STRUCTURE GEOTECHNICAL REPORT

IL 116 (FAP 669) over Kickapoo Creek, Union Pacific Railroad (UPRR), and Kickapoo Creek Road

Existing S.N. 072-0037
Proposed S.N. 072-0249

FAP ROUTE 669
SECTION (10R-VBY)BR
PEORIA COUNTY, ILLINOIS
JOB NO. P-94-015-09
PTB 159/025 WO #2
KEG NO. 11-1014.00

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EXECUTIVE SUMMARY

IL 116 over Kickapoo Creek, Union Pacific Railroad (UPRR), and Kickapoo Creek Road
F.A.P. 669
Section (10R-VBY)BR
Peoria County, Illinois
Job No. P-94-015-09
PTB 159/025 WO #2
Existing Structure No. 072-0037
Proposed Structure No. 072-0249

The original structure (SN 072-0037) will be replaced by a four-span structure located at Illinois 116 (IL 116) over Kickapoo Creek, Union Pacific Railraod (UPRR), and Kickapoo Creek Road in Peoria County, Illinois. This report summarizes the analysis of the proposed structure replacement.

The proposed structure will result in endslopes at both abutments, whereas currently a retaining wall is present at the east abutment. Additionally, slope stability was analyzed at the banks along Kickapoo Creek. The results of the analysis, as provided in Table 4.2, indicates an acceptable FOS will exist under undrained and drained conditions at all locations..

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1.0 Project Description and Proposed Structure Information

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed bridge at IL 116 over Kickapoo Creek, Union Pacific Railroad and Kickapoo Creek Road in Peoria County, Illinois. The purpose of the report is to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of replacment of the existing bridge (SN 072-0037) located at IL 116 over Kickapoo Creek. The project is located west of Peoria, Illinois, and east of Bellevue, IL. The general location of the bridge is shown on a USGS Topographic Location Map, Exhibit A. The site lies within the limits of the Fourth Principal Meridian, (T. 8N, R. 7E, Section 12) within the Galesburg Plain of the Till Plains Section of the Central Lowland Province. The Bloomington Ridged Plain and Ancient Illinois Floodplain are also located near the project.

1.3 Proposed Bridge Information

The proposed structure located at IL 116 over Kickapoo Creek will consist of a single, four-span bridge with a 14 degree 30 minute skew from the centerline. See Type, Size, and Location Plan (TS&L), Exhibit B. The proposed structure will measure 650 ft.- 1.25 in. back-to-back abutments, with a roadway width of 66 ft. The bridge spans from Station 242+30.75 to 248+80.77 along IL 116. The bridge will carry five, 12-foot lanes.

Further substructure details will be based on the findings of this SGR. The project will utilize staged construction to maintain one lane of traffic during construction.

2.0 Existing Bridge Information

The original structure was built in 1935, widened in 1967, and the superstructure replaced in 1988 with the exception of the deck truss in Span 7. In Span 7 the concrete deck was replaced, an expansion bearing at Pier 6 was replaced, and the steel deck truss was painted and substructure repaired and modified. In 2004, a Scour Mitigation plan was implemented. Back-to-back abutment length measures 637 ft.-10.25 in., while the out-to-out length at the east abutment measures 62 ft., and 67 ft. – 8 in. at the west abutment. The bridge is eleven spans.

3.0 Site Investigation, Subsurface Exploration, and Generalized Subsurface Conditions

The site investigation plan was developed by KEG and approved by IDOT District 4 Geotechnical personnel. A representative of KEG conducted a site visit, laid out the borings, observed drilling operations, and logged subsurface conditions. Boring locations were staked by Quigg Engineering, Inc.

Eight standard penetration test (SPT) borings, designated SB-1, SB-2, SB-2A, SB-4, SB-5, SB-6, SB-7, and SB-8 were drilled in the embankments and near proposed pier locations between the dates of August 24 and September 1, 2015. Rock coring was completed on three of these boreholes. In addition, a boring previously completed by IDOT in December of 1986, designated as B-1, was substituted for proposed boring SB-3 to aid in developing the SGR. The boring locations are shown on a Boring Location Plan under TS&L, Exhibit B. Detailed information

regarding the nature and thickness of the soils and rock encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit C. The soil profile for the above mentioned borings can be found in Subsurface Profile, Exhibit D.

Table 3.0 – Boring Stations and Offsets

Designation	Stationing	Offset from Proposed Centerline	Surface Elevation (ft.)
B-1 (IDOT)	243+30	31.0 LT	482.2
SB-1	239+98	53.0 RT	504.2
SB-2	243+78	106.5 RT	477.3
SB-2A	244+01	106.5 RT	477.3
SB-4	245+41	52.0 RT	462.0
SB-5	245+38	-25.0 LT	462.5
SB-6	247+27	19.0 RT	461.6
SB-7	247+54	-45.0 LT	462.6
SB-8	248+73	-49.0 LT	475.4

3.1 Subsurface Conditions

Boring B-1 (IDOT 1986) consisted of silty loam from the ground surface (El. 482.2) to El. 467.7. The driving resistances (N-values) ranged from 2 to 16 blows per foot (bpf), with unconfined compressive strengths (Q_u) between 0.3 to 2.2 tons per square foot (tsf), and moisture contents from 17 to 25 percent. A silty clay loam followed to El. 460.7, with N-values ranging from 5 to 7 bpf, Q_u values between 0.5 to 2.0 tsf, and moisture contents from 20 to 31 percent. A silty clay loam with a seam of sandy loam and traces of coal followed to El. 455.7. N-values ranged from 7 to 14 bpf, Q_u values between 0.4 and 0.9 tsf, and moisture contents from 20 to 25 percent. A silty clay loam followed to El. 453.2, with an N-value of 3 bpf, a Q_u value of 0.3 tsf, and a moisture content of 26 percent. Shaley clay loam followed to El. 448.2, with an N-value of 12 bpf, a Q_u value of 1.5 tsf, and moisture contents from 16 to 21 percent. A gray shale followed to boring termination at El. 441.7, with N-values ranging from 50/2 in. to 100/5 in., a Q_u value of 4.1 tsf, and moisture contents from 13 to 17 percent. This historical boring was used for informational purposes only, and was not used for the geotechnical analysis of the proposed structure.

Boring SB-1 had nine inches of topsoil present. A silt fill followed from El. 503.5 to 500.7, which had a N-value of 14 bpf, a Q_u of 3.8 tsf, and a moisture content of 19 percent. A silty clay loam fill followed to El. 498.2, which had an N-value of 8 bpf, a Q_u of 3.0 tsf, and a moisture content of 20 percent. A silty loam fill followed to El. 495.7, with an N-value of 16 bpf, a Q_u value of 1.1 tsf, and a moisture content of 19 percent. A fine sand followed to El. 493.2, with an N-value of 11 bpf, a Q_u value of 2.3 tsf, and a moisture content of 15 percent. Weathered shale followed to El. 485.7, with N-values ranging from 11 to 53 bpf, Q_u values >4.5 tsf, and moisture contents between 16 and 26 percent. A coal layer followed to El. 483.2, with an N-value of 50/5 in. and a moisture content of 24 percent. The boring then transitioned back into shale until auger refusal at El. 466.5. N-values for the shale ranged from 50/3 in. to around 90 (40+50/3 in.) bpf, with moisture contents between 2 to 16 percent.

