
251	138	56
293	161	57
324	178	60
346	190	65
348	191	66
350	192	67
351	193	68
353	194	69
435	239	70
Steel HP 12 X 84		
75	41	27
91	50	30
98	54	32
124	68	50
124	68	51
124	68	52
124	68	53
125	69	54
216	119	55
257	142	56
299	164	57
329	181	60
351	193	65
353	194	66
355	195	67
357	196	68
359	197	69
440	242	70

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
69	38	25
90	49	27
104	57	30
112	62	32
143	79	50
143	79	51
143	79	52
144	79	53
144	79	54
240	132	55
289	159	56
338	186	57
387	213	58
388	213	60
415	228	65
418	230	66
420	231	67
422	232	68
424	233	69
507	279	70
Steel HP 14 X 89		
70	39	25
91	50	27
106	58	30
115	63	32
145	80	50
145	80	51
145	80	52
145	80	53
145	80	54
250	138	55
299	165	56
349	192	57
393	216	60
421	232	65
423	233	66
425	234	67
428	235	68
430	236	69
517	285	70
Steel HP 14 X 102		
71	39	25
92	51	27
108	60	30
117	64	32
146	80	50
146	81	51
147	81	52
147	81	53
147	81	54
258	142	55
307	169	56
357	196	57
398	219	60
427	235	65
429	236	66
431	237	67
433	238	68
435	239	69
524	288	70
Steel HP 14 X 117		
72	39	25
93	51	27
111	61	30
120	66	32
148	81	50
148	81	51
148	81	52
148	82	53
148	82	54
267	147	55
317	174	56
367	202	57
403	222	60
432	238	65
434	239	66
437	240	67
439	241	68
441	243	69
534	294	70
Precast 14"x 14"		
82	45	15
95	52	17
121	66	25
173	95	27
Timber Pile		
84	46	27
107	59	32

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========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 KIPS

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

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
413 KIPS	**357** KIPS	**196** KIPS	**26** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				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.)
551.00	2.32		14	Sandy Gravel	14.1		45.4				45	0	0	25	4
548.50	2.50	2.67	7		20.2	31.3	63.6				64	0	0	35	7
546.00	2.50	2.50	23		19.3	29.3	77.0				77	0	0	42	9
543.50	2.50	2.00	14		16.7	23.5	94.3				94	0	0	52	12
541.00	2.50	2.05	9		17.0	24.0	104.1				104	0	0	57	14
538.50	2.50	1.44	6		13.4	16.9	105.9				106	0	0	58	17
536.00	2.50	0.45	4		5.1	5.3	117.8				118	0	0	65	19
533.50	2.50	1.03	5		10.4	12.1	170.0				170	0	0	93	22
531.00	2.50		8	Sandy Gravel	8.7	53.8	333.4				333	0	0	183	24
530.50	0.50		31	Sandy Gravel	7.9	208.6	341.3				341	0	0	188	25
529.50	1.00		31	Sandy Gravel	15.7	208.6	357.0				357	0	0	196	26
528.50	1.00		31	Sandy Gravel	15.7	208.6	675.6				~~676~~	~~0~~	~~0~~	~~372~~	~~27~~
527.50	1.00		76	Medium Sand	51.8	511.4	727.4				~~727~~	~~0~~	~~0~~	~~400~~	~~28~~
526.50	1.00		76	Medium Sand	51.8	511.4	779.2				~~779~~	~~0~~	~~0~~	~~429~~	~~29~~
525.50	1.00		76	Medium Sand	51.8	511.4	831.0				~~831~~	~~0~~	~~0~~	~~457~~	~~30~~
524.50	1.00		76	Medium Sand	51.8	511.4	882.7				~~883~~	~~0~~	~~0~~	~~486~~	~~31~~
523.50	1.00		76	Medium Sand	51.8	511.4	500.0				~~500~~	~~0~~	~~0~~	~~275~~	~~32~~
518.50	5.00	6.56	22		59.6	76.9	551.4				~~551~~	~~0~~	~~0~~	~~303~~	~~37~~
513.50	5.00	5.86	28		59.6	68.7	602.5				~~603~~	~~0~~	~~0~~	~~331~~	~~42~~
508.50	5.00	5.13	27		59.6	60.2	797.1				~~797~~	~~0~~	~~0~~	~~438~~	~~47~~
503.50	5.00		29	Medium Sand	50.6	195.2	827.5				~~828~~	~~0~~	~~0~~	~~455~~	~~52~~
501.00	2.50		26	Sandy Gravel	29.5	175.0	857.0				~~857~~	~~0~~	~~0~~	~~471~~	~~54~~
498.50	2.50		26	Sandy Gravel	29.5	175.0	1229.7				~~1230~~	~~0~~	~~0~~	~~676~~	~~57~~
497.50	1.00		77	Sandy Gravel	90.0	518.2	1319.7				~~1320~~	~~0~~	~~0~~	~~726~~	~~58~~
496.50	1.00		77	Sandy Gravel	90.0	518.2	1409.6				~~1410~~	~~0~~	~~0~~	~~775~~	~~59~~
495.50	1.00		77	Sandy Gravel	90.0	518.2	1499.6				~~1500~~	~~0~~	~~0~~	~~825~~	~~60~~
494.50	1.00		77	Sandy Gravel	90.0	518.2	1589.6				~~1590~~	~~0~~	~~0~~	~~874~~	~~61~~
493.50	1.00		77	Sandy Gravel	90.0	518.2	1672.9				~~1673~~	~~0~~	~~0~~	~~920~~	~~62~~
491.00	2.50		76	Sandy Gravel	220.6	511.4	1893.5				~~1893~~	~~0~~	~~0~~	~~1041~~	~~64~~
488.50	2.50		76	Sandy Gravel	220.6	511.4	1905.5				~~1906~~	~~0~~	~~0~~	~~1048~~	~~67~~
486.00	2.50		45	Sandy Gravel	86.5	302.8	1992.0				~~1992~~	~~0~~	~~0~~	~~1096~~	~~69~~
483.50	2.50		45	Sandy Gravel	86.5	302.8	2280.4				~~2280~~	~~0~~	~~0~~	~~1254~~	~~72~~
482.50	1.00		100	Hard Till		504.7									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 KIPS

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

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
513 KIPS	**357** KIPS	**196** KIPS	**26** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				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.)
551.00	2.32		14	Sandy Gravel	14.1		45.4				45	0	0	25	4
548.50	2.50	2.67	7		20.2	31.3	63.6				64	0	0	35	7
546.00	2.50	2.50	23		19.3	29.3	77.0				77	0	0	42	9
543.50	2.50	2.00	14		16.7	23.5	94.3				94	0	0	52	12
541.00	2.50	2.05	9		17.0	24.0	104.1				104	0	0	57	14
538.50	2.50	1.44	6		13.4	16.9	105.9				106	0	0	58	17
536.00	2.50	0.45	4		5.1	5.3	117.8				118	0	0	65	19
533.50	2.50	1.03	5		10.4	12.1	170.0				170	0	0	93	22
531.00	2.50		8	Sandy Gravel	8.7	53.8	333.4				333	0	0	183	24
530.50	0.50		31	Sandy Gravel	7.9	208.6	341.3				341	0	0	188	25
529.50	1.00		31	Sandy Gravel	15.7	208.6	357.0				357	0	0	196	26
528.50	1.00		31	Sandy Gravel	15.7	208.6	675.6				~~676~~	~~0~~	~~0~~	~~372~~	~~27~~
527.50	1.00		76	Medium Sand	51.8	511.4	727.4				~~727~~	~~0~~	~~0~~	~~400~~	~~28~~
526.50	1.00		76	Medium Sand	51.8	511.4	779.2				~~779~~	~~0~~	~~0~~	~~429~~	~~29~~
525.50	1.00		76	Medium Sand	51.8	511.4	831.0				~~831~~	~~0~~	~~0~~	~~457~~	~~30~~
524.50	1.00		76	Medium Sand	51.8	511.4	882.7				~~883~~	~~0~~	~~0~~	~~486~~	~~31~~
523.50	1.00		76	Medium Sand	51.8	511.4	500.0				500	0	0	275	32
518.50	5.00	6.56	22		59.6	76.9	551.4				~~551~~	~~0~~	~~0~~	~~303~~	~~37~~
513.50	5.00	5.86	28		59.6	68.7	602.5				~~603~~	~~0~~	~~0~~	~~331~~	~~42~~
508.50	5.00	5.13	27		59.6	60.2	797.1				~~797~~	~~0~~	~~0~~	~~438~~	~~47~~
503.50	5.00		29	Medium Sand	50.6	195.2	827.5				~~828~~	~~0~~	~~0~~	~~455~~	~~52~~
501.00	2.50		26	Sandy Gravel	29.5	175.0	857.0				~~857~~	~~0~~	~~0~~	~~471~~	~~54~~
498.50	2.50		26	Sandy Gravel	29.5	175.0	1229.7				~~1230~~	~~0~~	~~0~~	~~676~~	~~57~~
497.50	1.00		77	Sandy Gravel	90.0	518.2	1319.7				~~1320~~	~~0~~	~~0~~	~~726~~	~~58~~
496.50	1.00		77	Sandy Gravel	90.0	518.2	1409.6				~~1410~~	~~0~~	~~0~~	~~775~~	~~59~~
495.50	1.00		77	Sandy Gravel	90.0	518.2	1499.6				~~1500~~	~~0~~	~~0~~	~~825~~	~~60~~
494.50	1.00		77	Sandy Gravel	90.0	518.2	1589.6				~~1590~~	~~0~~	~~0~~	~~874~~	~~61~~
493.50	1.00		77	Sandy Gravel	90.0	518.2	1672.9				~~1673~~	~~0~~	~~0~~	~~920~~	~~62~~
491.00	2.50		76	Sandy Gravel	220.6	511.4	1893.5				~~1893~~	~~0~~	~~0~~	~~1041~~	~~64~~
488.50	2.50		76	Sandy Gravel	220.6	511.4	1905.5				~~1906~~	~~0~~	~~0~~	~~1048~~	~~67~~
486.00	2.50		45	Sandy Gravel	86.5	302.8	1992.0				~~1992~~	~~0~~	~~0~~	~~1096~~	~~69~~
483.50	2.50		45	Sandy Gravel	86.5	302.8	2280.4				~~2280~~	~~0~~	~~0~~	~~1254~~	~~72~~
482.50	1.00		100	Hard Till		504.7									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
335 KIPS	**277** KIPS	**152** KIPS	**54** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
551.00	2.32		14	Sandy Gravel	2.5		28.0	3.7		***6.9***	7	0	0	4	4
548.50	2.50	2.67	7		11.6	25.5	38.0	17.1	3.2	***23.8***	24	0	0	13	7
546.00	2.50	2.50	23		11.1	23.8	44.3	16.4	3.0	***39.6***	40	0	0	22	9
543.50	2.50	2.00	14		9.6	19.1	54.4	14.1	2.4	***53.8***	54	0	0	30	12
541.00	2.50	2.05	9		9.8	19.5	***58.3***	14.4	2.5	67.4	58	0	0	32	14
538.50	2.50	1.44	6		7.7	13.7	***56.6***	11.4	1.7	77.6	57	0	0	31	17
536.00	2.50	0.45	4		2.9	4.3	***65.1***	4.3	0.5	82.6	65	0	0	36	19
533.50	2.50	1.03	5		6.0	9.8	***74.8***	8.8	1.2	91.9	75	0	0	41	22
531.00	2.50		8	Sandy Gravel	1.5	13.6	115.3	2.3	1.7	***99.1***	99	0	0	54	24
530.50	0.50		31	Sandy Gravel	1.4	52.5	116.7	2.1	6.6	***101.1***	101	0	0	56	25
529.50	1.00		31	Sandy Gravel	2.8	52.5	119.5	4.1	6.6	***105.3***	105	0	0	58	26
528.50	1.00		31	Sandy Gravel	2.8	52.5	198.6	4.1	6.6	***119.0***	119	0	0	65	27
527.50	1.00		76	Medium Sand	9.2	128.8	207.8	13.6	16.3	***132.6***	133	0	0	73	28
526.50	1.00		76	Medium Sand	9.2	128.8	217.1	13.6	16.3	***146.2***	146	0	0	80	29
525.50	1.00		76	Medium Sand	9.2	128.8	226.3	13.6	16.3	***159.8***	160	0	0	88	30
524.50	1.00		76	Medium Sand	9.2	128.8	235.5	13.6	16.3	***173.4***	173	0	0	95	31
523.50	1.00		76	Medium Sand	9.2	128.8	***178.5***	13.6	16.3	178.6	178	0	0	98	32
518.50	5.00	6.56	22		34.3	62.5	***206.1***	50.5	7.9	228.2	206	0	0	113	37
513.50	5.00	5.86	28		34.3	55.9	***233.4***	50.5	7.1	277.8	233	0	0	128	42
508.50	5.00	5.13	27		34.3	48.9	***268.0***	50.5	6.2	328.4	268	0	0	147	47
503.50	5.00		29	Medium Sand	9.0	49.2	***271.9***	13.3	6.2	341.0	272	0	0	150	52
501.00	2.50		26	Sandy Gravel	5.3	44.1	***277.2***	7.7	5.6	348.7	277	0	0	152	54
498.50	2.50		26	Sandy Gravel	5.3	44.1	368.9	7.7	5.6	***367.4***	~~367~~	~~0~~	~~0~~	~~202~~	~~57~~
497.50	1.00		77	Sandy Gravel	16.0	130.5	***384.9***	23.6	16.5	391.0	~~385~~	~~0~~	~~0~~	~~212~~	~~58~~
496.50	1.00		77	Sandy Gravel	16.0	130.5	***400.9***	23.6	16.5	414.6	~~401~~	~~0~~	~~0~~	~~221~~	~~59~~
495.50	1.00		77	Sandy Gravel	16.0	130.5	***417.0***	23.6	16.5	438.2	~~417~~	~~0~~	~~0~~	~~229~~	~~60~~
494.50	1.00		77	Sandy Gravel	16.0	130.5	***433.0***	23.6	16.5	461.8	~~433~~	~~0~~	~~0~~	~~238~~	~~61~~
493.50	1.00		77	Sandy Gravel	16.0	130.5	***447.3***	23.6	16.5	485.2	~~447~~	~~0~~	~~0~~	~~246~~	~~62~~
491.00	2.50		76	Sandy Gravel	39.3	128.8	***486.6***	57.9	16.3	543.1	~~487~~	~~0~~	~~0~~	~~268~~	~~64~~
488.50	2.50		76	Sandy Gravel	39.3	128.8	***473.4***	57.9	16.3	594.3	~~473~~	~~0~~	~~0~~	~~260~~	~~67~~
486.00	2.50		45	Sandy Gravel	15.4	76.3	***488.8***	22.7	9.7	617.0	~~489~~	~~0~~	~~0~~	~~269~~	~~69~~
483.50	2.50		45	Sandy Gravel	15.4	76.3	***555.1***	22.7	9.7	646.1	~~555~~	~~0~~	~~0~~	~~305~~	~~72~~
482.50	1.00		100	Hard Till		127.1			16.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
418 KIPS	**344** KIPS	**189** KIPS	**54** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
551.00	2.32		14	Sandy Gravel	3.0		39.8	4.4		***8.4***	8	0	0	5	4
548.50	2.50	2.67	7		14.0	36.8	51.4	20.4	4.0	***28.6***	29	0	0	16	7
546.00	2.50	2.50	23		13.4	34.5	57.9	19.5	3.8	***47.4***	47	0	0	26	9
543.50	2.50	2.00	14		11.5	27.6	70.1	16.9	3.0	***64.3***	64	0	0	35	12
541.00	2.50	2.05	9		11.7	28.3	***73.5***	17.1	3.1	80.6	73	0	0	40	14
538.50	2.50	1.44	6		9.3	19.8	***69.1***	13.6	2.2	92.6	69	0	0	38	17
536.00	2.50	0.45	4		3.5	6.2	***80.6***	5.1	0.7	98.6	81	0	0	44	19
533.50	2.50	1.03	5		7.2	14.2	***93.2***	10.5	1.6	109.8	93	0	0	51	22
531.00	2.50		8	Sandy Gravel	1.9	19.6	151.4	2.7	2.1	***118.6***	119	0	0	65	24
530.50	0.50		31	Sandy Gravel	1.7	75.9	153.1	2.5	8.3	***121.1***	121	0	0	67	25
529.50	1.00		31	Sandy Gravel	3.4	75.9	156.5	4.9	8.3	***126.0***	126	0	0	69	26
528.50	1.00		31	Sandy Gravel	3.4	75.9	270.1	4.9	8.3	***143.0***	143	0	0	79	27
527.50	1.00		76	Medium Sand	11.1	186.2	281.2	16.2	20.4	***159.2***	159	0	0	88	28
526.50	1.00		76	Medium Sand	11.1	186.2	292.3	16.2	20.4	***175.5***	175	0	0	97	29
525.50	1.00		76	Medium Sand	11.1	186.2	303.4	16.2	20.4	***191.7***	192	0	0	105	30
524.50	1.00		76	Medium Sand	11.1	186.2	314.4	16.2	20.4	***207.9***	208	0	0	114	31
523.50	1.00		76	Medium Sand	11.1	186.2	229.7	16.2	20.4	***213.6***	214	0	0	117	32
518.50	5.00	6.56	22		41.2	90.4	***261.3***	60.3	9.9	272.9	261	0	0	144	37
513.50	5.00	5.86	28		41.2	80.8	***292.5***	60.3	8.8	332.0	292	0	0	161	42
508.50	5.00	5.13	27		41.2	70.7	***334.1***	60.3	7.7	392.4	334	0	0	184	47
503.50	5.00		29	Medium Sand	10.8	71.0	***337.6***	15.8	7.8	407.4	338	0	0	186	52
501.00	2.50		26	Sandy Gravel	6.3	63.7	***343.9***	9.2	7.0	416.6	344	0	0	189	54
498.50	2.50		26	Sandy Gravel	6.3	63.7	475.1	9.2	7.0	***439.5***	~~440~~	~~0~~	~~0~~	~~242~~	~~57~~
497.50	1.00		77	Sandy Gravel	19.3	188.6	494.4	28.2	20.6	***467.7***	~~468~~	~~0~~	~~0~~	~~257~~	~~58~~
496.50	1.00		77	Sandy Gravel	19.3	188.6	513.7	28.2	20.6	***495.9***	~~496~~	~~0~~	~~0~~	~~273~~	~~59~~
495.50	1.00		77	Sandy Gravel	19.3	188.6	532.9	28.2	20.6	***524.1***	~~524~~	~~0~~	~~0~~	~~288~~	~~60~~
494.50	1.00		77	Sandy Gravel	19.3	188.6	***552.2***	28.2	20.6	552.2	~~552~~	~~0~~	~~0~~	~~304~~	~~61~~
493.50	1.00		77	Sandy Gravel	19.3	188.6	***569.0***	28.2	20.6	580.2	~~569~~	~~0~~	~~0~~	~~313~~	~~62~~
491.00	2.50		76	Sandy Gravel	47.3	186.2	***616.3***	69.1	20.4	649.2	~~616~~	~~0~~	~~0~~	~~339~~	~~64~~
488.50	2.50		76	Sandy Gravel	47.3	186.2	***587.6***	69.1	20.4	710.0	~~588~~	~~0~~	~~0~~	~~323~~	~~67~~
486.00	2.50		45	Sandy Gravel	18.5	110.2	***606.1***	27.1	12.1	737.1	~~606~~	~~0~~	~~0~~	~~333~~	~~69~~
483.50	2.50		45	Sandy Gravel	18.5	110.2	***698.1***	27.1	12.1	772.3	~~698~~	~~0~~	~~0~~	~~384~~	~~72~~
482.50	1.00		100	Hard Till		183.7			20.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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
497 KIPS	**478** KIPS	**263** KIPS	**58** 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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
551.00	2.32		14	Sandy Gravel	3.0		40.5	4.5		***9.2***	9	0	0	5	4
548.50	2.50	2.67	7		14.1	37.4	52.2	20.7	4.8	***29.7***	30	0	0	16	7
546.00	2.50	2.50	23		13.5	35.0	58.6	19.8	4.5	***48.6***	49	0	0	27	9
543.50	2.50	2.00	14		11.6	28.0	71.0	17.1	3.6	***65.8***	66	0	0	36	12
541.00	2.50	2.05	9		11.8	28.7	***74.2***	17.4	3.7	82.1	74	0	0	41	14
538.50	2.50	1.44	6		9.4	20.2	***69.7***	13.8	2.6	94.1	70	0	0	38	17
536.00	2.50	0.45	4		3.5	6.3	***81.4***	5.2	0.8	100.3	81	0	0	45	19
533.50	2.50	1.03	5		7.3	14.4	***94.2***	10.7	1.8	111.7	94	0	0	52	22
531.00	2.50		8	Sandy Gravel	1.9	19.9	153.3	2.7	2.5	***121.8***	122	0	0	67	24
530.50	0.50		31	Sandy Gravel	1.7	77.2	155.0	2.5	9.9	***124.3***	124	0	0	68	25
529.50	1.00		31	Sandy Gravel	3.4	77.2	158.4	5.0	9.9	***129.3***	129	0	0	71	26
528.50	1.00		31	Sandy Gravel	3.4	77.2	273.9	5.0	9.9	***148.6***	149	0	0	82	27
527.50	1.00		76	Medium Sand	11.2	189.3	285.1	16.4	24.2	***165.1***	165	0	0	91	28
526.50	1.00		76	Medium Sand	11.2	189.3	296.3	16.4	24.2	***181.5***	182	0	0	100	29
525.50	1.00		76	Medium Sand	11.2	189.3	307.5	16.4	24.2	***198.0***	198	0	0	109	30
524.50	1.00		76	Medium Sand	11.2	189.3	318.7	16.4	24.2	***214.4***	214	0	0	118	31
523.50	1.00		76	Medium Sand	11.2	189.3	232.4	16.4	24.2	***218.4***	218	0	0	120	32
518.50	5.00	6.56	22		41.6	91.9	***264.2***	61.2	11.7	278.3	264	0	0	145	37
513.50	5.00	5.86	28		41.6	82.1	***295.6***	61.2	10.5	338.2	296	0	0	163	42
508.50	5.00	5.13	27		41.6	71.9	***337.5***	61.2	9.2	399.4	337	0	0	186	47
503.50	5.00		29	Medium Sand	10.9	72.2	***340.9***	16.1	9.2	414.5	341	0	0	188	52
501.00	2.50		26	Sandy Gravel	6.4	64.8	***347.3***	9.4	8.3	423.8	347	0	0	191	54
498.50	2.50		26	Sandy Gravel	6.4	64.8	480.7	9.4	8.3	***449.4***	449	0	0	247	57
497.50	1.00		77	Sandy Gravel	19.4	191.8	500.2	28.6	24.5	***478.0***	478	0	0	263	58
496.50	1.00		77	Sandy Gravel	19.4	191.8	519.6	28.6	24.5	***506.6***	~~507~~	~~0~~	~~0~~	~~279~~	~~59~~
495.50	1.00		77	Sandy Gravel	19.4	191.8	539.0	28.6	24.5	***535.2***	~~535~~	~~0~~	~~0~~	~~294~~	~~60~~
494.50	1.00		77	Sandy Gravel	19.4	191.8	***558.5***	28.6	24.5	563.8	~~558~~	~~0~~	~~0~~	~~307~~	~~61~~
493.50	1.00		77	Sandy Gravel	19.4	191.8	***575.4***	28.6	24.5	592.0	~~575~~	~~0~~	~~0~~	~~316~~	~~62~~
491.00	2.50		76	Sandy Gravel	47.6	189.3	***623.0***	70.1	24.2	662.1	~~623~~	~~0~~	~~0~~	~~343~~	~~64~~
488.50	2.50		76	Sandy Gravel	47.6	189.3	***593.5***	70.1	24.2	722.3	~~593~~	~~0~~	~~0~~	~~326~~	~~67~~
486.00	2.50		45	Sandy Gravel	18.7	112.1	***612.1***	27.5	14.3	749.8	~~612~~	~~0~~	~~0~~	~~337~~	~~69~~
483.50	2.50		45	Sandy Gravel	18.7	112.1	***705.6***	27.5	14.3	786.8	~~706~~	~~0~~	~~0~~	~~388~~	~~72~~
482.50	1.00		100	Hard Till		186.8			23.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
578 KIPS	**566** KIPS	**311** KIPS	**58** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
551.00	2.32		14	Sandy Gravel	3.6		55.2	5.3		***10.9***	11	0	0	6	4
548.50	2.50	2.67	7		16.6	51.6	68.4	24.6	5.6	***35.1***	35	0	0	19	7
546.00	2.50	2.50	23		15.8	48.3	74.6	23.5	5.2	***57.5***	58	0	0	32	9
543.50	2.50	2.00	14		13.7	38.6	89.2	20.3	4.2	***77.9***	78	0	0	43	12
541.00	2.50	2.05	9		13.9	39.6	***91.3***	20.6	4.3	97.3	91	0	0	50	14
538.50	2.50	1.44	6		11.0	27.8	***83.2***	16.3	3.0	111.5	83	0	0	46	17
536.00	2.50	0.45	4		4.2	8.7	***98.6***	6.2	0.9	118.9	99	0	0	54	19
533.50	2.50	1.03	5		8.5	19.9	***114.7***	12.7	2.1	132.4	115	0	0	63	22
531.00	2.50		8	Sandy Gravel	2.2	27.5	195.9	3.3	3.0	***144.2***	144	0	0	79	24
530.50	0.50		31	Sandy Gravel	2.0	106.5	197.9	3.0	11.5	***147.1***	147	0	0	81	25
529.50	1.00		31	Sandy Gravel	4.0	106.5	201.9	5.9	11.5	***153.1***	153	0	0	84	26
528.50	1.00		31	Sandy Gravel	4.0	106.5	360.5	5.9	11.5	***175.6***	176	0	0	97	27
527.50	1.00		76	Medium Sand	13.1	261.1	373.6	19.5	28.1	***195.1***	195	0	0	107	28
526.50	1.00		76	Medium Sand	13.1	261.1	386.8	19.5	28.1	***214.6***	215	0	0	118	29
525.50	1.00		76	Medium Sand	13.1	261.1	399.9	19.5	28.1	***234.2***	234	0	0	129	30
524.50	1.00		76	Medium Sand	13.1	261.1	413.1	19.5	28.1	***253.7***	254	0	0	140	31
523.50	1.00		76	Medium Sand	13.1	261.1	291.9	19.5	28.1	***258.7***	259	0	0	142	32
518.50	5.00	6.56	22		48.9	126.8	***327.2***	72.5	13.7	329.7	327	0	0	180	37
513.50	5.00	5.86	28		48.9	113.2	***361.9***	72.5	12.2	400.7	362	0	0	199	42
508.50	5.00	5.13	27		48.9	99.1	***411.3***	72.5	10.7	473.2	411	0	0	226	47
503.50	5.00		29	Medium Sand	12.8	99.6	***413.8***	19.0	10.7	491.2	414	0	0	228	52
501.00	2.50		26	Sandy Gravel	7.5	89.3	***421.3***	11.1	9.6	502.3	421	0	0	232	54
498.50	2.50		26	Sandy Gravel	7.5	89.3	604.0	11.1	9.6	***532.3***	532	0	0	293	57
497.50	1.00		77	Sandy Gravel	22.8	264.5	626.8	33.9	28.5	***566.1***	566	0	0	311	58
496.50	1.00		77	Sandy Gravel	22.8	264.5	649.6	33.9	28.5	***600.0***	~~600~~	~~0~~	~~0~~	~~330~~	~~59~~
495.50	1.00		77	Sandy Gravel	22.8	264.5	672.5	33.9	28.5	***633.9***	~~634~~	~~0~~	~~0~~	~~349~~	~~60~~
494.50	1.00		77	Sandy Gravel	22.8	264.5	695.3	33.9	28.5	***667.8***	~~668~~	~~0~~	~~0~~	~~367~~	~~61~~
493.50	1.00		77	Sandy Gravel	22.8	264.5	714.7	33.9	28.5	***701.3***	~~701~~	~~0~~	~~0~~	~~386~~	~~62~~
491.00	2.50		76	Sandy Gravel	56.0	261.1	***770.7***	83.1	28.1	784.4	~~771~~	~~0~~	~~0~~	~~424~~	~~64~~
488.50	2.50		76	Sandy Gravel	56.0	261.1	***720.2***	83.1	28.1	856.0	~~720~~	~~0~~	~~0~~	~~396~~	~~67~~
486.00	2.50		45	Sandy Gravel	22.0	154.6	***742.1***	32.6	16.7	888.6	~~742~~	~~0~~	~~0~~	~~408~~	~~69~~
483.50	2.50		45	Sandy Gravel	22.0	154.6	***867.2***	32.6	16.7	932.3	~~867~~	~~0~~	~~0~~	~~477~~	~~72~~
482.50	1.00		100	Hard Till		257.7			27.8						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== B-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 555.32 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 553.32 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

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 568 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 ===== 129.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 48.45 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.

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
705 KIPS	**679** KIPS	**374** KIPS	**61** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
551.00	2.32		14	Sandy Gravel	3.6		56.3	5.3		***12.1***	12	0	0	7	4
548.50	2.50	2.67	7		16.7	52.7	69.7	24.8	6.8	***36.5***	36	0	0	20	7
546.00	2.50	2.50	23		16.0	49.4	75.8	23.7	6.4	***58.9***	59	0	0	32	9
543.50	2.50	2.00	14		13.8	39.5	90.6	20.5	5.1	***79.5***	79	0	0	44	12
541.00	2.50	2.05	9		14.0	40.5	***92.6***	20.8	5.2	98.7	93	0	0	51	14
538.50	2.50	1.44	6		11.1	28.4	***84.2***	16.4	3.7	112.6	84	0	0	46	17
536.00	2.50	0.45	4		4.2	8.9	***99.8***	6.2	1.1	120.3	100	0	0	55	19
533.50	2.50	1.03	5		8.6	20.3	***116.2***	12.8	2.6	134.1	116	0	0	64	22
531.00	2.50		8	Sandy Gravel	2.2	28.1	199.2	3.3	3.6	***147.8***	148	0	0	81	24
530.50	0.50		31	Sandy Gravel	2.0	108.8	201.2	3.0	14.0	***150.8***	151	0	0	83	25
529.50	1.00		31	Sandy Gravel	4.0	108.8	205.2	6.0	14.0	***156.8***	157	0	0	86	26
528.50	1.00		31	Sandy Gravel	4.0	108.8	367.2	6.0	14.0	***183.1***	183	0	0	101	27
527.50	1.00		76	Medium Sand	13.3	266.7	380.5	19.7	34.3	***202.7***	203	0	0	112	28
526.50	1.00		76	Medium Sand	13.3	266.7	393.8	19.7	34.3	***222.4***	222	0	0	122	29
525.50	1.00		76	Medium Sand	13.3	266.7	407.0	19.7	34.3	***242.1***	242	0	0	133	30
524.50	1.00		76	Medium Sand	13.3	266.7	420.3	19.7	34.3	***261.7***	262	0	0	144	31
523.50	1.00		76	Medium Sand	13.3	266.7	296.4	19.7	34.3	***263.7***	264	0	0	145	32
518.50	5.00	6.56	22		49.4	129.5	***331.9***	73.1	16.7	335.1	332	0	0	183	37
513.50	5.00	5.86	28		49.4	115.7	***366.9***	73.1	14.9	406.3	367	0	0	202	42
508.50	5.00	5.13	27		49.4	101.3	***416.8***	73.1	13.0	479.5	417	0	0	229	47
503.50	5.00		29	Medium Sand	13.0	101.8	***419.2***	19.2	13.1	497.3	419	0	0	231	52
501.00	2.50		26	Sandy Gravel	7.6	91.3	***426.8***	11.2	11.7	508.5	427	0	0	235	54
498.50	2.50		26	Sandy Gravel	7.6	91.3	613.3	11.2	11.7	***542.7***	543	0	0	299	57
497.50	1.00		77	Sandy Gravel	23.1	270.3	636.4	34.2	34.8	***576.9***	577	0	0	317	58
496.50	1.00		77	Sandy Gravel	23.1	270.3	659.5	34.2	34.8	***611.1***	611	0	0	336	59
495.50	1.00		77	Sandy Gravel	23.1	270.3	682.5	34.2	34.8	***645.3***	645	0	0	355	60
494.50	1.00		77	Sandy Gravel	23.1	270.3	705.6	34.2	34.8	***679.4***	679	0	0	374	61
493.50	1.00		77	Sandy Gravel	23.1	270.3	725.2	34.2	34.8	***713.1***	~~713~~	~~0~~	~~0~~	~~392~~	~~62~~
491.00	2.50		76	Sandy Gravel	56.6	266.7	***781.8***	83.8	34.3	796.9	~~782~~	~~0~~	~~0~~	~~430~~	~~64~~
488.50	2.50		76	Sandy Gravel	56.6	266.7	***729.5***	83.8	34.3	866.7	~~730~~	~~0~~	~~0~~	~~401~~	~~67~~
486.00	2.50		45	Sandy Gravel	22.2	157.9	***751.7***	32.9	20.3	899.6	~~752~~	~~0~~	~~0~~	~~413~~	~~69~~
483.50	2.50		45	Sandy Gravel	22.2	157.9	***879.2***	32.9	20.3	946.0	~~879~~	~~0~~	~~0~~	~~484~~	~~72~~
482.50	1.00		100	Hard Till		263.2			33.9						

Pile Design Table for East Abutment utilizing Boring #B-4

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
87	48	14
90	50	17
99	55	19
139	77	22
Metal Shell 12"Φ w/.25" walls		
87	48	14
90	50	17
99	55	19
139	77	22
260	143	24
267	147	25
280	154	26
Metal Shell 14"Φ w/.25" walls		
77	42	9
94	52	12
104	57	14
106	58	17
118	65	19
170	93	22
333	183	24
341	188	25
357	196	26
Metal Shell 14"Φ w/.312" walls		
77	42	9
94	52	12
104	57	14
106	58	17
118	65	19
170	93	22
333	183	24
341	188	25
357	196	26
Steel HP 8 X 36		
85	47	26
96	53	27
107	59	28
118	65	29
129	71	30
136	75	32
160	88	37
183	101	42
212	116	47
215	119	52
220	121	54
282	155	57
Steel HP 10 X 42		
75	41	22
99	54	24
101	56	25
105	58	26
119	65	27
133	73	28
146	80	29
160	88	30
173	95	31
178	98	32
206	113	37
233	128	42
268	147	47
272	150	52
277	152	54