Boring SB-2 consisted of silt, with N-values of 13 to 50/4 in., a Q_u value of 2.0 tsf, and moisture contents between 9 and 19 percent. Boring SB-2 was terminated 4.7 ft. below ground surface elevation (GSE) due to inability for the augers to advance. Boring SB-2A was located 3 ft. east of SB-2 and sampling was started after blind drilling to a depth of 6 ft. Silty loam was present

from El. 471.3 to 468.8, with an N-value of 5 bpf, a Q_u value of 1.3 tsf, and a moisture content of 17 percent. Weathered sandstone followed to El. 466.3, with an N-value of 58 bpf, and a moisture content of 10 percent. Shale followed to El. 463.8, with an N-value around 50/4 in., and a moisture content of 9 percent. A Sandy shale followed to El. 458.8, with N-values between 44 bpf and 50/6 in., and moisture content ranging from 8 to 10 percent. Shale followed until spoon refusal at El. 452.8, with N-values between 50/4 in. and around 50/6 in. and moisture contents between 9 and 10 percent.

Boring SB-4 had 4 inches of topsoil. A sandy silt followed to El. 456.0, with N-values between 5 to 9 bpf, Q_u values from 0.8 to 2.0 tsf, and moisture contents from 15 to 16 percent. A silty loam followed to El. 451.0, with an N-value of 4 bpf, a Q_u value of 0.4 tsf, and a moisture content of 20 percent. A Shelby Tube (ST) sample was taken in this interval from 8.5 to 10.5 ft. below GSE, and had a recovery of 21 in., a Qu value of 0.3 tsf, and a moisture content of 27. A silty clay loam followed to El. 448.5 with an N-value of 4 bpf, a Q_u value of 0.3 tsf, and a moisture content of 26 percent. A sand followed to El. 438.5, with N-values between 2 to 17 bpf, and moisture contents between 17 to 25 percent. A gravel layer was present to El. 436.0, with an N-value of 11 bpf, and a moisture content of 10 percent. Shale followed until rock coring began at El. 427.5. N-values ranged from 50/5 in. to 50/6 in., with moisture contents between 14 and 15 percent. Twenty-five feet of rock core was obtained from three runs, all of which were classified as a shale. Run 1 was 10 feet in length, with a recovery of 100 percent, a Rock Quality Designation (RQD) of 92 percent, and a strength of 8.7 tsf. Run 2 was also 10 feet in length, with a recovery of 96 percent, a RQD of 92 percent, and a strength of 36.0 tsf. Run 3 was a 5-foot run, with a recovery of 82 percent, a RQD of 78 percent, and a strength of 21.8 tsf. The boring was terminated at El. 402.5.

Boring SB-5 consisted of rip-rap and rock residuals from ground surface (El. 462.5) to El. 459.0, with an N-value of 25 bpf and a moisture content of 7 percent. A silty loam followed to El. 449.0. N-values ranged from 2 to 10 bpf, with Q_u values between 0.3 to 3.0 tsf, and moisture contents from 19 to 33 percent. A ST sample was taken from 11 to 13 ft. below GSE, and had a Q_u value of 0.3 tsf, and a moisture content of 32 percent. Clay followed to El. 445.5, with N-values between 3 and 4 bpf, Q_u values between <0.25 and 0.3 tsf, and moisture contents from 33 to 34 percent. A gravelly sandy loam followed to El. 441.5, with an N-value of 4 bpf, and a moisture content of 17 percent. A gravel followed to El. 436.5, with N-values of 5 to 6 bpf, and moisture contents from 15 to 21 percent. Shale followed until boring termination at El. 428.6 and had N-values from 76 to 50/6 in., and moisture contents from 11 to 16 percent.

Boring SB-6 consisted of a fine sand from the ground surface (El. 461.6) to El. 460.6. A clayey silt followed to El. 455.6, with N-values ranging between 6 and 8 bpf, and Q_u values between 0.5 to 1.3 tsf. Moisture contents varied from 20 to 21 percent. A silty clay loam followed to El. 453.1 with an N-value of 3 bpf, a Q_u value of 0.4 tsf, and a moisture content of 31 percent. A silty loam, classified by a ST taken from 8.5 to 10.5 ft. below GSE, followed to El. 450.6, and had a Q_u value of 0.3 tsf, and a moisture content of 27 percent. A silty sand followed to El. 448.1, with an N-value of 11 bpf, a Q_u of 0.9 tsf, and a moisture content of 13 percent. A gravelly sandy loam followed to El. 438.1, with N-values ranging from 6 to 21 bpf, and moisture contents from 6 to 27 percent. A gravel followed to El. 435.1, with an N-value of 17 bpf, and a moisture content of 10 percent. Shale followed until the beginning of rock coring at El. 432.1. N-values ranged from 50/4 in. to 50/5 in., and moisture contents varied from 13 to 14 percent. Thirty feet of rock core was obtained from four runs, all of which were classified as a shale. Run 1 was a 5-foot run, but only 8.5 in. of core sample was recovered due to the core getting stuck/destroyed in the barrel. Run 2 was a 5-foot run, with a recovery of 70 percent, a RQD of 70 percent, and a strength of 9.0 tsf. Run 3 was a 10-foot run, with a recovery of 100 percent, a RQD of 100 percent, and a strength of 10.0 tsf. Run 4 was a 10-foot run, with a recovery of 71 percent, a RQD of 69 percent, and a

strength of 9.4 tsf. The last three feet of sample from this run was lost upon sampler retrieval. The boring was terminated at El. 402.1.

Boring SB-7 consisted of a fine sand from the ground surface (El. 462.6) to El. 461.6. A sandy silt followed to El. 459.1, with an N-value of 19 bpf, a Q_u value of 1.5 tsf, and a moisture content of 16 percent. A clayey silt followed to El. 456.6, with an N-value of 4 bpf, a Q_u value of 0.8 tsf, and a moisture content of 20 percent. A silty loam followed to El. 449.1. N-values were between 2 and 3 bpf, with Q_u values between <0.25 to 0.3 tsf, and moisture contents from 26 to 29 percent. A ST was taken at a depth of 11 to 13 ft. below GSE. Its Q_u value was 1.3 tsf, with a moisture of 28 percent. A clay layer followed from El. 449.1 to 446.6. The N-value was 5 bpf, with a Q_u value of 0.4 tsf, and a moisture content of 29 percent. A gravelly sand followed to El. 436.1, with N-values ranging between 1 and 25 bpf, and moisture contents from 9 to 32 percent. Shale followed to the beginning of rock core depth at El. 428.1. N-values ranged from 50/3 in. to 50/5.5 in., with moisture contents from 13 to 14 percent. Twenty-five feet of rock core was obtained from three runs, all of which were classified as a shale. Run 1 was a 5-foot run, with a recovery of 92 percent, a RQD of 77 percent, and a strength of 3.2 tsf. Run 2 was a 10-foot run, with a recovery of 97 percent, a RQD of 93 percent, and a strength of 7.8 tsf. Run 3 was a 10-foot run, with a recovery of 100 percent, a RQD of 97 percent, and a strength of 31.3 tsf. The boring was terminated at El. 403.1.