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
77	42	22
102	56	24
104	57	25
108	59	26
125	69	27
139	76	28
153	84	29
166	91	30
180	99	31
182	100	32
211	116	37
239	131	42
274	151	47
278	153	52
284	156	54
375	206	57
395	217	58
411	226	59
428	235	60
444	244	61
Steel HP 12 X 53		
81	44	19
93	51	22
119	65	24
121	67	25
126	69	26
143	79	27
159	88	28
175	97	29
192	105	30
208	114	31
214	117	32
261	144	37
292	161	42
334	184	47
338	186	52
344	189	54
Steel HP 12 X 63		
81	45	19
94	52	22
122	67	24
124	68	25
129	71	26
149	82	27
165	91	28
182	100	29
198	109	30
214	118	31
218	120	32
264	145	37
296	163	42
337	186	47
341	188	52
347	191	54
449	247	57
478	263	58
Steel HP 12 X 74		
83	45	19
96	53	22
124	68	24
127	70	25
132	72	26
154	84	27
170	94	28
187	103	29
203	112	30
220	121	31
221	122	32
269	148	37
300	165	42
343	188	47
346	190	52
352	194	54
456	251	57
484	266	58
513	282	59
542	298	60
568	312	61
585	322	62
Steel HP 12 X 84		
84	46	19
97	53	22
126	69	24
129	71	25
134	74	26
158	87	27
175	96	28
191	105	29
208	114	30
224	123	32
273	150	37
305	168	42
348	191	47
351	193	52
358	197	54
462	254	57
491	270	58
520	286	59
548	302	60
577	318	61
595	327	62
611	336	67
630	347	69

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
83	46	17
99	54	19
115	63	22
144	79	24
147	81	25
153	84	26
176	97	27
195	107	28
215	118	29
234	129	30
254	140	31
259	142	32
327	180	37
362	199	42
411	226	47
414	228	52
421	232	54
532	293	57
566	311	58
Steel HP 14 X 89		
84	46	17
100	55	19
116	64	22
148	81	24
151	83	25
157	86	26
183	101	27
203	112	28
222	122	29
242	133	30
262	144	31
264	145	32
332	183	37
367	202	42
417	229	47
419	231	52
427	235	54
543	299	57
577	317	58
611	336	59
645	355	60
679	374	61
Steel HP 14 X 102		
85	47	17
101	56	19
118	65	22
150	83	24
153	84	25
159	88	26
189	104	27
208	115	28
228	126	29
248	136	30
267	147	32
337	185	37
372	205	42
422	232	47
425	234	52
432	238	54
550	302	57
584	321	58
618	340	59
653	359	60
687	378	61
721	396	62
739	406	67
761	419	69
Steel HP 14 X 117		
86	47	17
102	56	19
119	66	22
154	85	24
157	86	25
163	90	26
196	108	27
216	119	28
236	130	29
255	140	30
272	150	32
341	188	37
377	207	42
428	235	47
430	237	52
438	241	54
560	308	57
594	327	58
629	346	59
664	365	60
698	384	61
732	403	62
748	412	67
771	424	69
904	497	72
Precast 14"x 14"		
81	45	7
98	54	9
120	66	12
133	73	14
135	74	17
150	82	19
216	119	22
Timber Pile		
88	48	17
94	52	19
113	62	22

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
335 KIPS	**272** KIPS	**81** KIPS	**66** 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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		2	Medium Sand	0.1		5.6	0.2		***0.9***	1	0	0	0	28
526.10	2.50		8	Medium Sand	1.2	5.5	8.5	1.8	0.7	***2.8***	3	1	0	1	31
523.60	2.50		6	Medium Sand	0.9	7.2	10.7	1.3	0.9	***4.3***	4	1	0	1	33
521.10	2.50		5	Medium Sand	0.8	8.5	50.6	1.1	1.1	***10.4***	10	2	0	4	36
518.60	2.50	5.00	10		17.1	47.7	80.8	25.2	6.0	***37.3***	37	11	0	9	38
516.10	2.50	6.36	29		17.1	60.6	80.3	25.2	7.7	***60.3***	60	20	0	13	41
513.60	2.50	4.51	18		17.1	43.0	119.7	25.2	5.4	***88.4***	88	30	0	19	43
511.10	2.50	6.85	29		17.1	65.3	136.9	25.2	8.3	***113.6***	114	39	0	23	46
508.60	2.50	6.85	29		17.1	65.3	***120.5***	25.2	8.3	134.6	120	49	0	17	48
506.10	2.50		25	Very Fine Silty Sand	3.2	31.8	***123.7***	4.7	4.0	139.4	124	51	0	17	51
503.60	2.50		25	Very Fine Silty Sand	3.2	31.8	***132.4***	4.7	4.0	144.8	132	52	0	21	53
501.10	2.50		22	Fine Sand	3.1	37.3	***135.5***	4.6	4.7	149.4	136	54	0	21	56
498.60	2.50		22	Fine Sand	3.1	37.3	270.9	4.6	4.7	***170.7***	171	56	0	38	58
497.60	1.00		100	Sandy Gravel	23.1	169.5	294.0	34.0	21.5	***204.7***	205	68	0	44	59
496.60	1.00		100	Sandy Gravel	23.1	169.5	317.1	34.0	21.5	***238.8***	239	68	0	63	60
495.60	1.00		100	Sandy Gravel	23.1	169.5	340.2	34.0	21.5	***272.8***	273	68	0	82	61
494.60	1.00		100	Sandy Gravel	23.1	169.5	363.4	34.0	21.5	***306.8***	307	68	0	100	62
493.60	1.00		100	Sandy Gravel	23.1	169.5	***267.8***	34.0	21.5	325.9	268	68	0	79	63
491.10	2.50		30	Fine Sand	4.3	50.9	***272.1***	6.3	6.4	332.2	272	68	0	81	66
488.60	2.50		30	Fine Sand	4.3	50.9	395.0	6.3	6.4	***353.5***	~~353~~	~~68~~	~~0~~	~~126~~	~~68~~
487.60	1.00		100	Sandy Gravel	23.1	169.5	418.1	34.0	21.5	***387.5***	~~388~~	~~68~~	~~0~~	~~145~~	~~69~~
486.60	1.00		100	Sandy Gravel	23.1	169.5	441.3	34.0	21.5	***421.5***	~~422~~	~~68~~	~~0~~	~~163~~	~~70~~
485.60	1.00		100	Sandy Gravel	23.1	169.5	464.4	34.0	21.5	***455.6***	~~456~~	~~68~~	~~0~~	~~182~~	~~71~~
484.60	1.00		100	Sandy Gravel	23.1	169.5	***487.5***	34.0	21.5	489.6	~~488~~	~~68~~	~~0~~	~~200~~	~~72~~
483.60	1.00		100	Sandy Gravel	23.1	169.5	***468.3***	34.0	21.5	518.3	~~468~~	~~68~~	~~0~~	~~189~~	~~73~~
482.60	1.00		100	Hard Till		127.1			16.1						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
418 KIPS	**339** KIPS	**104** KIPS	**66** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		2	Medium Sand	0.1		6.8	0.2		***0.9***	1	0	0	0	28
526.10	2.50		8	Medium Sand	1.4	6.7	10.2	2.1	0.7	***3.3***	3	1	0	1	31
523.60	2.50		6	Medium Sand	1.1	8.7	12.9	1.6	0.9	***5.0***	5	1	0	1	33
521.10	2.50		5	Medium Sand	0.9	10.3	72.5	1.3	1.1	***12.7***	13	2	0	5	36
518.60	2.50	5.00	10		20.6	68.9	111.8	30.1	7.5	***44.9***	45	13	0	11	38
516.10	2.50	6.36	29		20.6	87.6	106.9	30.1	9.6	***72.3***	72	25	0	15	41
513.60	2.50	4.51	18		20.6	62.2	159.8	30.1	6.8	***106.0***	106	36	0	22	43
511.10	2.50	6.85	29		20.6	94.4	180.4	30.1	10.3	***136.1***	136	47	0	28	46
508.60	2.50	6.85	29		20.6	94.4	***152.6***	30.1	10.3	160.9	153	59	0	25	48
506.10	2.50		25	Very Fine Silty Sand	3.9	45.9	***156.4***	5.6	5.0	166.6	156	61	0	25	51
503.60	2.50		25	Very Fine Silty Sand	3.9	45.9	***168.3***	5.6	5.0	173.1	168	63	0	30	53
501.10	2.50		22	Fine Sand	3.7	53.9	***172.0***	5.5	5.9	178.6	172	65	0	30	56
498.60	2.50		22	Fine Sand	3.7	53.9	366.8	5.5	5.9	***204.9***	205	67	0	46	58
497.60	1.00		100	Sandy Gravel	27.8	245.0	394.6	40.6	26.8	***245.6***	246	82	0	53	59
496.60	1.00		100	Sandy Gravel	27.8	245.0	422.4	40.6	26.8	***286.2***	286	82	0	75	60
495.60	1.00		100	Sandy Gravel	27.8	245.0	450.2	40.6	26.8	***326.9***	327	82	0	97	61
494.60	1.00		100	Sandy Gravel	27.8	245.0	478.0	40.6	26.8	***367.5***	368	82	0	120	62
493.60	1.00		100	Sandy Gravel	27.8	245.0	***334.3***	40.6	26.8	389.4	334	82	0	102	63
491.10	2.50		30	Fine Sand	5.1	73.5	***339.4***	7.5	8.0	396.9	339	82	0	104	66
488.60	2.50		30	Fine Sand	5.1	73.5	516.1	7.5	8.0	***423.2***	~~423~~	~~82~~	~~0~~	~~150~~	~~68~~
487.60	1.00		100	Sandy Gravel	27.8	245.0	543.9	40.6	26.8	***463.8***	~~464~~	~~82~~	~~0~~	~~173~~	~~69~~
486.60	1.00		100	Sandy Gravel	27.8	245.0	571.7	40.6	26.8	***504.4***	~~504~~	~~82~~	~~0~~	~~195~~	~~70~~
485.60	1.00		100	Sandy Gravel	27.8	245.0	599.4	40.6	26.8	***545.1***	~~545~~	~~82~~	~~0~~	~~218~~	~~71~~
484.60	1.00		100	Sandy Gravel	27.8	245.0	627.2	40.6	26.8	***585.7***	~~586~~	~~82~~	~~0~~	~~240~~	~~72~~
483.60	1.00		100	Sandy Gravel	27.8	245.0	***593.8***	40.6	26.8	619.7	~~594~~	~~82~~	~~0~~	~~244~~	~~73~~
482.60	1.00		100	Hard Till		183.7			20.1						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
497 KIPS	**475** KIPS	**178** KIPS	**69** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		2	Medium Sand	0.1		6.9	0.2		***1.1***	1	0	0	1	28
526.10	2.50		8	Medium Sand	1.5	6.8	10.4	2.1	0.9	***3.5***	3	1	0	1	31
523.60	2.50		6	Medium Sand	1.1	8.8	13.1	1.6	1.1	***5.3***	5	1	0	1	33
521.10	2.50		5	Medium Sand	0.9	10.5	73.7	1.3	1.3	***14.2***	14	2	0	6	36
518.60	2.50	5.00	10		20.8	70.1	113.5	30.6	9.0	***47.3***	47	13	0	13	38
516.10	2.50	6.36	29		20.8	89.1	108.4	30.6	11.4	***74.5***	75	25	0	16	41
513.60	2.50	4.51	18		20.8	63.2	161.9	30.6	8.1	***109.3***	109	36	0	24	43
511.10	2.50	6.85	29		20.8	96.0	182.7	30.6	12.3	***139.9***	140	48	0	29	46
508.60	2.50	6.85	29		20.8	96.0	***154.2***	30.6	12.3	164.1	154	59	0	26	48
506.10	2.50		25	Very Fine Silty Sand	3.9	46.7	***158.1***	5.7	6.0	169.9	158	61	0	26	51
503.60	2.50		25	Very Fine Silty Sand	3.9	46.7	***170.1***	5.7	6.0	176.6	170	63	0	30	53
501.10	2.50		22	Fine Sand	3.8	54.8	***173.9***	5.5	7.0	182.2	174	65	0	30	56
498.60	2.50		22	Fine Sand	3.8	54.8	372.0	5.5	7.0	***212.5***	213	68	0	49	58
497.60	1.00		100	Sandy Gravel	28.0	249.1	400.0	41.2	31.8	***253.8***	254	83	0	57	59
496.60	1.00		100	Sandy Gravel	28.0	249.1	428.0	41.2	31.8	***295.0***	295	83	0	79	60
495.60	1.00		100	Sandy Gravel	28.0	249.1	456.1	41.2	31.8	***336.2***	336	83	0	102	61
494.60	1.00		100	Sandy Gravel	28.0	249.1	484.1	41.2	31.8	***377.4***	377	83	0	125	62
493.60	1.00		100	Sandy Gravel	28.0	249.1	***337.7***	41.2	31.8	396.4	338	83	0	103	63
491.10	2.50		30	Fine Sand	5.2	74.7	***342.9***	7.6	9.6	404.0	343	83	0	106	66
488.60	2.50		30	Fine Sand	5.2	74.7	522.5	7.6	9.6	***433.9***	434	83	0	156	68
487.60	1.00		100	Sandy Gravel	28.0	249.1	550.5	41.2	31.8	***475.1***	475	83	0	178	69
486.60	1.00		100	Sandy Gravel	28.0	249.1	578.5	41.2	31.8	***516.3***	~~516~~	~~*83*~~	~~*0*~~	~~*201*~~	~~*70*~~
485.60	1.00		100	Sandy Gravel	28.0	249.1	606.6	41.2	31.8	***557.6***	~~558~~	~~*83*~~	~~*0*~~	~~*224*~~	~~*71*~~
484.60	1.00		100	Sandy Gravel	28.0	249.1	634.6	41.2	31.8	***598.8***	~~599~~	~~*83*~~	~~*0*~~	~~*246*~~	~~*72*~~
483.60	1.00		100	Sandy Gravel	28.0	249.1	***600.3***	41.2	31.8	632.1	~~600~~	~~*83*~~	~~*0*~~	~~*247*~~	~~*73*~~
482.60	1.00		100	Hard Till		186.8			23.9						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
578 KIPS	**563** KIPS	**212** KIPS	**69** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		2	Medium Sand	0.2		8.2	0.2		***1.1***	1	0	0	1	28
526.10	2.50		8	Medium Sand	1.7	8.0	12.3	2.5	0.9	***3.9***	4	1	0	1	31
523.60	2.50		6	Medium Sand	1.3	10.4	15.5	1.9	1.1	***6.0***	6	2	0	2	33
521.10	2.50		5	Medium Sand	1.1	12.4	100.8	1.6	1.3	***16.7***	17	2	0	7	36
518.60	2.50	5.00	10		24.4	96.6	151.5	36.2	10.4	***55.8***	56	16	0	15	38
516.10	2.50	6.36	29		24.4	122.9	140.2	36.2	13.2	***88.2***	88	29	0	19	41
513.60	2.50	4.51	18		24.4	87.2	209.9	36.2	9.4	***129.3***	129	43	0	28	43
511.10	2.50	6.85	29		24.4	132.4	234.3	36.2	14.3	***165.5***	166	56	0	35	46
508.60	2.50	6.85	29		24.4	132.4	***190.8***	36.2	14.3	194.5	191	69	0	35	48
506.10	2.50		25	Very Fine Silty Sand	4.6	64.4	***195.3***	6.8	6.9	201.2	195	72	0	35	51
503.60	2.50		25	Very Fine Silty Sand	4.6	64.4	211.1	6.8	6.9	***209.2***	209	75	0	41	53
501.10	2.50		22	Fine Sand	4.4	75.6	***215.5***	6.6	8.1	215.8	216	77	0	42	56
498.60	2.50		22	Fine Sand	4.4	75.6	487.9	6.6	8.1	***251.2***	251	79	0	59	58
497.60	1.00		100	Sandy Gravel	32.9	343.5	520.8	48.9	37.0	***300.1***	300	98	0	68	59
496.60	1.00		100	Sandy Gravel	32.9	343.5	553.8	48.9	37.0	***349.0***	349	98	0	94	60
495.60	1.00		100	Sandy Gravel	32.9	343.5	586.7	48.9	37.0	***397.9***	398	98	0	121	61
494.60	1.00		100	Sandy Gravel	32.9	343.5	619.6	48.9	37.0	***446.7***	447	98	0	148	62
493.60	1.00		100	Sandy Gravel	32.9	343.5	***412.1***	48.9	37.0	469.7	412	98	0	129	63
491.10	2.50		30	Fine Sand	6.1	103.1	***418.2***	9.0	11.1	478.7	418	98	0	132	66
488.60	2.50		30	Fine Sand	6.1	103.1	664.7	9.0	11.1	***513.7***	514	98	0	185	68
487.60	1.00		100	Sandy Gravel	32.9	343.5	697.7	48.9	37.0	***562.6***	563	98	0	212	69
486.60	1.00		100	Sandy Gravel	32.9	343.5	730.6	48.9	37.0	***611.4***	~~611~~	~~98~~	~~0~~	~~239~~	~~70~~
485.60	1.00		100	Sandy Gravel	32.9	343.5	763.5	48.9	37.0	***660.3***	~~660~~	~~98~~	~~0~~	~~266~~	~~71~~
484.60	1.00		100	Sandy Gravel	32.9	343.5	796.5	48.9	37.0	***709.2***	~~709~~	~~98~~	~~0~~	~~293~~	~~72~~
483.60	1.00		100	Sandy Gravel	32.9	343.5	***743.5***	48.9	37.0	748.8	~~744~~	~~98~~	~~0~~	~~311~~	~~73~~
482.60	1.00		100	Hard Till		257.7			27.8						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
705 KIPS	**674** KIPS	**272** KIPS	**71** 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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		2	Medium Sand	0.2		8.3	0.2		***1.3***	1	0	0	1	28
526.10	2.50		8	Medium Sand	1.7	8.2	12.5	2.6	1.1	***4.2***	4	1	0	1	31
523.60	2.50		6	Medium Sand	1.3	10.6	15.8	1.9	1.4	***6.3***	6	2	0	2	33
521.10	2.50		5	Medium Sand	1.1	12.6	103.0	1.6	1.6	***19.0***	19	2	0	8	36
518.60	2.50	5.00	10		24.7	98.7	154.5	36.6	12.7	***59.0***	59	16	0	17	38
516.10	2.50	6.36	29		24.7	125.6	142.7	36.6	16.2	***90.9***	91	30	0	20	41
513.60	2.50	4.51	18		24.7	89.0	213.6	36.6	11.5	***133.4***	133	43	0	30	43
511.10	2.50	6.85	29		24.7	135.2	238.2	36.6	17.4	***169.9***	170	57	0	37	46
508.60	2.50	6.85	29		24.7	135.2	***193.5***	36.6	17.4	197.5	194	70	0	36	48
506.10	2.50		25	Very Fine Silty Sand	4.6	65.8	***198.1***	6.8	8.5	204.4	198	73	0	36	51
503.60	2.50		25	Very Fine Silty Sand	4.6	65.8	214.2	6.8	8.5	***212.7***	213	75	0	42	53
501.10	2.50		22	Fine Sand	4.5	77.2	***218.6***	6.6	9.9	219.3	219	78	0	42	56
498.60	2.50		22	Fine Sand	4.5	77.2	496.9	6.6	9.9	***261.2***	261	80	0	63	58
497.60	1.00		100	Sandy Gravel	33.3	351.0	530.2	49.3	45.2	***310.5***	310	99	0	72	59
496.60	1.00		100	Sandy Gravel	33.3	351.0	563.4	49.3	45.2	***359.8***	360	99	0	99	60
495.60	1.00		100	Sandy Gravel	33.3	351.0	596.7	49.3	45.2	***409.0***	409	99	0	126	61
494.60	1.00		100	Sandy Gravel	33.3	351.0	630.0	49.3	45.2	***458.3***	458	99	0	154	62
493.60	1.00		100	Sandy Gravel	33.3	351.0	***417.6***	49.3	45.2	476.0	418	99	0	131	63
491.10	2.50		30	Fine Sand	6.1	105.3	***423.8***	9.1	13.6	485.1	424	99	0	135	66
488.60	2.50		30	Fine Sand	6.1	105.3	675.6	9.1	13.6	***525.8***	526	99	0	191	68
487.60	1.00		100	Sandy Gravel	33.3	351.0	708.9	49.3	45.2	***575.1***	575	99	0	218	69
486.60	1.00		100	Sandy Gravel	33.3	351.0	742.2	49.3	45.2	***624.4***	624	99	0	245	70
485.60	1.00		100	Sandy Gravel	33.3	351.0	775.4	49.3	45.2	***673.7***	674	99	0	272	71
484.60	1.00		100	Sandy Gravel	33.3	351.0	808.7	49.3	45.2	***722.9***	~~723~~	~~99~~	~~0~~	~~299~~	~~72~~
483.60	1.00		100	Sandy Gravel	33.3	351.0	***754.3***	49.3	45.2	760.9	~~754~~	~~99~~	~~0~~	~~316~~	~~73~~
482.60	1.00		100	Hard Till		263.2			33.9						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
929 KIPS	**776** KIPS	**326** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		2	Medium Sand	0.2		8.7	0.2		***1.6***	2	0	0	1	28
526.10	2.50		8	Medium Sand	1.8	8.5	13.0	2.6	1.4	***4.6***	5	1	0	1	31
523.60	2.50		6	Medium Sand	1.3	11.1	16.4	1.9	1.8	***6.9***	7	2	0	2	33
521.10	2.50		5	Medium Sand	1.1	13.2	107.3	1.6	2.1	***23.1***	23	2	0	10	36
518.60	2.50	5.00	10		25.2	103.0	160.5	37.0	16.7	***64.7***	65	16	0	19	38
516.10	2.50	6.36	29		25.2	131.0	147.6	37.0	21.3	***95.5***	95	30	0	22	41
513.60	2.50	4.51	18		25.2	92.9	221.0	37.0	15.1	***140.3***	140	44	0	33	43
511.10	2.50	6.85	29		25.2	141.1	246.2	37.0	22.9	***177.3***	177	58	0	40	46
508.60	2.50	6.85	29		25.2	141.1	***199.0***	37.0	22.9	202.5	199	72	0	38	48
506.10	2.50		25	Very Fine Silty Sand	4.7	68.6	***203.7***	6.9	11.2	209.4	204	74	0	38	51
503.60	2.50		25	Very Fine Silty Sand	4.7	68.6	220.4	6.9	11.2	***218.3***	218	77	0	43	53
501.10	2.50		22	Fine Sand	4.6	80.5	***224.9***	6.7	13.1	225.0	225	79	0	44	56
498.60	2.50		22	Fine Sand	4.6	80.5	515.0	6.7	13.1	***278.1***	278	82	0	71	58
497.60	1.00		100	Sandy Gravel	34.0	366.1	549.0	49.9	59.5	***328.0***	328	101	0	80	59
496.60	1.00		100	Sandy Gravel	34.0	366.1	583.0	49.9	59.5	***377.8***	378	101	0	107	60
495.60	1.00		100	Sandy Gravel	34.0	366.1	617.0	49.9	59.5	***427.7***	428	101	0	135	61
494.60	1.00		100	Sandy Gravel	34.0	366.1	651.0	49.9	59.5	***477.6***	478	101	0	162	62
493.60	1.00		100	Sandy Gravel	34.0	366.1	***428.7***	49.9	59.5	485.8	429	101	0	135	63
491.10	2.50		30	Fine Sand	6.3	109.8	***435.0***	9.2	17.9	495.0	435	101	0	139	66
488.60	2.50		30	Fine Sand	6.3	109.8	697.5	9.2	17.9	***545.9***	546	101	0	200	68
487.60	1.00		100	Sandy Gravel	34.0	366.1	731.5	49.9	59.5	***595.7***	596	101	0	227	69
486.60	1.00		100	Sandy Gravel	34.0	366.1	765.5	49.9	59.5	***645.6***	646	101	0	254	70
485.60	1.00		100	Sandy Gravel	34.0	366.1	799.5	49.9	59.5	***695.5***	695	101	0	282	71
484.60	1.00		100	Sandy Gravel	34.0	366.1	833.4	49.9	59.5	***745.3***	745	101	0	309	72
483.60	1.00		100	Sandy Gravel	34.0	366.1	***775.9***	49.9	59.5	780.3	776	101	0	326	73
482.60	1.00		100	Hard Till		274.6			44.6						