Boring SB-8 consisted of a fine sand/fill from GSE (El. 475.4) to El. 474.7. Below this, a silt followed to El. 471.9, with an N-value of 20 bpf, a Q_u value of 2.5 tsf, and a moisture content of 14 percent. A gravel and fine sand mix followed to El. 469.4, with an N-value of 28 bpf, and moisture content of 9 percent. Weathered rock followed to El. 464.4, with N-values ranging from 27 to 48 bpf, a Q_u value of > 4.5 tsf, and moisture contents between 12 and 14 percent. Shale followed to spoon refusal at El. 451.1. N-values ranged from 50/4 in. to around 50/5.5 in., with moisture contents from 7 to 9 percent.

3.2 Shale

Shale was encountered in each of the borings. Table 3.2 shows the elevations at which shale was first encountered for each of the borings. This does not include any shale or other rock that appears to be a weathering layer.

Table 3.2 – Shale Elevations

Boring	Elevation (ft.)
B-1 (IDOT 1986)	448.2
SB-1	493.2
SB-2A	458.8
SB-4	436.0
SB-5	436.5
SB-6	435.1
SB-7	436.1
SB-8	464.4

3.3 Groundwater

Groundwater was encountered in five of the nine recent borings. Table 3.3 shows the elevation that groundwater was encountered during drilling. It should be noted that the groundwater level is subject to seasonal and climatic variations. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

Table 3.3 – Groundwater Elevations

Boring	Station/Offset (ft.)	Elevation (ft.)
B-1 (IDOT)	243+30/31.0 LT	459.6
SB-1	239+98/53.0 RT	470.7
SB-4	245+41/52.0 RT	447.5
SB-5	245+38/-25.0 LT	445.5 (432.5 after drilling)
SB-6	247+27/19.0 RT	449.1 (450.5 after 15 hrs.)
SB-7	247+54/-45.0 LT	452.6 (452.4 after 16 hrs.)

4.0 Geotechnical Evaluations

4.1 Settlement

The proposed structure will require placement of new fill at the east abutment location. Based on Boring SB-8, obtained in the immediate vicinity of the proposed east abutment, the underlying soils are comprised of granular materials overlayed on the top of shale bedrock. The granular materials are not susceptible to consolidation settlement, and any compaction due to vibratory and constructions activities are anticipated to occur simultaneously with fill placement.

4.2 Slope Stability

The proposed structure will result in endslopes at both abutments, whereas currently a retaining wall is present at the east abutment. Additionally, slope stability was analyzed at the banks along Kickapoo Creek.

The proposed endslopes are at a 1 vertical to 2 horizontal (1V:2H) slope, to the toe. Slope stability of the endslopes was analyzed using SLOPE-W; the soil properties at the site, including those in Borings SB-1 and SB-8; and the endslope geometrics. The banks of Kickapoo Creek were analyzed using Borings SB-4 and SB-6. The bank slopes were estimated to be constructed at a 1V:2H slope, to the toe in the creek. Three conditions were modeled: end-of-construction, long-term, and a design seismic event. A critical factor of safety (FOS) was calculated for each condition. According to current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability and 1.0 for the design seismic event.

In order to model the end-of-construction condition, undrained soil parameters were used with a friction angle of 0 degrees assumed for cohesive soils. Drained soil parameters with assumed friction angles ranging from 12 to 38 degrees were used to model the long-term and seismic conditions to analyze the condition where excess pore water pressure from construction has dissipated. For cohesive materials, a nominal cohesion value between 50 and 250 psf was included in the drained strength parameters.

The Modified Bishop Method, which generates circular-arc failure surfaces, was used to calculate the critical failure surfaces and FOS for the analyzed conditions. The FOS obtained in the analysis is shown in Table 4.2. SLOPE-W program output from this analysis can be found in SLOPE/W Stability Analysis, Exhibit E.

Table 4.2 – Slope Stability Critical FOS

Location	End-of-Construction	Long-Term	Seismic
East Abutment - Full	3.0	1.7	1.5
East Abutment - Top	2.8	1.7	1.5
East Abutment - Bottom	19.1	1.9	16.9
West Abutment - Full	9.2	9.1	6.8
West Abutment - Top	2.9	1.5	1.3
West Abutment - Bottom	2.3	1.5	1.3
East Bank	2.6	1.8	1.6
West Bank	2.8	1.7	1.5

The results of the analysis, as provided in Table 4.2, indicates an acceptable FOS will exist under undrained and drained conditions at all locations.

4.3 Seismic Considerations

The determination of Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1 – Seismic Site Class Definition and the IDOT-provided spreadsheet titled: Seismic Site Class Determination. Using these resources, the controlling global site class for this project is Soil Site Class C.

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. The USGS published information and mapping (http://earthquake.usgs.gov/), including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to determine the parameters for the project site location. The values, based on a 1000-Year Return Period with a Probability of Exceedance (PE) of 7 percent in 75 years and the Soil Site Class C, are summarized below.

Table 4.3 – Summary of Seismic Parameters

Parameter	Value
Soil Site Class	C
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.132 g
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.080 g
Seismic Performance Zone	1

As indicated in the table above, the Seismic Performance Zone (SPZ) is 1, based on S_{D1} and Table 3.15.2-1 in the IDOT Bridge Manual, the Soil Site Class C, and Figure 2.3.10-2 in the IDOT Bridge Manual. According to IDOT, seismic parameters and analyses are not necessary for structures in SPZ 1.

4.4 Scour

The design scour elevations for the proposed structure are shown in Table 4.4. Class A4 stone riprap will be placed on the surface of the proposed abutment endslopes and Class A6 riprap will be placed on the surface of the streambed, to reduce the potential for future scour. The scour depths at the pier locations have been reduced accordingly based on the cohesive soils observed in the borings.

Table 4.4 – Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)					Item 113
	West Abutment	Pier 1	Pier 2	Pier 3	East Abutment	
Q_{100}	494.7	458.7	448.1	438.8	497.3	5
Q_{200}	494.7	458.7	448.1	437.8	497.3	
Design	494.7	458.7	448.1	438.8	497.3	
Check	494.7	458.7	448.1	437.8	497.3	

4.5 Mining Activity

According to the Illinois State Geological Survey (ISGS) website, Peoria County, Illinois Coal Mines and Industrial Mineral Mines map, dated August 3, 2016, obtained from the ISGS website (http://www.isgs.illinois.edu/research/coal/maps/county), mining has occurred at and around the project location. An interactive IL Mines map (http://isgs.illinois.edu/ilmines) by the ISGS shows an indefinite boundary of an underground mine and underground mine proximity region within the project area.

The listed disclaimer indicates locations of some features on the mine map may be offset by 500 feet or more due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors.

No visual indication of surface or subsurface mining activities was evident at the project location. KEG's site observations did not detect any apparent depressions which could indicate a mine subsidence or shafts beneath the project location. Refer to Illinois State Geological Survey Mine Map for Peoria County, Exhibit H, for additional information.

4.6 Liquefaction

A liquefaction analysis is not required to be performed for structures located in SPZ 1. Therefore, liquefaction was not considered as a reduction for the pile design capacity or other foundation considerations included herein.

4.7 Approach Slab

In accordance with the IDOT Bridge Manual, KEG has evaluated the foundation soils at the approach slabs for bearing capacity and excessive settlement. With proper compaction of the abutment wall backfill, the bearing capacity and settlement requirements of the IDOT Bridge Manual will be satisfied.

5.0 Foundation Evaluations and Design Recommendations

5.1 General Feasibility

The IDOT Static Method of Estimating Pile Length provided by IDOT BBS Foundations and Geotechnical Unit was used to determine the design length of the piles. Based on the boring logs, the depth to bedrock, and the results of the pile design analysis, H-piles may be a feasible option for support of the proposed substructures. If H-piles are chosen by the designer for support of the proposed structure, the lateral capacity and adequate pile embedment depths should be verified by a licensed structural engineer in consideration of the minimal amount of cohesive overburden soils present at the substructure units.

Due to the lateral capacity and inadequate pile embedment depth concerns combined with the presence of relatively shallow bedrock throughout the footprint of the proposed structure, drilled shafts are feasible support options at all substructure units. The boring logs indicated bedrock near the proposed ground surface elevation at the west abutment, and shallow foundations are feasible at the west abutment location; however; the large proposed factored loads and deeper bedrock for the pier locations, and the depth to bedrock (below the new fill) at the proposed east abutment would result in spread footings that are over-sized and cost prohibitive.

5.2 Pile Supported Foundations

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loadings. The IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (IDOT Static Method of Estimating Pile Length, Exhibit F).

The factored reactions and the preliminary design loads, as provided by Veenstra & Kimm, Inc., are provided in Table 5.2. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving, as well as assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

Table 5.2 – Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
West Abutment	3047.6
East Abutment	3942.7
Pier 1	6641.8
Pier 2	10001.6
Pier 3	11511.9

The estimated pile lengths for the pile types considered are shown in Tables 5.2.1 – 5.2.5 below. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving, and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

Table 5.2.1 – Estimated Pile Lengths for HP 10x42 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1	223	123	48	495.7
	270	149	49	495.7
	311	171	50	495.7
	335	184	51	495.7
Pier 1* (Westbound & Eastbound) B-1	198	95	24	472.1
	253	126	25	472.1
	294	148	26	472.1
	335	184	27	472.1
Pier 2* (Westbound) SB-5	145	66	26	461.0
	205	100	27	461.0
	258	129	28	461.0
	335	184	29	461.0
Pier 2* (Eastbound) SB-4	169	84	27	461.0
	230	117	28	461.0
	275	142	29	461.0
	335	184	30	461.0
Pier 3* (Westbound) SB-7	180	84	26	460.5
	240	117	27	460.5
	282	140	28	460.5
	335	184	29	460.5
Pier 3* (Eastbound) SB-6	177	83	27	460.5
	237	116	28	460.5
	280	139	29	460.5
	335	184	30	460.5
East Abutment SB-8	191	105	29	498.3
	248	137	30	498.3
	290	159	31	498.3
	335	184	32	498.3

***Scour elevations included in capacity estimates**

Table 5.2.2 – Estimated Pile Lengths for HP 12x53 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1	267	147	48	495.7
	339	187	49	495.7
	395	217	50	495.7
	418	230	51	495.7
Pier 1* (Westbound & Eastbound) B-1	165	74	23	472.1
	237	114	24	472.1
	309	154	25	472.1
	418	230	26	472.1
Pier 2* (Westbound) SB-5	246	119	27	461.0
	318	159	28	461.0
	380	193	29	461.0
	418	230	30	461.0
Pier 2* (Eastbound) SB-4	203	100	27	461.0
	275	140	28	461.0
	347	180	29	461.0
	418	230	30	461.0
Pier 3* (Westbound) SB-7	215	101	26	460.5
	287	140	27	460.5
	359	180	28	460.5
	418	230	29	460.5
Pier 3* (Eastbound) SB-6	212	99	27	460.5
	284	139	28	460.5
	356	178	29	460.5
	418	230	30	460.5
East Abutment SB-8	229	126	29	498.3
	301	166	30	498.3
	369	203	31	498.3
	418	230	32	498.3

***Scour elevations included in capacity estimates**

Table 5.2.3 – Estimated Pile Lengths for HP 12x74 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1	456	251	51	495.7
	507	279	52	495.7
	557	306	53	495.7
	589	324	54	495.7
Pier 1* (Westbound & Eastbound) B-1	435	223	27	472.1
	485	251	28	472.1
	536	278	29	472.1
	589	324	30	472.1
Pier 2* (Westbound) SB-5	441	226	30	461.0
	492	254	31	461.0
	542	282	32	461.0
	589	324	33	461.0
Pier 2* (Eastbound) SB-4	411	215	30	461.0
	462	242	31	461.0
	512	270	32	461.0
	589	324	33	461.0
Pier 3* (Westbound) SB-7	420	213	29	460.5
	470	241	30	460.5
	521	268	31	460.5
	589	324	32	460.5
Pier 3* (Eastbound) SB-6	418	212	30	460.5
	468	239	31	460.5
	518	267	32	460.5
	589	324	33	460.5
East Abutment SB-8	429	236	32	498.3
	480	264	33	498.3
	530	292	34	498.3
	589	324	35	498.3

***Scour elevations included in capacity estimates**

Table 5.2.4 – Estimated Pile Lengths for HP 14x73 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1	410	226	49	495.7
	494	272	50	495.7
	553	304	51	495.7
	578	318	52	495.7
Pier 1* (Westbound & Eastbound) B-1	287	139	24	472.1
	374	187	25	472.1
	461	234	26	472.1
	578	318	27	472.1
Pier 2* (Westbound) SB-5	385	193	28	461.0
	472	241	29	461.0
	536	276	30	461.0
	578	318	31	461.0
Pier 2* (Eastbound) SB-4	333	170	28	461.0
	420	218	29	461.0
	501	262	30	461.0
	578	318	31	461.0
Pier 3* (Westbound) SB-7	348	171	27	460.5
	435	218	28	460.5
	511	260	29	460.5
	578	318	30	460.5
Pier 3* (Eastbound) SB-6	344	168	28	460.5
	431	216	29	460.5
	508	259	30	460.5
	578	318	31	460.5
East Abutment SB-8	364	200	30	498.3
	451	248	31	498.3
	522	287	32	498.3
	578	318	33	498.3