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

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
250	51	51
Metal Shell 12"Φ w/.25" walls		
297	60	56
Metal Shell 14"Φ w/.25" walls		
367	81	56
Metal Shell 14"Φ w/.312" walls		
367	81	56
Steel HP 8 X 36		
284	100	68
Steel HP 10 X 42		
272	81	66

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
278	83	66
363	130	68
397	149	69
431	167	70
Steel HP 12 X 53		
339	104	66
Steel HP 12 X 63		
343	106	66
434	156	68
475	178	69
Steel HP 12 X 74		
348	107	66
441	159	68
483	182	69
524	204	70
566	227	71
Steel HP 12 X 84		
353	109	66
449	162	68
490	185	69
532	207	70
573	230	71
615	253	72
620	256	73

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
349	94	60
398	121	61
412	129	63
418	132	66
514	185	68
563	212	69
Steel HP 14 X 89		
360	99	60
409	126	61
418	131	63
424	135	66
526	191	68
575	218	69
624	245	70
674	272	71
Steel HP 14 X 102		
368	103	60
417	130	61
423	133	63
429	137	66
534	194	68
584	221	69
633	249	70
683	276	71
732	303	72
765	321	73
Steel HP 14 X 117		
378	107	60
428	135	61
429	135	63
435	139	66
546	200	68
596	227	69
646	254	70
695	282	71
745	309	72
776	326	73
Precast 14"x 14"		
237	56	43
Timber Pile		
137	11	46

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
335 KIPS	**323** KIPS	**121** KIPS	**69** 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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	5.00	30		19.2		59.1	28.3		***33.3***	33	11	0	8	30
524.20	2.50		37	Hard Till	3.4	39.9	69.7	5.0	5.0	***39.3***	39	12	0	9	33
521.70	2.50		37	Hard Till	3.4	47.0	91.4	5.0	6.0	***46.6***	47	14	0	11	35
519.20	2.50	6.85	27		17.1	65.3	108.5	25.2	8.3	***71.9***	72	24	0	16	38
516.70	2.50	6.85	27		17.1	65.3	109.3	25.2	8.3	***95.0***	95	33	0	19	40
514.20	2.50	5.13	30		17.1	48.9	126.4	25.2	6.2	***120.3***	120	43	0	24	43
511.70	2.50	5.13	30		17.1	48.9	***120.1***	25.2	6.2	142.6	120	52	0	14	45
509.20	2.50		15	Medium Sand	2.3	25.4	***122.3***	3.3	3.2	145.9	122	53	0	14	48
506.70	2.50		15	Medium Sand	2.3	25.4	***117.8***	3.3	3.2	148.3	118	55	0	10	50
504.20	2.50		11	Medium Sand	1.7	18.6	***119.5***	2.4	2.4	150.8	119	55	0	10	53
501.70	2.50		11	Medium Sand	1.7	18.6	***122.8***	2.4	2.4	153.4	123	56	0	11	55
499.20	2.50		12	Fine Sand	1.7	20.3	***124.5***	2.5	2.6	155.9	125	57	0	11	58
496.70	2.50		12	Fine Sand	1.7	20.3	197.4	2.5	2.6	***167.4***	167	57	0	35	60
495.70	1.00		54	Sandy Gravel	8.9	91.5	206.3	13.2	11.6	***180.6***	181	57	0	42	61
494.70	1.00		54	Sandy Gravel	8.9	91.5	215.3	13.2	11.6	***193.8***	194	57	0	49	62
493.70	1.00		54	Sandy Gravel	8.9	91.5	224.2	13.2	11.6	***206.9***	207	57	0	57	63
492.70	1.00		54	Sandy Gravel	8.9	91.5	233.2	13.2	11.6	***220.1***	220	57	0	64	64
491.70	1.00		54	Sandy Gravel	8.9	91.5	320.1	13.2	11.6	***243.1***	243	57	0	76	65
490.70	1.00		100	Medium Sand	13.6	169.5	333.7	20.0	21.5	***263.2***	263	57	0	87	66
489.70	1.00		100	Medium Sand	13.6	169.5	347.3	20.0	21.5	***283.2***	283	57	0	98	67
488.70	1.00		100	Medium Sand	13.6	169.5	360.9	20.0	21.5	***303.3***	303	57	0	110	68
487.70	1.00		100	Medium Sand	13.6	169.5	374.5	20.0	21.5	***323.3***	323	57	0	121	69
486.70	1.00		100	Medium Sand	13.6	169.5	345.8	20.0	21.5	***338.0***	~~338~~	~~57~~	~~0~~	~~129~~	~~70~~
485.70	1.00		100	Hard Till		127.1			16.1						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
418 KIPS	**404** KIPS	**154** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	5.00	30		23.1		71.1	33.8		***39.0***	39	13	0	9	30
524.20	2.50		37	Hard Till	4.1	48.0	95.2	6.0	5.3	***47.2***	47	15	0	11	33
521.70	2.50		37	Hard Till	4.1	68.0	125.7	6.0	7.4	***56.1***	56	17	0	14	35
519.20	2.50	6.85	27		20.6	94.4	146.3	30.1	10.3	***86.3***	86	29	0	19	38
516.70	2.50	6.85	27		20.6	94.4	143.2	30.1	10.3	***113.8***	114	40	0	23	40
514.20	2.50	5.13	30		20.6	70.7	163.9	30.1	7.7	***143.9***	144	51	0	28	43
511.70	2.50	5.13	30		20.6	70.7	***150.5***	30.1	7.7	170.4	151	63	0	20	45
509.20	2.50		15	Medium Sand	2.7	36.7	***153.2***	4.0	4.0	174.3	153	64	0	20	48
506.70	2.50		15	Medium Sand	2.7	36.7	***146.1***	4.0	4.0	177.2	146	66	0	15	50
504.20	2.50		11	Medium Sand	2.0	26.9	***148.1***	2.9	2.9	180.1	148	67	0	15	53
501.70	2.50		11	Medium Sand	2.0	26.9	***152.6***	2.9	2.9	183.3	153	68	0	16	55
499.20	2.50		12	Fine Sand	2.0	29.4	***154.6***	3.0	3.2	186.3	155	69	0	16	58
496.70	2.50		12	Fine Sand	2.0	29.4	259.5	3.0	3.2	***200.5***	201	69	0	41	60
495.70	1.00		54	Sandy Gravel	10.7	132.3	270.3	15.7	14.5	***216.2***	216	69	0	50	61
494.70	1.00		54	Sandy Gravel	10.7	132.3	281.0	15.7	14.5	***232.0***	232	69	0	59	62
493.70	1.00		54	Sandy Gravel	10.7	132.3	291.8	15.7	14.5	***247.7***	248	69	0	67	63
492.70	1.00		54	Sandy Gravel	10.7	132.3	302.5	15.7	14.5	***263.4***	263	69	0	76	64
491.70	1.00		54	Sandy Gravel	10.7	132.3	426.0	15.7	14.5	***291.4***	291	69	0	91	65
490.70	1.00		100	Medium Sand	16.4	245.0	442.3	23.9	26.8	***315.4***	315	69	0	105	66
489.70	1.00		100	Medium Sand	16.4	245.0	458.7	23.9	26.8	***339.3***	339	69	0	118	67
488.70	1.00		100	Medium Sand	16.4	245.0	475.1	23.9	26.8	***363.2***	363	69	0	131	68
487.70	1.00		100	Medium Sand	16.4	245.0	491.4	23.9	26.8	***387.2***	387	69	0	144	69
486.70	1.00		100	Medium Sand	16.4	245.0	446.6	23.9	26.8	***404.4***	404	69	0	154	70
485.70	1.00		100	Hard Till		183.7			20.1						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
497 KIPS	**414** KIPS	**158** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	5.00	30		23.3		72.1	34.2		***40.5***	40	13	0	9	30
524.20	2.50		37	Hard Till	4.1	48.9	96.6	6.1	6.2	***49.2***	49	15	0	12	33
521.70	2.50		37	Hard Till	4.1	69.1	127.6	6.1	8.8	***58.7***	59	17	0	15	35
519.20	2.50	6.85	27		20.8	96.0	148.4	30.6	12.3	***89.3***	89	29	0	20	38
516.70	2.50	6.85	27		20.8	96.0	145.0	30.6	12.3	***116.8***	117	40	0	24	40
514.20	2.50	5.13	30		20.8	71.9	165.8	30.6	9.2	***147.4***	147	52	0	29	43
511.70	2.50	5.13	30		20.8	71.9	***152.1***	30.6	9.2	173.5	152	63	0	21	45
509.20	2.50		15	Medium Sand	2.7	37.4	***154.8***	4.0	4.8	177.5	155	65	0	21	48
506.70	2.50		15	Medium Sand	2.7	37.4	***147.6***	4.0	4.8	180.3	148	66	0	15	50
504.20	2.50		11	Medium Sand	2.0	27.4	***149.6***	2.9	3.5	183.2	150	67	0	15	53
501.70	2.50		11	Medium Sand	2.0	27.4	***154.1***	2.9	3.5	186.5	154	68	0	16	55
499.20	2.50		12	Fine Sand	2.1	29.9	***156.2***	3.0	3.8	189.5	156	69	0	16	58
496.70	2.50		12	Fine Sand	2.1	29.9	262.8	3.0	3.8	***205.9***	206	69	0	44	60
495.70	1.00		54	Sandy Gravel	10.8	134.5	273.7	15.9	17.2	***221.9***	222	69	0	53	61
494.70	1.00		54	Sandy Gravel	10.8	134.5	284.5	15.9	17.2	***237.8***	238	69	0	61	62
493.70	1.00		54	Sandy Gravel	10.8	134.5	295.4	15.9	17.2	***253.7***	254	69	0	70	63
492.70	1.00		54	Sandy Gravel	10.8	134.5	306.2	15.9	17.2	***269.7***	270	69	0	79	64
491.70	1.00		54	Sandy Gravel	10.8	134.5	431.6	15.9	17.2	***300.3***	300	69	0	96	65
490.70	1.00		100	Medium Sand	16.5	249.1	448.1	24.3	31.8	***324.5***	325	69	0	109	66
489.70	1.00		100	Medium Sand	16.5	249.1	464.6	24.3	31.8	***348.8***	349	69	0	122	67
488.70	1.00		100	Medium Sand	16.5	249.1	481.1	24.3	31.8	***373.1***	373	69	0	136	68
487.70	1.00		100	Medium Sand	16.5	249.1	497.6	24.3	31.8	***397.4***	397	69	0	149	69
486.70	1.00		100	Medium Sand	16.5	249.1	451.9	24.3	31.8	***413.7***	414	69	0	158	70
485.70	1.00		100	Hard Till		186.8			23.9						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
578 KIPS	**490** KIPS	**188** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	5.00	30		27.4		85.1	40.6		***46.8***	47	15	0	11	30
524.20	2.50		37	Hard Till	4.9	57.7	117.2	7.2	6.2	***57.0***	57	18	0	14	33
521.70	2.50		37	Hard Till	4.9	85.0	169.5	7.2	9.2	***69.3***	69	20	0	18	35
519.20	2.50	6.85	27		24.4	132.4	193.9	36.2	14.3	***105.6***	106	34	0	24	38
516.70	2.50	6.85	27		24.4	132.4	185.1	36.2	14.3	***138.2***	138	47	0	29	40
514.20	2.50	5.13	30		24.4	99.1	209.5	36.2	10.7	***174.5***	174	61	0	35	43
511.70	2.50	5.13	30		24.4	99.1	***186.3***	36.2	10.7	205.6	186	74	0	28	45
509.20	2.50		15	Medium Sand	3.2	51.5	***189.5***	4.8	5.6	210.4	190	76	0	28	48
506.70	2.50		15	Medium Sand	3.2	51.5	***179.0***	4.8	5.6	213.7	179	78	0	21	50
504.20	2.50		11	Medium Sand	2.4	37.8	***181.4***	3.5	4.1	217.2	181	79	0	21	53
501.70	2.50		11	Medium Sand	2.4	37.8	***187.2***	3.5	4.1	221.0	187	80	0	23	55
499.20	2.50		12	Fine Sand	2.4	41.2	***189.6***	3.6	4.4	224.6	190	82	0	23	58
496.70	2.50		12	Fine Sand	2.4	41.2	336.3	3.6	4.4	***243.7***	244	82	0	52	60
495.70	1.00		54	Sandy Gravel	12.7	185.5	349.0	18.9	20.0	***262.6***	263	82	0	63	61
494.70	1.00		54	Sandy Gravel	12.7	185.5	361.7	18.9	20.0	***281.5***	282	82	0	73	62
493.70	1.00		54	Sandy Gravel	12.7	185.5	374.5	18.9	20.0	***300.4***	300	82	0	84	63
492.70	1.00		54	Sandy Gravel	12.7	185.5	387.2	18.9	20.0	***319.3***	319	82	0	94	64
491.70	1.00		54	Sandy Gravel	12.7	185.5	558.0	18.9	20.0	***355.3***	355	82	0	114	65
490.70	1.00		100	Medium Sand	19.4	343.5	577.4	28.8	37.0	***384.0***	384	82	0	130	66
489.70	1.00		100	Medium Sand	19.4	343.5	596.8	28.8	37.0	***412.8***	413	82	0	145	67
488.70	1.00		100	Medium Sand	19.4	343.5	616.2	28.8	37.0	***441.6***	442	82	0	161	68
487.70	1.00		100	Medium Sand	19.4	343.5	635.6	28.8	37.0	***470.4***	470	82	0	177	69
486.70	1.00		100	Medium Sand	19.4	343.5	569.1	28.8	37.0	***489.9***	490	82	0	188	70
485.70	1.00		100	Hard Till		257.7			27.8						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
705 KIPS	**500** KIPS	**192** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	5.00	30		27.6		86.6	40.9		***48.5***	49	15	0	11	30
524.20	2.50		37	Hard Till	4.9	59.0	119.4	7.3	7.6	***59.4***	59	18	0	15	33
521.70	2.50		37	Hard Till	4.9	86.8	172.7	7.3	11.2	***72.9***	73	21	0	19	35
519.20	2.50	6.85	27		24.7	135.2	197.4	36.6	17.4	***109.5***	109	34	0	26	38
516.70	2.50	6.85	27		24.7	135.2	188.1	36.6	17.4	***141.7***	142	48	0	30	40
514.20	2.50	5.13	30		24.7	101.3	212.8	36.6	13.0	***178.2***	178	61	0	37	43
511.70	2.50	5.13	30		24.7	101.3	***188.9***	36.6	13.0	208.5	189	75	0	29	45
509.20	2.50		15	Medium Sand	3.2	52.6	***192.1***	4.8	6.8	213.3	192	77	0	29	48
506.70	2.50		15	Medium Sand	3.2	52.6	***181.3***	4.8	6.8	216.3	181	79	0	21	50
504.20	2.50		11	Medium Sand	2.4	38.6	***183.7***	3.5	5.0	219.8	184	80	0	21	53
501.70	2.50		11	Medium Sand	2.4	38.6	***189.6***	3.5	5.0	223.8	190	81	0	23	55
499.20	2.50		12	Fine Sand	2.4	42.1	***192.0***	3.6	5.4	227.4	192	82	0	23	58
496.70	2.50		12	Fine Sand	2.4	42.1	341.9	3.6	5.4	***250.0***	250	82	0	55	60
495.70	1.00		54	Sandy Gravel	12.9	189.5	354.8	19.1	24.4	***269.1***	269	82	0	66	61
494.70	1.00		54	Sandy Gravel	12.9	189.5	367.6	19.1	24.4	***288.1***	288	82	0	76	62
493.70	1.00		54	Sandy Gravel	12.9	189.5	380.5	19.1	24.4	***307.2***	307	82	0	86	63
492.70	1.00		54	Sandy Gravel	12.9	189.5	393.4	19.1	24.4	***326.2***	326	82	0	97	64
491.70	1.00		54	Sandy Gravel	12.9	189.5	567.7	19.1	24.4	***366.1***	366	82	0	119	65
490.70	1.00		100	Medium Sand	19.6	351.0	587.3	29.0	45.2	***395.1***	395	82	0	135	66
489.70	1.00		100	Medium Sand	19.6	351.0	606.9	29.0	45.2	***424.1***	424	82	0	151	67
488.70	1.00		100	Medium Sand	19.6	351.0	626.5	29.0	45.2	***453.1***	453	82	0	167	68
487.70	1.00		100	Medium Sand	19.6	351.0	646.1	29.0	45.2	***482.2***	482	82	0	183	69
486.70	1.00		100	Medium Sand	19.6	351.0	578.0	29.0	45.2	***499.9***	500	82	0	192	70
485.70	1.00		100	Hard Till		263.2			33.9						