***Scour elevations included in capacity estimates**

Table 5.2.5 – Estimated Pile Lengths for HP 14x117 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1	758	417	54	495.7
	818	450	55	495.7
	878	483	56	495.7
	929	511	57	495.7
Pier 1* (Westbound & Eastbound) B-1	732	383	30	472.1
	793	416	31	472.1
	853	450	32	472.1
	929	511	33	472.1
Pier 2* (Westbound) SB-5	734	384	33	461.0
	794	417	34	461.0
	855	440	35	461.0
	929	511	36	461.0
Pier 2* (Eastbound) SB-4	704	373	33	461.0
	764	406	34	461.0
	825	440	35	461.0
	929	511	36	461.0
Pier 3* (Westbound) SB-7	714	371	32	460.5
	775	405	33	460.5
	835	438	34	460.5
	929	511	35	460.5
Pier 3* (Eastbound) SB-6	711	370	33	460.5
	772	403	34	460.5
	832	436	35	460.5
	929	511	36	460.5
East Abutment SB-8	726	399	35	498.3
	786	432	36	498.3
	846	466	37	498.3
	929	511	38	498.3

***Scour elevations included in capacity estimates**

As shown in the Tables above and in IDOT Static Method of Estimating Pile Length, Exhibit F, scour has been included in the capacity estimates for the piers. Downdrag and liquefaction have not been considered at the substructure locations.

Due to varying depth to bedrock throughout the proposed structure footprint, KEG recommends one test pile be performed at both abutment locations, and one pier location. A test pile is performed prior to production driving so that actual, on-site field data can be gathered to determine pile driving requirements for the project. This also is the manner in which the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

5.3 Foundations on Drilled Shafts

Due to the relatively shallow bedrock, drilled shafts are an alternative foundation choice for the proposed substructures. The characteristics of the underlying shales are relatively uniform and competent throughout the project limits, at or below the elevations indicated in Table 5.3 below.

Based off of the subsurface exploration, competent shale is encountered below elevation El. 448 in Boring B-1, El. 483 in Boring SB-1, El. 466 in SB-2A, El. 436 in SB-4, El. 436 in SB-5, El. 435 in SB-6, El. 436 in SB-7, and El. 464 in SB-8. Based on these elevations, Table 5.3a below provides Estimated Bedrock Elevations by substructure for use in design and construction.

Table 5.3 – Estimated Bedrock Elevations

Substructure Unit	Reference Boring(s)	Top of Rock Depth-bgs (Ft)	Top of Rock Elevation (Ft)
West Abutment	B-1	34	448.0
Pier 1	B-1	34	448.0
Pier 2	SB-4/SB-5	26	436.0
Pier 3	SB-6/SB-7	26.5	435.0
East Abutment	SB-8	11	464.0

Recommedations for drilleds shafts with sockets extending various depths into the underlying shale, developing capacity from end and side resistance, are provided for support of the abutments and piers. The provided capacities are based off boring information on Boring B-1 and laboratory unconfined compressive strength tests performed on rock core samples from Borings SB-4, SB-6, and SB-7, and utilizing the IDOT Drilled Shaft Axial Capacity in Shale < 100 KSF spreadsheet as provided by IDOT BBS Foundations and Geotechnical Unit. LRFD Resistance Factors of 0.5 for side resistance and tip resistance are incorporated into the allowable capacities, respectively.

Tables 5.4.1. thru 5.4.3 – Drilled Shaft Axial Capacity below contain a summary of Factored Shaft Resistances available for various shaft diameters based on socket depths into the underlying shales for each substructure. IDOT Drilled Axial Capacity Input sheets and Design tables are included in Exhibit G, for additional information.

Table 5.4.1 – Estimated Drilled Shaft Axial Capacity for 36-inch Diameter Shaft

Substructure Unit	Socket Depth (ft.)	Cum. Nominal Side Resistance Available (kips)	Nominal Tip Resistance Available (kips)	Total Factored Shaft Resistance Available (kips)	Tip Elevation (ft.)
West Abutment B-1 & SB-4	5	116	205	160	443.0
	10	232	219	225	438.0
	15	348	266	307	433.0
	20	464	482	473	428.0
Pier 1 B-1 & SB-4	5	116	205	160	443.0
	10	232	219	225	438.0
	15	348	266	307	433.0
	20	464	482	473	428.0
Pier 2 SB-4	5	246	434	340	431.0
	10	492	465	478	426.0
	15	738	975	856	421.0
	20	1138	1996	1567	416.0
Pier 3 SB-6	5	254	449	352	430.0
	10	509	508	508	425.0
	15	775	548	661	420.0
	20	1057	538	798	415.0
East Abutment SB-8	5	90	160	125	459.0
	10	181	171	176	454.0
	15	271	175	223	449.0
	20	362	177	270	444.0

Table 5.4.2 – Estimated Drilled Shaft Axial Capacity for 48-inch Diameter Shaft

Substructure Unit	Socket Depth (ft.)	Cum. Nominal Resistance Available (kips)	Nominal Tip Resistance Available (kips)	Total Factored Shaft Resistance Available (kips)	Tip Elevation (ft.)
West Abutment B-1 & SB-4	5	155	350	252	443.0
	10	309	380	345	438.0
	15	464	558	511	433.0
	20	618	847	733	428.0
Pier 1 B-1 & SB-4	5	155	350	252	443.0
	10	309	380	345	438.0
	15	464	558	511	433.0
	20	618	847	733	428.0
Pier 2 SB-4	5	328	743	535	431.0
	10	656	807	731	426.0
	15	984	2140	1562	421.0
	20	1518	3505	2511	416.0
Pier 3 SB-6	5	339	768	554	430.0
	10	679	893	786	425.0
	15	1033	958	995	420.0
	20	1410	937	1173	415.0
East Abutment SB-8	5	121	273	197	459.0
	10	241	297	269	454.0
	15	362	306	334	449.0
	20	483	312	397	444.0

Table 5.4.3 – Estimated Drilled Shaft Axial Capacity for 72-inch Diameter Shaft

Substructure Unit	Socket Depth (ft.)	Cum. Nominal Side Resistance Available (kips)	Nominal Tip Resistance Available (kips)	Total Factored Shaft Resistance Available (kips)	Tip Elevation (ft.)
West Abutment B-1 & SB-4	5	232	773	502	443.0
	10	464	972	718	438.0
	15	696	1416	1056	433.0
Pier 1 B-1 & SB-4	5	232	773	502	443.0
	10	464	972	718	438.0
	15	696	1416	1056	433.0
Pier 2 SB-4	5	492	1640	1066	431.0
	10	984	3099	2042	426.0
	15	1476	5614	3545	421.0
Pier 3 SB-6	5	509	1759	1134	430.0
	10	1018	1946	1482	425.0
	15	1549	2045	1797	420.0
East Abutment SB-8	5	181	603	392	459.0
	10	363	639	500	454.0
	15	543	668	605	449.0

5.4 Shallow Foundations

The foundation supporting the proposed west abutment must provided sufficient support to resist dead and live loads, including seismic loading. Based on the encountered subsurface conditions and the information available to date, the use of shallow foundations at the west abutment bearing in shale is a viable foundation alternative. The factored load for the west abutment was 3047.6 kips, as provided by Veenstra & Kimm, Inc.

The boring log (SB-1) indicates competent shale material with an average N-value over 100 bpf and average moisture content of 12 percent. Based on AASHTO LRFD Bridge Design Specifications Section 10.4.6.4, Tables 10.4.6.4-1 and C10.6.2.6.1-1, and the unconfined compressive strength tests performed on respresentative samples of shale throughout the project footprint, we recommend a bearing resistance of 16 ksf (8 tsf) for footings bearing in the competent shale. The sliding resistance of the shale material is estimated to be 650 kips.

5.5 Lateral Pile Response

Generally, the geotechnical engineer provides soil parameters to the structural engineer so that an L-Pile program or other approved software can be used for the lateral or displacement analysis of the foundations. Table 5.5 is included for the structural engineer's use in determining lateral pile response.

Table 5.5 – Soil Parameters for Lateral Pile Load Analysis

Boring	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term		N	Assumed % fines < #200	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)				
SB-1	500.7	115	0	3800	28	100	14	65	1000	0.005
	498.2	120	0	3000	26	100	8	70	1000	0.005
	495.7	115	0	1100	28	100	16	70	500	0.007
	493.2	110	34	0	34	0	11	3	90	n/a
	485.7	125	12	500	12	500	26	n/a	n/a	n/a
	483.2	94	30	0	30	0	50	n/a	n/a	n/a
	466.5	125	12	5000	12	5000	50	n/a	n/a	n/a
SB-2 to SB-2A	471.3	115	0	2000	28	100	13	65	500	0.007
	468.8	115	0	1300	28	100	5	65	500	0.007
	466.3	145	45	n/a	45	n/a	58	n/a	n/a	n/a
	463.8	125	12	5000	12	5000	95	n/a	n/a	n/a
	458.8	130	14	5000	14	5000	47	n/a	n/a	n/a
	452.8	125	12	5000	12	5000	50	n/a	n/a	n/a
SB-4	456.0	115	0	1400	28	100	7	60	500	0.007
	451.0	115	0	350	28	50	4	65	30	0.020
	448.5	120	0	300	26	50	4	70	30	0.020
	438.5	110	34	0	34	0	10	3	20	n/a
	436.0	130	38	0	38	0	11	n/a	n/a	n/a
	402.5	125	12	5000	12	5000	50	n/a	n/a	n/a
SB-5	459.0	145	42	0	42	0	25	n/a	n/a	n/a
	457.0	115	0	3000	28	100	10	65	1000	0.005
	449.0	115	0	350	28	50	2	65	30	0.020
	445.5	125	0	275	26	50	3	80	30	0.020
	441.5	115	28	0	28	0	4	60	20	n/a
	436.5	130	38	0	38	0	5	n/a	n/a	n/a
	428.6	125	12	5000	12	5000	59	n/a	n/a	n/a
SB-6	455.6	115	0	900	28	50	7	65	100	0.010
	453.1	120	0	400	26	50	3	70	30	0.020
	450.6	115	0	300	28	50	n/a	65	30	0.020
	448.1	110	34	0	34	0	11	3	60	n/a
	438.1	115	28	0	28	0	12	60	60	n/a
	435.1	130	38	0	38	0	17	n/a	n/a	n/a
	402.1	125	12	5000	12	5000	50	n/a	n/a	n/a
SB-7	459.1	115	0	1500	28	100	19	65	500	0.007
	456.6	115	0	800	28	50	4	65	100	0.010
	449.1	115	0	500	28	50	2	65	30	0.020
	446.6	125	0	400	26	50	5	80	30	0.020
	436.1	115	36	0	36	0	16	3	60	n/a

Boring	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term		N	Assumed % fines < #200	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)				
	403.1	125	12	5000	12	5000	50	n/a	n/a	n/a
SB-8	471.9	115	0	2500	28	100	20	65	1000	0.005
	469.4	120	34	0	34	0	28	3	90	n/a
	464.4	130	12	4500	12	4500	38	n/a	n/a	n/a
	451.1	125	12	5000	12	5000	50	n/a	n/a	n/a

6.0 Construction Considerations

6.1 Construction Activities

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.

6.2 Temporary Sheeting and Soil Retention

At this stage, temporary sheeting is not anticipated to be required. If during final design temporary sheeting is determined to be required, KEG should be contacted.

6.3 Site and Soil Conditions

Should any bridge or embankment design considerations assumed by either IDOT or KEG change, KEG should be contacted to verify if the recommendations stated in this report still apply.

6.4 Foundation Construction

Conventional pile driving equipment and methodologies should be assumed. Protective tips should be provided for the piles.

A JULIE locate shall be conducted to determine if any underground utilities are present in the area of the proposed structure prior to construction. Any utilities that may interfere with construction shall be moved by the owner. If utilities become a problem during construction, the appropriate owner shall be contacted immediately. In addition, the UP Railroad and BNSF Railroad should be contacted for construction permitting and coordination.

7.0 Computations

Computations and analyses for special circumstances, if any, are included as exhibits. Please refer to each section of the report for reference to the exhibit containing any such calculations or analysis used.