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. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
929 KIPS	**516** KIPS	**200** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	5.00	30		28.2		89.8	41.4		***51.4***	51	16	0	13	30
524.20	2.50		37	Hard Till	5.0	61.5	123.8	7.4	10.0	***63.5***	64	18	0	17	33
521.70	2.50		37	Hard Till	5.0	90.6	179.3	7.4	14.7	***79.1***	79	21	0	22	35
519.20	2.50	6.85	27		25.2	141.1	204.5	37.0	22.9	***116.1***	116	35	0	29	38
516.70	2.50	6.85	27		25.2	141.1	194.3	37.0	22.9	***147.3***	147	49	0	32	40
514.20	2.50	5.13	30		25.2	105.6	219.5	37.0	17.2	***184.3***	184	63	0	39	43
511.70	2.50	5.13	30		25.2	105.6	***194.0***	37.0	17.2	213.0	194	77	0	30	45
509.20	2.50		15	Medium Sand	3.3	54.9	***197.3***	4.9	8.9	217.9	197	78	0	30	48
506.70	2.50		15	Medium Sand	3.3	54.9	***186.0***	4.9	8.9	220.4	186	80	0	22	50
504.20	2.50		11	Medium Sand	2.4	40.3	***188.4***	3.6	6.5	224.0	188	81	0	22	53
501.70	2.50		11	Medium Sand	2.4	40.3	***194.5***	3.6	6.5	228.1	195	83	0	24	55
499.20	2.50		12	Fine Sand	2.5	43.9	***197.0***	3.7	7.1	231.8	197	84	0	24	58
496.70	2.50		12	Fine Sand	2.5	43.9	353.3	3.7	7.1	***260.4***	260	84	0	59	60
495.70	1.00		54	Sandy Gravel	13.1	197.7	366.4	19.3	32.1	***279.7***	280	84	0	70	61
494.70	1.00		54	Sandy Gravel	13.1	197.7	379.5	19.3	32.1	***299.0***	299	84	0	80	62
493.70	1.00		54	Sandy Gravel	13.1	197.7	392.7	19.3	32.1	***318.3***	318	84	0	91	63
492.70	1.00		54	Sandy Gravel	13.1	197.7	405.8	19.3	32.1	***337.6***	338	84	0	101	64
491.70	1.00		54	Sandy Gravel	13.1	197.7	587.3	19.3	32.1	***384.2***	384	84	0	127	65
490.70	1.00		100	Medium Sand	20.0	366.1	607.4	29.4	59.5	***413.6***	414	84	0	143	66
489.70	1.00		100	Medium Sand	20.0	366.1	627.4	29.4	59.5	***443.0***	443	84	0	159	67
488.70	1.00		100	Medium Sand	20.0	366.1	647.4	29.4	59.5	***472.3***	472	84	0	176	68
487.70	1.00		100	Medium Sand	20.0	366.1	667.4	29.4	59.5	***501.7***	502	84	0	192	69
486.70	1.00		100	Medium Sand	20.0	366.1	595.9	29.4	59.5	***516.2***	516	84	0	200	70
485.70	1.00		100	Hard Till		274.6			44.6						

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

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
248	30	53
Metal Shell 12"Φ w/.25" walls		
269	33	58
Metal Shell 14"Φ w/.25" walls		
325	44	58
Metal Shell 14"Φ w/.312" walls		
325	44	58
Steel HP 8 X 36		
263	98	70
Steel HP 10 X 42		
303	110	68
323	121	69

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
292	102	67
312	113	68
332	124	69
345	132	70
Steel HP 12 X 53		
315	105	66
339	118	67
363	131	68
387	144	69
404	154	70
Steel HP 12 X 63		
325	109	66
349	122	67
373	136	68
397	149	69
414	158	70
Steel HP 12 X 74		
332	112	66
356	126	67
380	139	68
405	152	69
420	161	70
Steel HP 12 X 84		
314	101	65
338	115	66
363	128	67
387	142	68
412	155	69
426	163	70

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
319	94	64
355	114	65
384	130	66
413	145	67
442	161	68
470	177	69
490	188	70
Steel HP 14 X 89		
326	97	64
366	119	65
395	135	66
424	151	67
453	167	68
482	183	69
500	192	70
Steel HP 14 X 102		
331	99	64
374	122	65
403	138	66
432	154	67
461	170	68
490	186	69
507	195	70
Steel HP 14 X 117		
338	101	64
384	127	65
414	143	66
443	159	67
472	176	68
502	192	69
516	200	70
Precast 14"x 14"		
187	79	30
Timber Pile		
128	8	40

Appendix G

Part – V

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE==========Pier 1 - Augered
REFERENCE BORING ==========B-2
LRFD or ASD or SEISMIC ==========LRFD
PILE CUTOFF ELEV. ==========556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==========ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
335 KIPS	**325** KIPS	**159** KIPS	**71** FT.