8.0 Geotechnical Data

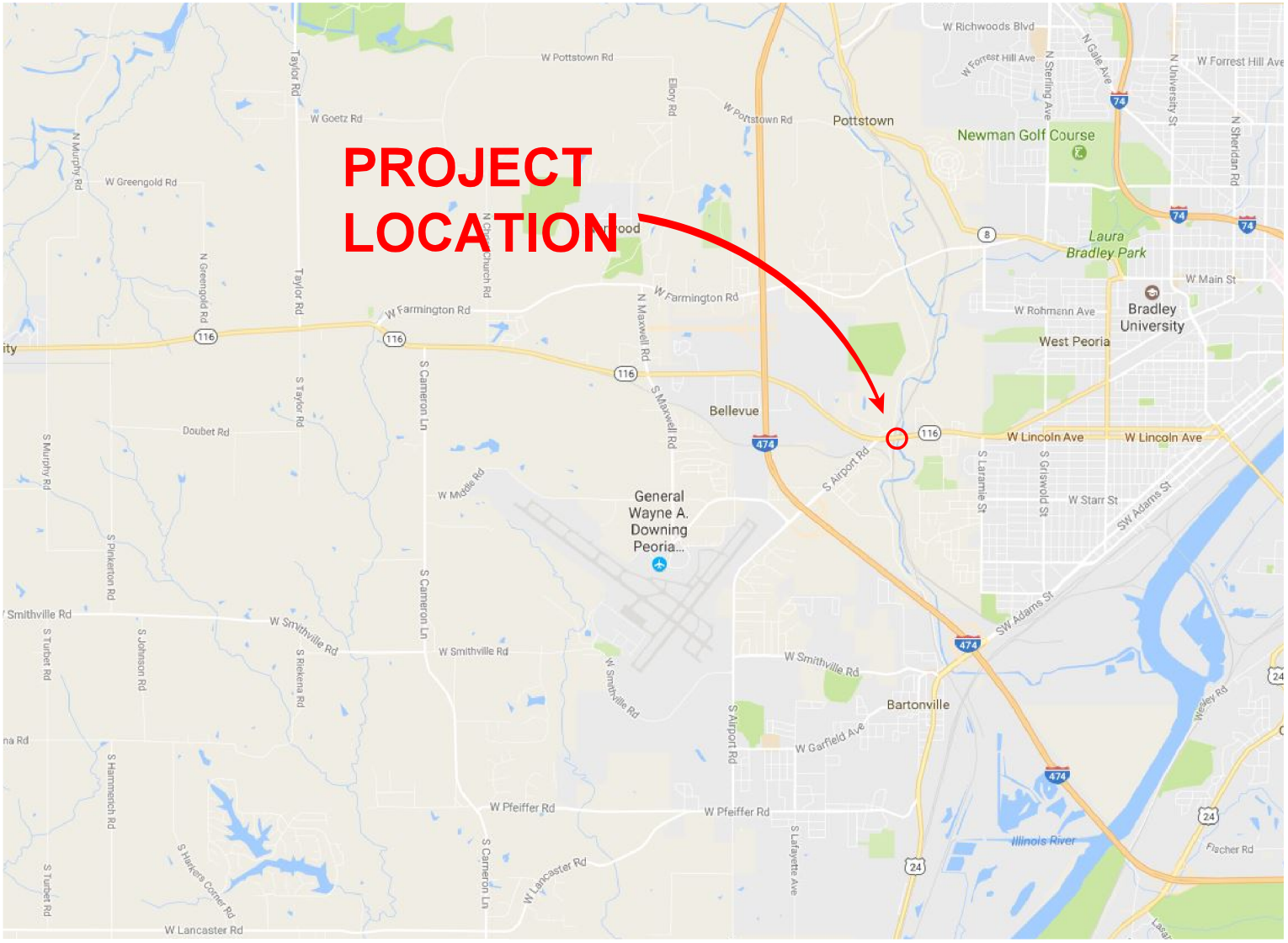
Soil boring logs can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

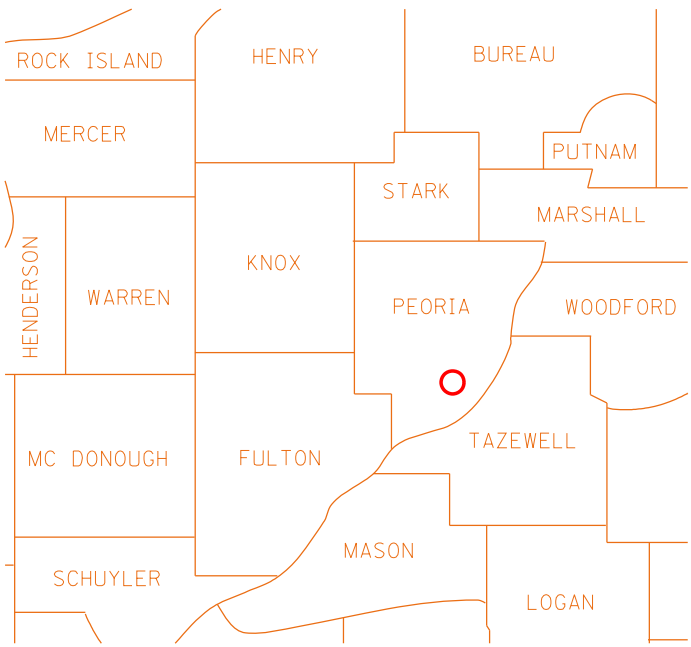
9.0 Limitations

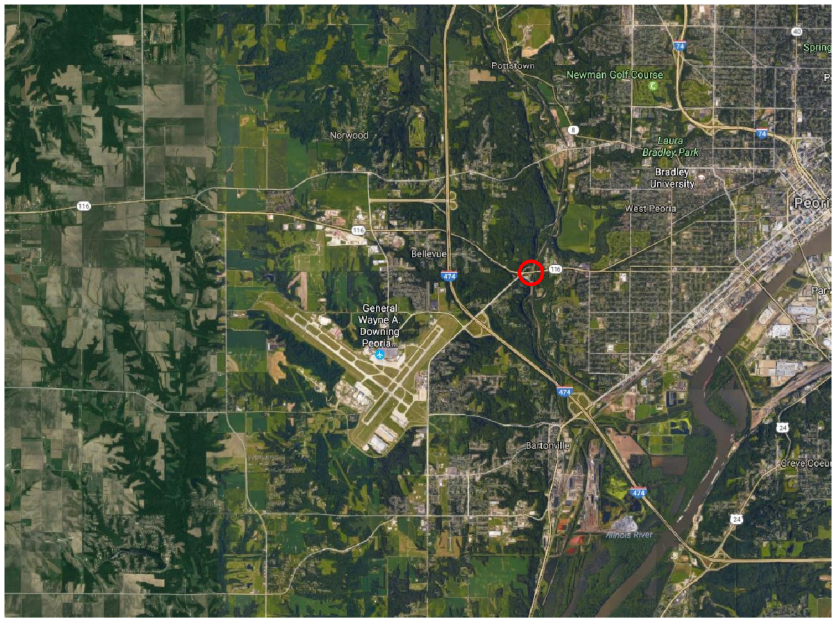
The recommendations provided herein are for the exclusive use of Veenstra & Kimm, Inc. and IDOT. They are specific only to the project described and are based on the subsurface information obtained at eight boring locations by KEG within the proposed bridge area and one boring location by IDOT in 1986, KEG's understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. KEG should be contacted if conditions encountered during construction are not consistent with those described.

EXHIBIT A

USGS TOPOGRAPHIC LOCATION MAP







Kaskaskia
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Belleville, Illinois 62220
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618.233.5977 fax
www.kaskaskiaeng.com

PROFESSIONAL REGISTRATIONS	LICENSE NO.
Illinois Professional Design Firm	184.004773
Professional Engineering Group	20-5080586

LOCATION MAP

IL 116 (FAP 669) OVER KICKAPOO CREEK, UNION PACIFIC RR, AND KICKAPOO CREEK ROAD
S.N. 072-0037 - PEORIA COUNTY, ILLINOIS

EXHIBIT NO.