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		0.1	Medium Sand	0.0		0.1	0.0		***0.0***	0	0	0	0	28
526.10	2.50		0.1	Medium Sand	0.0	0.1	0.1	0.0	0.0	***0.0***	0	0	0	0	31
523.60	2.50		0.1	Medium Sand	0.0	0.1	0.2	0.0	0.0	***0.1***	0	0	0	0	33
521.10	2.50		0.1	Medium Sand	0.0	0.2	1.0	0.0	0.0	***0.2***	0	0	0	0	36
518.60	2.50	0.10	0.1		0.7	1.0	1.7	1.0	0.1	***1.2***	1	0	0	0	38
516.10	2.50	0.10	0.1		0.7	1.0	2.4	1.0	0.1	***2.2***	2	1	0	0	41
513.60	2.50	0.10	0.1		0.7	1.0	***3.1***	1.0	0.1	3.2	3	1	0	1	43
511.10	2.50	0.10	0.1		0.7	1.0	***3.8***	1.0	0.1	4.3	4	2	0	1	46
508.60	2.50	0.10	0.1		0.7	1.0	***3.6***	1.0	0.1	5.2	4	2	0	0	48
506.10	2.50		0.1	Very Fine Silty Sand	0.0	0.1	35.3	0.0	0.0	***9.2***	9	2	0	3	51
503.60	2.50		25	Very Fine Silty Sand	3.2	31.8	44.0	4.7	4.0	***14.6***	15	4	0	4	53
501.10	2.50		22	Fine Sand	3.1	37.3	47.1	4.6	4.7	***19.2***	19	5	0	5	56
498.60	2.50		22	Fine Sand	3.1	37.3	182.4	4.6	4.7	***40.5***	40	7	0	15	58
497.60	1.00		100	Sandy Gravel	23.1	169.5	205.6	34.0	21.5	***74.5***	75	20	0	21	59
496.60	1.00		100	Sandy Gravel	23.1	169.5	228.7	34.0	21.5	***108.6***	109	20	0	40	60
495.60	1.00		100	Sandy Gravel	23.1	169.5	251.8	34.0	21.5	***142.6***	143	20	0	59	61
494.60	1.00		100	Sandy Gravel	23.1	169.5	274.9	34.0	21.5	***176.7***	177	20	0	77	62
493.60	1.00		100	Sandy Gravel	23.1	169.5	***179.4***	34.0	21.5	195.7	179	20	0	79	63
491.10	2.50		30	Fine Sand	4.3	50.9	***183.7***	6.3	6.4	202.0	184	20	0	81	66
488.60	2.50		30	Fine Sand	4.3	50.9	306.6	6.3	6.4	***223.3***	223	20	0	103	68
487.60	1.00		100	Sandy Gravel	23.1	169.5	329.7	34.0	21.5	***257.3***	257	20	0	122	69
486.60	1.00		100	Sandy Gravel	23.1	169.5	352.8	34.0	21.5	***291.4***	291	20	0	140	70
485.60	1.00		100	Sandy Gravel	23.1	169.5	376.0	34.0	21.5	***325.4***	325	20	0	159	71
484.60	1.00		100	Sandy Gravel	23.1	169.5	399.1	34.0	21.5	***359.5***	~~359~~	~~20~~	~~0~~	~~178~~	~~72~~
483.60	1.00		100	Sandy Gravel	23.1	169.5	***379.8***	34.0	21.5	388.1	~~380~~	~~20~~	~~0~~	~~189~~	~~73~~
482.60	1.00		100	Hard Till		127.1			16.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== Pier 1 - Augered
REFERENCE BORING ========== B-2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
418 KIPS	**390** KIPS	**190** KIPS	**71** 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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		0.1	Medium Sand	0.0		0.1	0.0		***0.0***	0	0	0	0	28
526.10	2.50		0.1	Medium Sand	0.0	0.1	0.2	0.0	0.0	***0.1***	0	0	0	0	31
523.60	2.50		0.1	Medium Sand	0.0	0.1	0.2	0.0	0.0	***0.1***	0	0	0	0	33
521.10	2.50		0.1	Medium Sand	0.0	0.2	1.4	0.0	0.0	***0.2***	0	0	0	0	36
518.60	2.50	0.10	0.1		0.8	1.4	2.3	1.2	0.2	***1.5***	1	0	0	0	38
516.10	2.50	0.10	0.1		0.8	1.4	3.1	1.2	0.2	***2.7***	3	1	0	1	41
513.60	2.50	0.10	0.1		0.8	1.4	3.9	1.2	0.2	***3.9***	4	1	0	1	43
511.10	2.50	0.10	0.1		0.8	1.4	***4.8***	1.2	0.2	5.1	5	2	0	1	46
508.60	2.50	0.10	0.1		0.8	1.4	***4.4***	1.2	0.2	6.2	4	2	0	0	48
506.10	2.50		0.1	Very Fine Silty Sand	0.0	0.2	50.2	0.0	0.0	***11.2***	11	2	0	4	51
503.60	2.50		25	Very Fine Silty Sand	3.9	45.9	62.0	5.6	5.0	***17.7***	18	4	0	5	53
501.10	2.50		22	Fine Sand	3.7	53.9	65.7	5.5	5.9	***23.2***	23	6	0	6	56
498.60	2.50		22	Fine Sand	3.7	53.9	260.5	5.5	5.9	***49.5***	50	9	0	19	58
497.60	1.00		100	Sandy Gravel	27.8	245.0	288.3	40.6	26.8	***90.2***	90	24	0	26	59
496.60	1.00		100	Sandy Gravel	27.8	245.0	316.1	40.6	26.8	***130.8***	131	24	0	48	60
495.60	1.00		100	Sandy Gravel	27.8	245.0	343.9	40.6	26.8	***171.5***	171	24	0	70	61
494.60	1.00		100	Sandy Gravel	27.8	245.0	371.7	40.6	26.8	***212.1***	212	24	0	93	62
493.60	1.00		100	Sandy Gravel	27.8	245.0	***228.0***	40.6	26.8	234.0	228	24	0	102	63
491.10	2.50		30	Fine Sand	5.1	73.5	***233.2***	7.5	8.0	241.5	233	24	0	104	66
488.60	2.50		30	Fine Sand	5.1	73.5	409.8	7.5	8.0	***267.8***	268	24	0	123	68
487.60	1.00		100	Sandy Gravel	27.8	245.0	437.6	40.6	26.8	***308.4***	308	24	0	146	69
486.60	1.00		100	Sandy Gravel	27.8	245.0	465.4	40.6	26.8	***349.0***	349	24	0	168	70
485.60	1.00		100	Sandy Gravel	27.8	245.0	493.2	40.6	26.8	***389.7***	390	24	0	190	71
484.60	1.00		100	Sandy Gravel	27.8	245.0	521.0	40.6	26.8	***430.3***	~~430~~	~~*24*~~	~~*0*~~	~~*213*~~	~~*72*~~
483.60	1.00		100	Sandy Gravel	27.8	245.0	487.5	40.6	26.8	***464.3***	~~464~~	~~*24*~~	~~*0*~~	~~*232*~~	~~*73*~~
482.60	1.00		100	Hard Till		183.7			20.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE==========Pier 1 - Augered
REFERENCE BORING ==========B-2
LRFD or ASD or SEISMIC ==========LRFD
PILE CUTOFF ELEV. ==========556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==========ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
497 KIPS	**474** KIPS	**237** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		0.1	Medium Sand	0.0		0.1	0.0		***0.0***	0	0	0	0	28
526.10	2.50		0.1	Medium Sand	0.0	0.1	0.2	0.0	0.0	***0.1***	0	0	0	0	31
523.60	2.50		0.1	Medium Sand	0.0	0.1	0.3	0.0	0.0	***0.1***	0	0	0	0	33
521.10	2.50		0.1	Medium Sand	0.0	0.2	1.5	0.0	0.0	***0.3***	0	0	0	0	36
518.60	2.50	0.10	0.1		0.8	1.4	2.3	1.2	0.2	***1.5***	1	0	0	0	38
516.10	2.50	0.10	0.1		0.8	1.4	3.1	1.2	0.2	***2.7***	3	1	0	1	41
513.60	2.50	0.10	0.1		0.8	1.4	4.0	1.2	0.2	***4.0***	4	1	0	1	43
511.10	2.50	0.10	0.1		0.8	1.4	***4.8***	1.2	0.2	5.2	5	2	0	1	46
508.60	2.50	0.10	0.1		0.8	1.4	***4.4***	1.2	0.2	6.3	4	2	0	0	48
506.10	2.50		0.1	Very Fine Silty Sand	0.0	0.2	51.0	0.0	0.0	***12.2***	12	2	0	4	51
503.60	2.50		25	Very Fine Silty Sand	3.9	46.7	63.0	5.7	6.0	***19.0***	19	4	0	6	53
501.10	2.50		22	Fine Sand	3.8	54.8	66.7	5.5	7.0	***24.5***	25	7	0	7	56
498.60	2.50		22	Fine Sand	3.8	54.8	264.8	5.5	7.0	***54.9***	55	9	0	22	58
497.60	1.00		100	Sandy Gravel	28.0	249.1	292.8	41.2	31.8	***96.1***	96	24	0	29	59
496.60	1.00		100	Sandy Gravel	28.0	249.1	320.9	41.2	31.8	***137.4***	137	24	0	52	60
495.60	1.00		100	Sandy Gravel	28.0	249.1	348.9	41.2	31.8	***178.6***	179	24	0	74	61
494.60	1.00		100	Sandy Gravel	28.0	249.1	376.9	41.2	31.8	***219.8***	220	24	0	97	62
493.60	1.00		100	Sandy Gravel	28.0	249.1	***230.6***	41.2	31.8	238.7	231	24	0	103	63
491.10	2.50		30	Fine Sand	5.2	74.7	***235.7***	7.6	9.6	246.4	236	24	0	106	66
488.60	2.50		30	Fine Sand	5.2	74.7	415.3	7.6	9.6	***276.3***	276	24	0	128	68
487.60	1.00		100	Sandy Gravel	28.0	249.1	443.3	41.2	31.8	***317.5***	317	24	0	151	69
486.60	1.00		100	Sandy Gravel	28.0	249.1	471.4	41.2	31.8	***358.7***	359	24	0	173	70
485.60	1.00		100	Sandy Gravel	28.0	249.1	499.4	41.2	31.8	***399.9***	400	24	0	196	71
484.60	1.00		100	Sandy Gravel	28.0	249.1	527.4	41.2	31.8	***441.2***	441	24	0	219	72
483.60	1.00		100	Sandy Gravel	28.0	249.1	493.2	41.2	31.8	***474.4***	474	24	0	237	73
482.60	1.00		100	Hard Till		186.8			23.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== Pier 1 - Augered
REFERENCE BORING ========== B-2
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
578 KIPS	**562** KIPS	**281** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
528.60	0.90		0.1	Medium Sand	0.0		0.1	0.0		***0.0***	0	0	0	0	28
526.10	2.50		0.1	Medium Sand	0.0	0.1	0.2	0.0	0.0	***0.1***	0	0	0	0	31
523.60	2.50		0.1	Medium Sand	0.0	0.2	0.3	0.0	0.0	***0.1***	0	0	0	0	33
521.10	2.50		0.1	Medium Sand	0.0	0.2	2.0	0.0	0.0	***0.3***	0	0	0	0	36
518.60	2.50	0.10	0.1		1.0	1.9	3.0	1.5	0.2	***1.8***	2	1	0	0	38
516.10	2.50	0.10	0.1		1.0	1.9	4.0	1.5	0.2	***3.2***	3	1	0	1	41
513.60	2.50	0.10	0.1		1.0	1.9	4.9	1.5	0.2	***4.7***	5	2	0	1	43
511.10	2.50	0.10	0.1		1.0	1.9	***5.9***	1.5	0.2	6.1	6	2	0	1	46
508.60	2.50	0.10	0.1		1.0	1.9	***5.2***	1.5	0.2	7.4	5	3	0	0	48
506.10	2.50		0.1	Very Fine Silty Sand	0.0	0.3	69.4	0.0	0.0	***14.4***	14	3	0	5	51
503.60	2.50		25	Very Fine Silty Sand	4.6	64.4	85.1	6.8	6.9	***22.3***	22	5	0	7	53
501.10	2.50		22	Fine Sand	4.4	75.6	89.6	6.6	8.1	***28.9***	29	8	0	8	56
498.60	2.50		22	Fine Sand	4.4	75.6	362.0	6.6	8.1	***64.4***	64	10	0	25	58
497.60	1.00		100	Sandy Gravel	32.9	343.5	394.9	48.9	37.0	***113.2***	113	28	0	34	59
496.60	1.00		100	Sandy Gravel	32.9	343.5	427.8	48.9	37.0	***162.1***	162	28	0	61	60
495.60	1.00		100	Sandy Gravel	32.9	343.5	460.8	48.9	37.0	***211.0***	211	28	0	88	61
494.60	1.00		100	Sandy Gravel	32.9	343.5	493.7	48.9	37.0	***259.9***	260	28	0	115	62
493.60	1.00		100	Sandy Gravel	32.9	343.5	286.2	48.9	37.0	***282.8***	283	28	0	127	63
491.10	2.50		30	Fine Sand	6.1	103.1	292.2	9.0	11.1	***291.9***	292	28	0	132	66
488.60	2.50		30	Fine Sand	6.1	103.1	538.8	9.0	11.1	***326.8***	327	28	0	151	68
487.60	1.00		100	Sandy Gravel	32.9	343.5	571.7	48.9	37.0	***375.7***	376	28	0	178	69
486.60	1.00		100	Sandy Gravel	32.9	343.5	604.7	48.9	37.0	***424.5***	425	28	0	205	70
485.60	1.00		100	Sandy Gravel	32.9	343.5	637.6	48.9	37.0	***473.4***	473	28	0	232	71
484.60	1.00		100	Sandy Gravel	32.9	343.5	670.5	48.9	37.0	***522.3***	522	28	0	259	72
483.60	1.00		100	Sandy Gravel	32.9	343.5	617.6	48.9	37.0	***561.9***	562	28	0	281	73
482.60	1.00		100	Hard Till		257.7			27.8						

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

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
145	60	56
Metal Shell 12"Φ w/.25" walls		
145	60	56
Metal Shell 14"Φ w/.25" walls		
190	81	56
Metal Shell 14"Φ w/.312" walls		
190	81	56
Steel HP 8 X 36		
235	113	70
262	128	71
Steel HP 10 X 42		
223	103	68
257	122	69
291	140	70
325	159	71

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
232	107	68
266	126	69
300	145	70
335	164	71
369	183	72
390	194	73
Steel HP 12 X 53		
233	104	66
268	123	68
308	146	69
349	168	70
390	190	71
Steel HP 12 X 63		
236	106	66
276	128	68
317	151	69
359	173	70
400	196	71
441	219	72
474	237	73
Steel HP 12 X 74		
240	107	66
283	131	68
325	154	69
366	177	70
407	200	71
449	222	72
481	240	73
Steel HP 12 X 84		
244	109	66
289	135	68
331	157	69
373	180	70
414	203	71
456	226	72
487	243	73

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
211	88	61
260	115	62
283	127	63
292	132	66
327	151	68
376	178	69
425	205	70
473	232	71
522	259	72
562	281	73
Steel HP 14 X 89		
221	93	61
270	120	62
288	130	63
296	135	66
337	157	68
387	184	69
436	211	70
485	238	71
534	265	72
572	286	73
Steel HP 14 X 102		
228	97	61
277	124	62
291	131	63
300	136	66
345	161	68
395	188	69
444	215	70
494	243	71
543	270	72
579	290	73
Steel HP 14 X 117		
237	101	61
287	129	62
295	133	63
304	138	66
355	166	68
405	194	69
455	221	70
505	248	71
555	276	72
590	295	73
Precast 14"x 14"		
242	104	56
Timber Pile		
73	20	56

Appendix G

Part - VI

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT — Modified 10/18/2011

SUBSTRUCTURE========== Pier 2 - Augered
REFERENCE BORING ========== B-3
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
335 KIPS	**195** KIPS	**103** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	0.10	0.1		0.8		***0.9***	1.1		1.1	1	0	0	0	30
524.20	2.50		0.1	Hard Till	0.0	0.1	***0.9***	0.0	0.0	1.2	1	0	0	0	33
521.70	2.50		0.1	Hard Till	0.0	0.1	1.7	0.0	0.0	***1.3***	1	0	0	0	35
519.20	2.50	0.10	0.1		0.7	1.0	2.4	1.0	0.1	***2.3***	2	1	0	0	38
516.70	2.50	0.10	0.1		0.7	1.0	***3.1***	1.0	0.1	3.3	3	1	0	1	40
514.20	2.50	0.10	0.1		0.7	1.0	***3.8***	1.0	0.1	4.3	4	2	0	1	43
511.70	2.50	0.10	0.1		0.7	1.0	***3.7***	1.0	0.1	5.2	4	2	0	0	45
509.20	2.50		0.1	Medium Sand	0.0	0.2	***3.7***	0.0	0.0	5.3	4	2	0	0	48
506.70	2.50		0.1	Medium Sand	0.0	0.2	***3.7***	0.0	0.0	5.3	4	2	0	0	50
504.20	2.50		0.1	Medium Sand	0.0	0.2	22.2	0.0	0.0	***7.6***	8	2	0	2	53
501.70	2.50		11	Medium Sand	1.7	18.6	25.6	2.4	2.4	***10.3***	10	3	0	3	55
499.20	2.50		12	Fine Sand	1.7	20.3	27.3	2.5	2.6	***12.8***	13	4	0	3	58
496.70	2.50		12	Fine Sand	1.7	20.3	100.2	2.5	2.6	***24.3***	24	4	0	10	60
495.70	1.00		54	Sandy Gravel	8.9	91.5	109.1	13.2	11.6	***37.5***	37	4	0	17	61
494.70	1.00		54	Sandy Gravel	8.9	91.5	118.0	13.2	11.6	***50.6***	51	4	0	24	62
493.70	1.00		54	Sandy Gravel	8.9	91.5	127.0	13.2	11.6	***63.8***	64	4	0	31	63
492.70	1.00		54	Sandy Gravel	8.9	91.5	135.9	13.2	11.6	***76.9***	77	4	0	39	64
491.70	1.00		54	Sandy Gravel	8.9	91.5	222.8	13.2	11.6	***100.0***	100	4	0	51	65
490.70	1.00		100	Medium Sand	13.6	169.5	236.5	20.0	21.5	***120.0***	120	4	0	62	66
489.70	1.00		100	Medium Sand	13.6	169.5	250.1	20.0	21.5	***140.1***	140	4	0	73	67
488.70	1.00		100	Medium Sand	13.6	169.5	263.7	20.0	21.5	***160.1***	160	4	0	84	68
487.70	1.00		100	Medium Sand	13.6	169.5	277.3	20.0	21.5	***180.2***	180	4	0	95	69
486.70	1.00		100	Medium Sand	13.6	169.5	248.6	20.0	21.5	***194.9***	195	4	0	103	70
485.70	1.00		100	Hard Till		127.1			16.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== Pier 2 - Augered
REFERENCE BORING ========== B-3
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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
418 KIPS	**234** KIPS	**124** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	0.10	0.1		0.9		***1.1***	1.4		1.4	1	1	0	0	30
524.20	2.50		0.1	Hard Till	0.0	0.1	***1.1***	0.0	0.0	1.4	1	1	0	0	33
521.70	2.50		0.1	Hard Till	0.0	0.2	2.3	0.0	0.0	***1.5***	2	1	0	0	35
519.20	2.50	0.10	0.1		0.8	1.4	3.2	1.2	0.2	***2.7***	3	1	0	1	38
516.70	2.50	0.10	0.1		0.8	1.4	4.0	1.2	0.2	***4.0***	4	1	0	1	40
514.20	2.50	0.10	0.1		0.8	1.4	***4.8***	1.2	0.2	5.2	5	2	0	1	43
511.70	2.50	0.10	0.1		0.8	1.4	***4.5***	1.2	0.2	6.3	5	2	0	0	45
509.20	2.50		0.1	Medium Sand	0.0	0.2	***4.5***	0.0	0.0	6.3	5	2	0	0	48
506.70	2.50		0.1	Medium Sand	0.0	0.2	***4.5***	0.0	0.0	6.3	5	2	0	0	50
504.20	2.50		0.1	Medium Sand	0.0	0.2	31.3	0.0	0.0	***9.3***	9	2	0	3	53
501.70	2.50		11	Medium Sand	2.0	26.9	35.7	2.9	2.9	***12.4***	12	3	0	3	55
499.20	2.50		12	Fine Sand	2.0	29.4	37.7	3.0	3.2	***15.4***	15	5	0	4	58
496.70	2.50		12	Fine Sand	2.0	29.4	142.7	3.0	3.2	***29.7***	30	5	0	12	60
495.70	1.00		54	Sandy Gravel	10.7	132.3	153.4	15.7	14.5	***45.4***	45	5	0	20	61
494.70	1.00		54	Sandy Gravel	10.7	132.3	164.2	15.7	14.5	***61.1***	61	5	0	29	62
493.70	1.00		54	Sandy Gravel	10.7	132.3	174.9	15.7	14.5	***76.8***	77	5	0	38	63
492.70	1.00		54	Sandy Gravel	10.7	132.3	185.7	15.7	14.5	***92.5***	93	5	0	46	64
491.70	1.00		54	Sandy Gravel	10.7	132.3	309.1	15.7	14.5	***120.6***	121	5	0	62	65
490.70	1.00		100	Medium Sand	16.4	245.0	325.5	23.9	26.8	***144.5***	144	5	0	75	66
489.70	1.00		100	Medium Sand	16.4	245.0	341.8	23.9	26.8	***168.4***	168	5	0	88	67
488.70	1.00		100	Medium Sand	16.4	245.0	358.2	23.9	26.8	***192.4***	192	5	0	101	68
487.70	1.00		100	Medium Sand	16.4	245.0	374.6	23.9	26.8	***216.3***	216	5	0	114	69
486.70	1.00		100	Medium Sand	16.4	245.0	329.7	23.9	26.8	***233.5***	234	5	0	124	70
485.70	1.00		100	Hard Till		183.7			20.1						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE==========Pier 2 - Augered
REFERENCE BORING ==========B-3
LRFD or ASD or SEISMIC ==========LRFD
PILE CUTOFF ELEV. ==========556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==========ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
497 KIPS	**240** KIPS	**128** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	0.10	0.1		0.9		***1.1***	1.4		1.4	1	1	0	0	30
524.20	2.50		0.1	Hard Till	0.0	0.1	***1.1***	0.0	0.0	1.4	1	1	0	0	33
521.70	2.50		0.1	Hard Till	0.0	0.2	2.4	0.0	0.0	***1.6***	2	1	0	0	35
519.20	2.50	0.10	0.1		0.8	1.4	3.2	1.2	0.2	***2.8***	3	1	0	1	38
516.70	2.50	0.10	0.1		0.8	1.4	***4.0***	1.2	0.2	4.0	4	1	0	1	40
514.20	2.50	0.10	0.1		0.8	1.4	***4.9***	1.2	0.2	5.3	5	2	0	1	43
511.70	2.50	0.10	0.1		0.8	1.4	***4.5***	1.2	0.2	6.4	5	2	0	0	45
509.20	2.50		0.1	Medium Sand	0.0	0.2	***4.6***	0.0	0.0	6.4	5	2	0	0	48
506.70	2.50		0.1	Medium Sand	0.0	0.2	***4.6***	0.0	0.0	6.4	5	2	0	0	50
504.20	2.50		0.1	Medium Sand	0.0	0.2	31.8	0.0	0.0	***9.9***	10	2	0	3	53
501.70	2.50		11	Medium Sand	2.0	27.4	36.3	2.9	3.5	***13.2***	13	3	0	4	55
499.20	2.50		12	Fine Sand	2.1	29.9	38.3	3.0	3.8	***16.2***	16	5	0	4	58
496.70	2.50		12	Fine Sand	2.1	29.9	145.0	3.0	3.8	***32.6***	33	5	0	13	60
495.70	1.00		54	Sandy Gravel	10.8	134.5	155.8	15.9	17.2	***48.5***	49	5	0	22	61
494.70	1.00		54	Sandy Gravel	10.8	134.5	166.7	15.9	17.2	***64.5***	64	5	0	31	62
493.70	1.00		54	Sandy Gravel	10.8	134.5	177.5	15.9	17.2	***80.4***	80	5	0	40	63
492.70	1.00		54	Sandy Gravel	10.8	134.5	188.3	15.9	17.2	***96.3***	96	5	0	48	64
491.70	1.00		54	Sandy Gravel	10.8	134.5	313.8	15.9	17.2	***126.9***	127	5	0	65	65
490.70	1.00		100	Medium Sand	16.5	249.1	330.3	24.3	31.8	***151.2***	151	5	0	79	66
489.70	1.00		100	Medium Sand	16.5	249.1	346.8	24.3	31.8	***175.5***	175	5	0	92	67
488.70	1.00		100	Medium Sand	16.5	249.1	363.3	24.3	31.8	***199.8***	200	5	0	105	68
487.70	1.00		100	Medium Sand	16.5	249.1	379.8	24.3	31.8	***224.0***	224	5	0	119	69
486.70	1.00		100	Medium Sand	16.5	249.1	334.0	24.3	31.8	***240.4***	240	5	0	128	70
485.70	1.00		100	Hard Till		186.8			23.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE========== Pier 2 - Augered
REFERENCE BORING ========== B-3
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 556.98 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DR 529.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 496.85 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ==========ft

TOTAL FACTORED SUBSTRUCTURE LOAD ======== 1327 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 ===== 301.85 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 113.19 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.

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
578 KIPS	**284** KIPS	**151** KIPS	*** Below Boring

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 SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	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.)
526.70	2.80	0.10	0.1		1.1		***1.3***	1.6		1.6	1	1	0	0	30
524.20	2.50		0.1	Hard Till	0.0	0.2	***1.3***	0.0	0.0	1.7	1	1	0	0	33
521.70	2.50		0.1	Hard Till	0.0	0.2	3.1	0.0	0.0	***1.9***	2	1	0	0	35
519.20	2.50	0.10	0.1		1.0	1.9	4.0	1.5	0.2	***3.3***	3	1	0	1	38
516.70	2.50	0.10	0.1		1.0	1.9	5.0	1.5	0.2	***4.8***	5	2	0	1	40
514.20	2.50	0.10	0.1		1.0	1.9	***6.0***	1.5	0.2	6.2	6	2	0	1	43
511.70	2.50	0.10	0.1		1.0	1.9	***5.4***	1.5	0.2	7.5	5	3	0	0	45
509.20	2.50		0.1	Medium Sand	0.0	0.3	***5.4***	0.0	0.0	7.6	5	3	0	0	48
506.70	2.50		0.1	Medium Sand	0.0	0.3	***5.4***	0.0	0.0	7.6	5	3	0	0	50
504.20	2.50		0.1	Medium Sand	0.0	0.3	42.9	0.0	0.0	***11.7***	12	3	0	4	53
501.70	2.50		11	Medium Sand	2.4	37.8	48.7	3.5	4.1	***15.5***	16	4	0	4	55
499.20	2.50		12	Fine Sand	2.4	41.2	51.1	3.6	4.4	***19.1***	19	5	0	5	58
496.70	2.50		12	Fine Sand	2.4	41.2	197.8	3.6	4.4	***38.2***	38	5	0	16	60
495.70	1.00		54	Sandy Gravel	12.7	185.5	210.5	18.9	20.0	***57.1***	57	5	0	26	61
494.70	1.00		54	Sandy Gravel	12.7	185.5	223.3	18.9	20.0	***76.0***	76	5	0	36	62
493.70	1.00		54	Sandy Gravel	12.7	185.5	236.0	18.9	20.0	***94.9***	95	5	0	47	63
492.70	1.00		54	Sandy Gravel	12.7	185.5	248.7	18.9	20.0	***113.8***	114	5	0	57	64
491.70	1.00		54	Sandy Gravel	12.7	185.5	419.5	18.9	20.0	***149.8***	150	5	0	77	65
490.70	1.00		100	Medium Sand	19.4	343.5	438.9	28.8	37.0	***178.5***	179	5	0	93	66
489.70	1.00		100	Medium Sand	19.4	343.5	458.3	28.8	37.0	***207.3***	207	5	0	109	67
488.70	1.00		100	Medium Sand	19.4	343.5	477.7	28.8	37.0	***236.1***	236	5	0	124	68
487.70	1.00		100	Medium Sand	19.4	343.5	497.1	28.8	37.0	***264.9***	265	5	0	140	69
486.70	1.00		100	Medium Sand	19.4	343.5	430.6	28.8	37.0	***284.4***	284	5	0	151	70
485.70	1.00		100	Hard Till		257.7			27.8						

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

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
248	30	53
Metal Shell 12"Φ w/.25" walls		
269	33	58
Metal Shell 14"Φ w/.25" walls		
325	44	58
Metal Shell 14"Φ w/.312" walls		
325	44	58
Steel HP 8 X 36		
263	98	70
Steel HP 10 X 42		
303	110	68
323	121	69

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
292	102	67
312	113	68
332	124	69
345	132	70
Steel HP 12 X 53		
315	105	66
339	118	67
363	131	68
387	144	69
404	154	70
Steel HP 12 X 63		
325	109	66
349	122	67
373	136	68
397	149	69
414	158	70
Steel HP 12 X 74		
332	112	66
356	126	67
380	139	68
405	152	69
420	161	70
Steel HP 12 X 84		
314	101	65
338	115	66
363	128	67
387	142	68
412	155	69
426	163	70

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
319	94	64
355	114	65
384	130	66
413	145	67
442	161	68
470	177	69
490	188	70
Steel HP 14 X 89		
326	97	64
366	119	65
395	135	66
424	151	67
453	167	68
482	183	69
500	192	70
Steel HP 14 X 102		
331	99	64
374	122	65
403	138	66
432	154	67
461	170	68
490	186	69
507	195	70
Steel HP 14 X 117		
338	101	64
384	127	65
414	143	66
443	159	67
472	176	68
502	192	69
516	200	70
Precast 14"x 14"		
187	79	30
Timber Pile		
128	8	40

Appendix H

TERRA ENGINEERING LTD.

COMMUNICATION RECORD

DATE/TIME: February 7, 2013

PROJECT: SN 072-0231 IL 8 over West Fork of Kickapoo Creek (TERRA#09-164 WO5)

PARTICIPANTS: Paul Guthrie – IDOT Foundation Geotechnical Unit
Lindsey Ford – TERRA Engineering

MEANS:

- ☐ Personal Visit
- ☐ Group Meeting
- ☐ Voice Mail
- ☒ Telephone Conversation

REMARKS: Mr. Paul Guthrie called regarding the revised Structure Geotechnical Report submitted to IDOT with a revised date of 2/7/13. He requested that the following items be revised:

1. In Section 4.0 Construction Considerations of the report Mr. Guthrie asked that ABD Memo 11.2 be referenced in the following statement:
   "If Drilled Shaft foundation is chosen for the piers, a cofferdam is not necessary as long as permanent casing or removable forms are used to construct the foundation."

2. Under Tables 3.6.5 and 3.6.6 in the report there is a note that states the following:
   "Note: A core to depth of 3 times the diameter below the tip is needed for final design"
   Mr. Guthrie said that the Foundation Geotechnical Unit (FGU) believes that the rock cores taken at this site are deep enough for Drilled Shaft design. He asked that a statement similar to the following be added to the report "After speaking with FGU it was decided that additional borings are not needed for further drilled shaft design".

Mr. Guthrie said that if TERRA wanted to discuss this further we could contact Brad Hessing directly at 217-782-2704. He said that Mr. Hessing is the person requesting the changes.

Lindsey Ford, EI
Project Engineer
TERRA Engineering, Ltd.

CC:

Lindsey Ford

From: Guthrie, Paul S [Paul.Guthrie@illinois.gov]
Sent: Wednesday, February 13, 2013 6:54 AM
To: 'Lindsey Ford'
Subject: RE: SN 072-0231 IL 8 over West Fork of Kickapoo Creek

Due to the quality of the shale shown in the borings, we (FGU) do not feel it is necessary to get additional rock cores for drilled shaft design.

From: Lindsey Ford [mailto:lford@terraengineering.com]
Sent: Monday, February 11, 2013 1:49 PM
To: Guthrie, Paul S
Cc: dbell@terraengineering.com
Subject: RE: SN 072-0231 IL 8 over West Fork of Kickapoo Creek

Paul,

Per our phone conversation last week you asked that we revise the following items:

1. Revise Section 4.0 Construction Considerations to reference ABD Memo 11.2
2. Revise the note below Table 3.6.5 and Table 3.6.6 that states "A core to depth of 3 times the diameter below the tip is needed for final design". You mentioned in our phone conversation that it would be ok to state that the IDOT Structure Geotechnical Unit made the decision that additional borings/rock cores are not needed for further drilled shaft design.

Our responses are as follows:

1. Below is a revised paragraph for Section 4.0

4.0 CONSTRUCTION CONSIDERATIONS

Traffic will be detoured during the removal and replacement of the structure. The Estimated Water Surface Elevation (EWSE) is 536.4 ft. The elevation at the bottom of Pier 1 and Pier 2 is 529.5 ft. The difference between the EWSE elevation and bottom of pier elevation is greater than 6.0 ft., therefore Type 2 cofferdams are necessary for the construction of this structure if H-Pile foundation is used. Due to the sandy nature of the material at the elevation at the bottom of the proposed piers a seal coat should be used for the construction of both piers if a cofferdam is built. If Drilled Shaft foundation is chosen for the piers, a cofferdam is not necessary (see All Bridge Designers Memo 11.2 dated August 8, 2011). 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.

2. Can we get something in writing from IDOT stating the same thing we spoke about on the phone? We would like to include the written statement in the report so there is no confusion as to how the decision was made in future phases of design.

Let me know if you have any questions.

Thanks,

Lindsey Ford, E.I.
Project Engineer
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From: Lindsey Ford [mailto:lford@terraengineering.com]
Sent: Thursday, February 07, 2013 12:04 PM
To: 'Guthrie, Paul S'
Cc: 'dbell@terraengineering.com'; 'Matthew J. Joost'
Subject: RE: SN 072-0231 IL 8 over West Fork of Kickapoo Creek

Paul,

Please find attached the revised SGR for IL 8 over West Fork of Kickapoo Creek as requested. Let me know if you need anything else.

Thanks,

Lindsey Ford, E.I.
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From: Guthrie, Paul S [mailto:Paul.Guthrie@illinois.gov]
Sent: Thursday, February 07, 2013 11:43 AM
To: 'Lindsey Ford'
Subject: RE: SN 072-0231 IL 8 over West Fork of Kickapoo Creek

Looks good. Would you please send me the revised SGR with the original date & the revised date on the cover page? Thanks

---

From: Lindsey Ford [mailto:lford@terraengineering.com]
Sent: Thursday, February 07, 2013 11:29 AM
To: Guthrie, Paul S
Cc: dbell@terraengineering.com
Subject: SN 072-0231 IL 8 over West Fork of Kickapoo Creek

Paul,

I apologize for not getting this to you yesterday. We are proposing the following revised verbiage for section 4.0 of the SGR for IL 8 over West Fork of Kickapoo Creek (SN 072-0231):

5.0 CONSTRUCTION CONSIDERATIONS

Traffic will be detoured during the removal and replacement of the structure. The Estimated Water Surface Elevation (EWSE) is 536.4 ft. The elevation at the bottom of Pier 1 and Pier 2 is 529.5 ft. The difference between the EWSE elevation and bottom of pier elevation is greater than 6.0 ft., therefore Type 2 cofferdams are necessary for the construction of this structure if H-Pile foundation is used. Due to the sandy nature of the material at the elevation at the bottom of the proposed piers a seal coat should be used for the construction of both piers if a cofferdam is built. If Drilled Shaft foundation is chosen for the piers, a cofferdam is not necessary as long as permanent casing or removable forms are used to construct the foundation. 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.

Please let us know if you have any comments or if we should submit a full report with the above paragraph incorporated.

Thanks,

Lindsey Ford, E.I.
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Appendix I

Boring Information

Boring Number: B-2 (Pier 1)
Rock Type: Shale
Rock Core Data:

Core Run #	Start Depth	Recovery (%)	RQD (%)	Comp. Strength (tsf)
1	65	95.0%	75.0%	
	68.5			206.1
	71.5			154.8
2	75	100.0%	80.0%	
END	80			

Side Resistance Calculation (AASHTO LRFD Bridge Design Specification Manual)

Step 1:

Select E_m/E_i from Table C10.4.5.5-1 (Pg 10-26)

Lowest RQD: 75.0%

E_m/E_i for Closed Joints: 0.7

E_m/E_i for Open Joints: 0.1

Step 2:

Select reduction factor, α_E, from Table 10.8.3.5.4b-1 (Pg 10-137)

α_E for Closed Joints: 0.88 (use linear interpolation)

α_E for Open Joints: 0.55

Step 3:

Calculate resistance, q_s, from Equation 10.8.3.5.4b-1 (Pg 10-137)

$q_s = 0.65*\alpha_E*p_a*(q_u/p_a)^{0.5} < 7.8*p_a*(f'_c/p_a)^{0.5}$

Calculate concrete shear strength = $7.8*p_a*(f'_c/p_a)^{0.5}$

Assume f'_c = 3000 psi = 3 ksi

p_a = 2.12 ksf (given on Pg 10-137)

Concrete shear strength = 19.67 ksf

Calculate $q_s = 0.65*\alpha_E*p_a*(q_u/p_a)^{0.5}$

average q_u = 180.45 tsf = 360.9 ksf

q_s for Closed Joints:	15.82	ksf	<	19.67	ksf	so use q_s =	15.82 ksf
q_s for Open Joints:	9.89	ksf	<	19.67	ksf	so use q_s =	9.89 ksf

Boring Information

Boring Number: B-2 (Pier 1)
Rock Type: Shale
Rock Core Data:

Core Run #	Start Depth	Recovery (%)	RQD (%)	Comp. Strength (tsf)
1	65	95.0%	75.0%	
	68.5			206.1
	71.5			154.8
2	75	100.0%	80.0%	
END	80			

End Bearing Calculation (AASHTO LRFD Bridge Design Specification Manual)

Method #1: For tightly jointed rock up to a depth of 2.0B below shaft base and socket depth > 1.5B, then:

$q_p = 2.5*q_u$ Equation 10.8.3.5.4c-1 (Pg 10-138)

Average q_u = 180.45 tsf = 360.9 ksf

q_p = 902.25 ksf

Method #2: For jointed rock up to a depth of 2.0B below shaft base, then:

$q_p = [s^{0.5}+(m*s^{0.5}+s)^{0.5}]*q_u$ Equation 10.8.3.5.4c-2 (Pg 10-138)

Determine Rock Mass Rating (RMR) from Table 10.4.6.4-1

Step1: Average strength from core log = 180.45 tsf = 360.9 ksf
Relative Rating: 4

Step 2: Average RQD from core log = 77.5%
Relative Rating: 17

Step 3: Spacing of joints = 2 in - 1 ft
Relative Rating: 10

Step 4: Condition of joints = assume slightly rough
Relative Rating: 12

Step 5: Groundwater conditions = assume moist only
Relative Rating: 7

RMR Rating = 50

Rock Class Number and Description from Table 10.4.6.4-3 (Pg 10-23)

Class No.: III
Description: Fair Rock

Obtain s & m values from Table 10.4.6.4-4 (Pg 10-24)

Rock Type: B (Shale) m= 0.183
Description: Fair Rock s= 0.00009

Average q_u = 180.45 tsf = 360.9 ksf

Plug values into equation $q_p = [s^{0.5}+(m*s^{0.5}+s)^{0.5}]*q_u$

q_p = 18.8 ksf

Boring Information

Boring Number: B-3 (Pier 2) at Elevation 479.7 ft

Rock Type: Shale

Rock Core Data:

Core Run #	Start Depth	Recovery (%)	RQD (%)	Comp. Strength (tsf)
1	81	98.0%	88.0%	
	86			95.2
	90.5			38.9
2	91	100.0%	100.0%	
	93			74.9
	95.5			40.3
END	96			

Side Resistance Calculation (AASHTO LRFD Bridge Design Specification Manual)

Step 1:

Select E_m/E_i from Table C10.4.5.5-1 (Pg 10-26)

Lowest RQD: 88.0%

E_m/E_i for Closed Joints: 0.88 (use linear interpolation)

E_m/E_i for Open Joints: 0.30 (use linear interpolation)

Step 2:

Select reduction factor, α_E, from Table 10.8.3.5.4b-1 (Pg 10-137)

α_E for Closed Joints: 0.95 (use linear interpolation)

α_E for Open Joints: 0.7

Step 3:

Calculate resistance, q_s, from Equation 10.8.3.5.4b-1 (Pg 10-137)

$q_s = 0.65*\alpha_E*p_a*(q_u/p_a)^{0.5} < 7.8*p_a*(f'_c/p_a)^{0.5}$

Calculate concrete shear strength = $7.8*p_a*(f'_c/p_a)^{0.5}$

Assume f'_c = 3000 psi = 3 ksi

p_a = 2.12 ksf (given on Pg 10-137)

Concrete shear strength = 19.67 ksf

Calculate $q_s = 0.65*\alpha_E*p_a*(q_u/p_a)^{0.5}$

Average q_u = 67.05 tsf = 134.1 ksf

q_s for Closed Joints:	10.41	ksf	<	19.67	ksf	so use q_s = 10.41 ksf
q_s for Open Joints:	7.67	ksf	<	19.67	ksf	so use q_s = 7.67 ksf

Boring Information

Boring Number: B-3 (Pier 2) at Elevation 479.7 ft
Rock Type: Shale
Rock Core Data:

Core Run #	Start Depth	Recovery (%)	RQD (%)	Comp. Strength (tsf)
1	81	98.0%	88.0%	
	86			95.2
	90.5			38.9
2	91	100.0%	100.0%	
	93			74.9
	95.5			40.3
END	96			

End Bearing Calculation (AASHTO LRFD Bridge Design Specification Manual)

Method #1: For tightly jointed rock up to a depth of 2.0B below shaft base and socket depth > 1.5B, then:

$q_p = 2.5*q_u$ Equation 10.8.3.5.4c-1 (Pg 10-138)

Average q_u = tsf = 134.1 ksf

q_p = 335.25 ksf

Method #2: For jointed rock up to a depth of 2.0B below shaft base, then:

$q_p = [s^{0.5}+(m*s^{0.5}+s)^{0.5}]*q_u$ Equation 10.8.3.5.4c-2 (Pg 10-138)

Determine Rock Mass Rating (RMR) from Table 10.4.6.4-1

Step1: Average strength from core run 1 = 67.05 tsf = 134.1 ksf
Relative Rating: 1
Step 2: Average RQD from core log = 94.0%
Relative Rating: 20
Step 3: Spacing of joints = 2in - 1 ft
Relative Rating: 10
Step 4: Condition of joints = assume slightly rough
Relative Rating: 12
Step 5: Groundwater conditions = assume moist only
Relative Rating: 7

RMR Rating = 50

Rock Class Number and Description from Table 10.4.6.4-3 (Pg 10-23)

Class No.: III
Description: Fair Rock

Obtain s & m values from Table 10.4.6.4-4 (Pg 10-24)

Rock Type: B (Shale) m= 0.183
Description: Fair Rock s= 0.00009

Average q_u = 67.05 tsf = 134.1 ksf

Plug values into equation $q_p = [s^{0.5}+(m*s^{0.5}+s)^{0.5}]*q_u$

q_p = 7.0 ksf

Boring Information

Boring Number: B-3 (Pier 2) at Elevation 469.7 ft

Rock Type: Shale

Rock Core Data:

Core Run #	Start Depth	Recovery (%)	RQD (%)	Comp. Strength (tsf)
1	81	98.0%	88.0%	
	86			95.2
	90.5			38.9
2	91	100.0%	100.0%	
	93			74.9
	95.5			40.3
END	96			

Side Resistance Calculation (AASHTO LRFD Bridge Design Specification Manual)

Step 1:

Select E_m/E_i from Table C10.4.5.5-1 (Pg 10-26)

Lowest RQD: 100.0%

E_m/E_i for Closed Joints: 1 (use linear interpolation)

E_m/E_i for Open Joints: 0.60 (use linear interpolation)

Step 2:

Select reduction factor, α_E, from Table 10.8.3.5.4b-1 (Pg 10-137)

α_E for Closed Joints: 1 (use linear interpolation)

α_E for Open Joints: 0.84

Step 3:

Calculate resistance, q_s, from Equation 10.8.3.5.4b-1 (Pg 10-137)

$q_s = 0.65*\alpha_E*p_a*(q_u/p_a)^{0.5} < 7.8*p_a*(f'_c/p_a)^{0.5}$

Calculate concrete shear strength = $7.8*p_a*(f'_c/p_a)^{0.5}$

Assume f'_c = 3000 psi = 3 ksi

p_a = 2.12 ksf (given on Pg 10-137)

Concrete shear strength = 19.67 ksf

Calculate $q_s = 0.65*\alpha_E*p_a*(q_u/p_a)^{0.5}$

Average q_u = 57.6 tsf = 115.2 ksf

q_s for Closed Joints:	10.16	ksf	<	19.67	ksf	so use q_s =	10.16 ksf
q_s for Open Joints:	8.53	ksf	<	19.67	ksf	so use q_s =	8.53 ksf

Boring Information

Boring Number: B-3 (Pier 2) at Elevation 469.7 ft
Rock Type: Shale
Rock Core Data:

Core Run #	Start Depth	Recovery (%)	RQD (%)	Comp. Strength (tsf)
1	81	98.0%	88.0%	
	86			95.2
	90.5			38.9
2	91	100.0%	100.0%	
	93			74.9
	95.5			40.3
END	96			

End Bearing Calculation (AASHTO LRFD Bridge Design Specification Manual)

Method #1: For tightly jointed rock up to a depth of 2.0B below shaft base and socket depth > 1.5B, then:

$q_p = 2.5*q_u$ Equation 10.8.3.5.4c-1 (Pg 10-138)

Average q_u = 57.6 tsf = 115.2 ksf

q_p = 288 ksf

Method #2: For jointed rock up to a depth of 2.0B below shaft base, then:

$q_p = [s^{0.5}+(m*s^{0.5}+s)^{0.5}]*q_u$ Equation 10.8.3.5.4c-2 (Pg 10-138)

Determine Rock Mass Rating (RMR) from Table 10.4.6.4-1

Step1: Average strength from core run 2 = 57.60 tsf = 115.2 ksf
Relative Rating: 1
Step 2: Average RQD from core log = 100.0%
Relative Rating: 20
Step 3: Spacing of joints = 3-10 FT
Relative Rating: 25
Step 4: Condition of joints = assume slightly rough
Relative Rating: 20
Step 5: Groundwater conditions = assume moist only
Relative Rating: 7

RMR Rating = 73

Rock Class Number and Description from Table 10.4.6.4-3 (Pg 10-23)

Class No.: II
Description: Good Rock

Obtain s & m values from Table 10.4.6.4-4 (Pg 10-24)

Rock Type: B (Shale) m= 0.821
Description: Good Rock s= 0.00293

Average q_u = 57.6 tsf = 115.2 ksf

Plug values into equation $q_p = [s^{0.5}+(m*s^{0.5}+s)^{0.5}]*q_u$

q_p = 31.3 ksf

Required factored loads (per email of 10-11-2012)
1610 k **with phi = 0.5**
1702 k **with phi = 1.0**

Pier #1 (B-2)
surface elevation 544.6
top of rock elevation 479.6

End Bearing									
number of DS	diameter (ft)	end area (ft^2)/DS			nominal end bearing (ksf)	phi		factored resistance available/DS	total factored resistance available
7	6	28.27			18.8	0.5		266	1860
NOT FEASIBLE					"Fair" rock				
side friction -pier 1 (Note: need a core to depth of 3D below tip)									
number of DS's	diameter in rock (ft)	length in rock (ft)	tip elevation	side area/ft	nominal side friction (ksf)	phi	nominal resistance available/DS kips	factored resistance available/DS kips	total factored resistance available kips
2	4	13	466.6	12.57	9.9	0.5	1617	809	1617
3	3	12	467.6	9.42	9.9	0.5	1120	560	1679
4	3	9	470.6	9.42	9.9	0.5	840	420	1679
4	2	13	466.6	6.28	9.9	0.5	809	404	1617

Required factored loads (per email of 10-11-2012)
1610 k **with phi = 0.5**
1702 k **with phi = 1.0**

Pier #2 (B-3)
surface elevation 560.7
top of rock elevation 479.7

end bearing with tip founded at elev. 469.7 (Note: a longer core is required to confirm this data)									
number of DS's	diameter in rock (ft)	end area (ft^2)/DS			nominal end bearing (ksf)	phi		factored resistance available/DS	total factored resistance available
5	5	19.63			31.3	0.5		307	1536
NOT FEASIBLE					"Good" rock				
side friction -pier 2 (Note: need a core to depth of 3D below tip)									
number	diameter (ft)	length in rock (ft)	tip elevation	side area/ft	nominal side friction (ksf)	phi	nominal resistance available/DS kips	factored resistance available/DS	total factored resistance available
2	4	10		12.57	7.7	0.5	968	484	968
2	4	7		12.57	8.5	0.5	748	374	748
sum		**17**	462.7				1715	858	**1715**
3	3	10		9.42	7.7	0.5	726	363	1089
3	3	5		9.42	8.5	0.5	401	200	601
sum		**15**	464.7				1126	563	**1689**
4	2	10		6.28	7.7	0.5	484	242	968
4	2	7		6.28	8.5	0.5	374	187	748
sum		**17**	462.7				858	429	**1715**

Appendix J

L-pile Input for Boring B-1
STA. 479+85
Offset 30.0 Ft. Right
Water Table Elevation 534.1 Ft.

Depth (Ft)	Elevation (Ft)			Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)		Soil Modulus	50% Strain
							γ_{wet}	γ_{sat}	k (pci)	ε_{50} (pci)
3.0	544.1	to	541.1	SILTY CLAY LOAM		0.97	119.2		500	0.007
5.5	541.1	to	538.6	SILTY LOAM		0.27	118.1		100	0.01
10.5	538.6	to	533.6	SILTY LOAM		0.29		124.3	100	0.01
17.0	533.6	to	527.1	SAND	28			120.5	20	--
18.0	527.1	to	526.1	SILT	27			132.5	20	--
20.5	526.1	to	523.6	SAND	32			120.5	20	--
23.0	523.6	to	521.1	SANDY LOAM	37		134.4		60	--
28.0	521.1	to	516.1	SILTY LOAM		2.34	111.4		2000	0.004
32.0	516.1	to	512.1	SILTY LOAM		3.10	123.8		2000	0.004
37.0	512.1	to	507.1	SILTY LOAM		2.77	109.4		2000	0.004
42.0	507.1	to	502.1	SAND/SANDY LOAM	31			121.5	20	--
48.0	502.1	to	496.1	SAND	28			120.5	20	--
52.0	496.1	to	492.1	SAND AND GRAVEL	50			124.0	125	--
57.0	492.1	to	487.1	SAND	38			127.7	125	--
61.0	487.1	to	483.1	SILTY LOAM		2.50	104.6		2000	0.004
66.0	483.1	to	478.1	SHALE		2.50	149.0		2000	0.004

L-pile Input for Boring B-2
STA. 480+35
Offset 30.0 Ft. Right

Depth (Ft)	Elevation (Ft)			Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)		Soil Modulus	50% Strain
							γ_{wet}	γ_{sat}	k (pci)	ε_{50} (pci)
3.0	544.6	to	541.6	SILTY LOAM		0.38	115.2		100	0.01
5.5	541.6	to	539.1	SILTY LOAM		0.93	115.2		500	0.007
10.5	539.1	to	534.1	SILTY LOAM		0.26		122.4	100	0.01
13.0	534.1	to	531.6	SILTY LOAM		0.13		121.9	30	0.02
23.0	531.6	to	521.6	SAND	29			126.7	20	--
31.0	521.6	to	513.6	SILTY LOAM/SILT		2.56	115.6		2000	0.004
34.0	513.6	to	510.6	SAND	31			121.5	60	--
37.0	510.6	to	507.6	SILTY LOAM		3.43	111.4		2000	0.004
42.0	507.6	to	502.6	SILT	34		108.6		60	--
48.0	502.6	to	496.6	SAND	33			122.6	60	--
52.0	496.6	to	492.6	SAND AND GRAVEL	50			124.0	125	--
57.0	492.6	to	487.6	SAND	33			120.5	60	--
59.5	487.6	to	485.1	SAND AND GRAVEL	50			131.4	125	--
80.0	485.1	to	464.6	SHALE		2.50	149.0		2000	0.004

L-pile Input for Boring B-3
STA. 481+15
Offset 13.0 Ft. Left
Water Table Elevation 542.7 Ft.

Depth (Ft)	Elevation (Ft)			Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)		Soil Modulus	50% Strain
							γ_{wet}	γ_{sat}	k (pci)	ε_{50} (pci)
10.5	560.7	to	550.2	SILTY CLAY LOAM		0.50	126.0		100	0.01
13.0	550.2	to	547.7	SILTY LOAM		0.78	118.1		500	0.007
15.5	547.7	to	545.2	SILTY LOAM		0.74	120.0		500	0.007
23.0	545.2	to	537.7	SANDY LOAM	29		146.8		25	--
25.5	537.7	to	535.2	SANDY LOAM	27			151.2	20	--
32.0	535.2	to	528.7	SAND	32			121.5	20	--
46.0	528.7	to	514.7	SILTY LOAM		2.64	110.1		2000	0.004
52.0	514.7	to	508.7	SILT/SILTY LOAM		2.57	111.4		2000	0.004
61.0	508.7	to	499.7	SANDY LOAM	32		145.8		60	--
67.0	499.7	to	493.7	SAND	32		122.6		60	--
72.0	493.7	to	488.7	SAND AND GRAVEL	50		124.0		125	--
78.0	488.7	to	482.7	SAND	50		120.5		125	--
96.0	482.7	to	464.7	SHALE		2.50	149.0		2000	0.004

L-pile Input for Boring B-4
STA. 481+65
Offset 25.0 Ft. Left
Water Table Elevation 540.0 Ft.

Depth (Ft)	Elevation (Ft)			Abbreviated Soil Description	Friction (ϕ)	Cohesion (tsf) (c)	Unit Weight (pcf)		Soil Modulus	50% Strain
							γ_{wet}	γ_{sat}	k (pci)	ε_{50} (pci)
3.0	560.0	to	557.0	SILTY LOAM		0.72	118.1		500	0.007
5.5	557.0	to	554.5	SILTY LOAM		0.31	121.0		100	0.01
8.0	554.5	to	552.0	SAND AND GRAVEL	32		121.9		90	--
13.0	552.0	to	547.0	SILTY LOAM		1.29	118.6		1000	0.005
20.5	547.0	to	539.5	SILTY LOAM		0.92		126.4	500	0.007
23.0	539.5	to	537.0	SILTY LOAM		0.23		121.0	30	0.02
25.5	537.0	to	534.5	SILTY LOAM		0.52		113.3	500	0.007
28.0	534.5	to	532.0	SAND AND GRAVEL	29			124.0	20	--
32.0	532.0	to	528.0	SAND AND GRAVEL	34			124.0	125	--
37.0	528.0	to	523.0	SANDY LOAM	50		135.6		125	--
52.0	523.0	to	508.0	SILTY LOAM		2.93	113.0		2000	0.004
57.0	508.0	to	503.0	SANDY LOAM	35		140.4		60	--
63.0	503.0	to	497.0	SAND AND GRAVEL	34			124.0	60	--
77.5	497.0	to	482.5	SAND AND GRAVEL	50			124.0	125	--
80.5	482.5	to	479.5	SHALE		2.50	149.0		2000	0.004