A

KEG JOB # 11-1014

$FILEL$

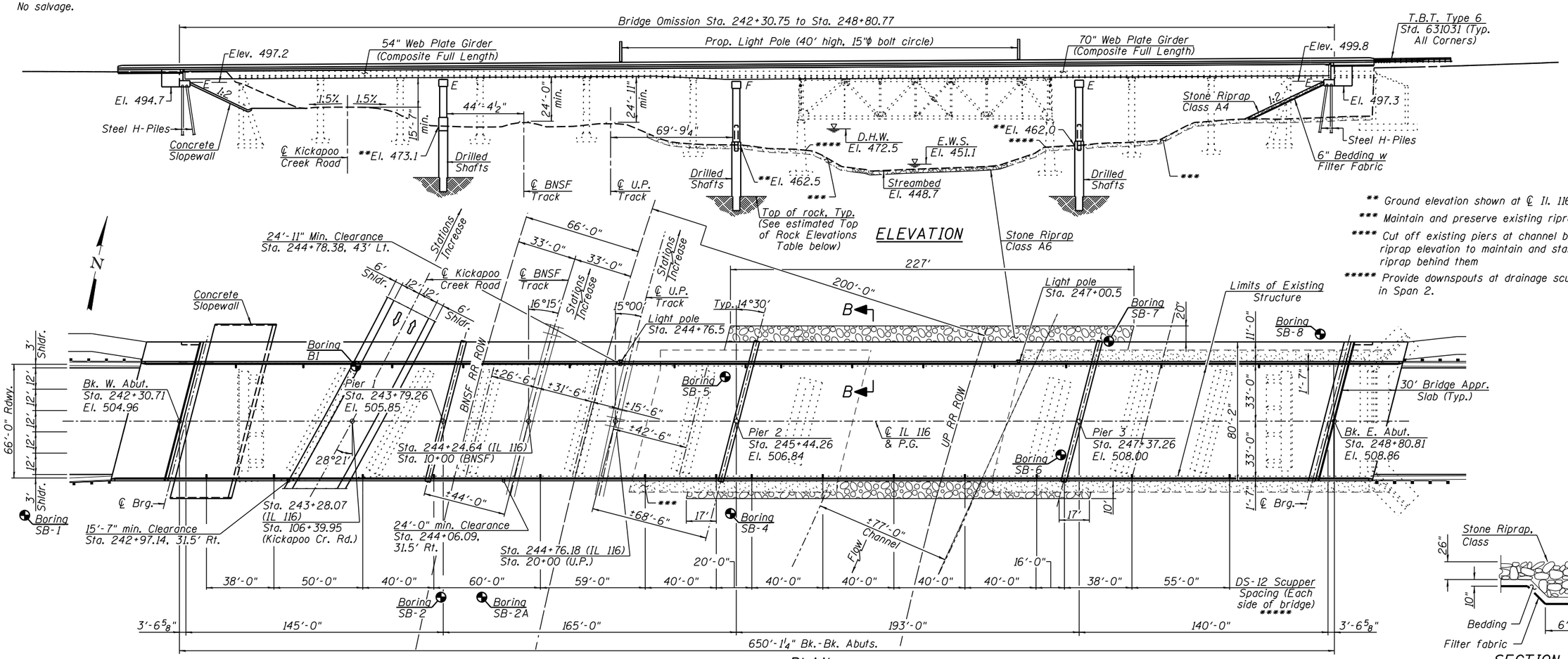
EXHIBIT B

TYPE, SIZE, AND LOCATION PLAN (TS&L)

BM#8 - IL. Div. of Highway Disk on top of bridge wall on Southwest side of bridge 33.7' Rt. Sta. 242+54. El. 506.08

Existing Structure: 072-0037 was built as S.B.I. Route 8, Section 10R-B, F & E-N.R.H. in 1935. The bridge was widened in 1967. The entire superstructure was replaced in 1988 except for the deck truss in Span 7 as Section (10RVBY)-1. In Span 7 the concrete deck was replaced, the truss's expansion bearings at Pier 6 were replaced, the steel deck truss was cleaned and painted and the substructure was repaired and modified as required. 637'-10¼" Bk. to Bk. Abutments. 62'-0" to 67'-8" out to out deck. In 2006 a scour mitigation plan was implemented. Road to be closed & traffic detoured during construction.

No salvage.



PLAN

SECTION B-B

WATERWAY INFORMATION

Drainage Area = 297.7 mi²

Exist. Overtopping Elev. 503.73 at Sta. 242+60
Prop. Overtopping Elev. 504.03 at Sta. 240+00

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	17500	2758	2784	468.4	0.8	0.7	469.2	469.1
Design	50	29100	3974	4014	472.5	0.8	0.8	473.3	473.3
Base	100	35000	4651	4701	474.3	0.8	0.8	475.1	475.1
	200	42000	5398	5398	476.1	0.9	0.9	477.0	477.0
Overtopping									
Max. Calc.	500	51000	6086	6188	477.7	1.1	0.9	478.8	478.6

10 year velocity through Existing Bridge = 5.9 fps
10 year velocity through Proposed Bridge = 5.8 fps

Event/Limit State	Design Scour Elevations (ft.) W. Abut.	Pier 1	Pier 2	Pier 3	E. Abut.	Item 113
0100	494.7	458.7	448.1	438.8	497.3	5
0200	494.7	458.7	448.1	437.8	497.3	
Design	494.7	458.7	448.1	438.8	497.3	
Check	494.7	458.7	448.1	437.8	497.3	

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Seismic Spectral Acceleration at 1.0 sec (S_{D1}) =0.080 g.
Seismic Spectral Acceleration at 0.2 sec (S_{DS}) =0.132 g.
Soil Site Class = C

HIGHWAY CLASSIFICATION

IL 116 - F.A.P. Rte. 669
Functional Class: Other Principal Arterial
ADT: 9100 (2015); 11103 (2035)
ADTT: 510 (2015); 623 (2035)
DHV: 910
Design Speed: 40 m.p.h.
Posted Speed: 40 m.p.h.
Two-way Traffic Directional Distribution 50:50

F.A.U. Rte. 6576
Functional Class: Major Collector (Urban)
ADT: 2200 (2012); 2685 (2032)
ADTT: 220 (2012); 269 (2032)
DHV: 220
Design Speed: 40 m.p.h.
Posted Speed: 40 m.p.h.
Two-way Traffic Directional Distribution 50:50

LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition, with 2015 & 2016 Interims.

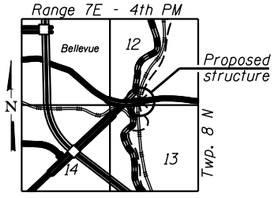
DESIGN STRESSES

FIELD UNITS

f'_c = 3,500 psi
f'_c = 4,000 psi (Superstructure Concrete)
f_y = 60,000 psi (reinforcement)
*f_y = 50,000 psi (M270 Grade 50)
* All new Structural steel shall be galvanized

ESTIMATED TOP OF ROCK ELEVATIONS

Location	Elevation
Pier 1	448.0
Pier 2	436.0
Pier 3	435.0



LOCATION SKETCH

Note: Free Fall Deck Drains will not be permitted in the span over railroad tracks or within 10' of cross arms of a railroad pole line.

GENERAL PLAN
IL. ROUTE 116 OVER KICKAPOO CREEK, U.P. RAILROAD, BNSF RAILROAD & KICKAPOO CREEK ROAD
F.A.P. RTE. 669 - SEC. (10R-VBY)BR
PEORIA COUNTY
STATION 245+55.76
STRUCTURE NO. 072-0249

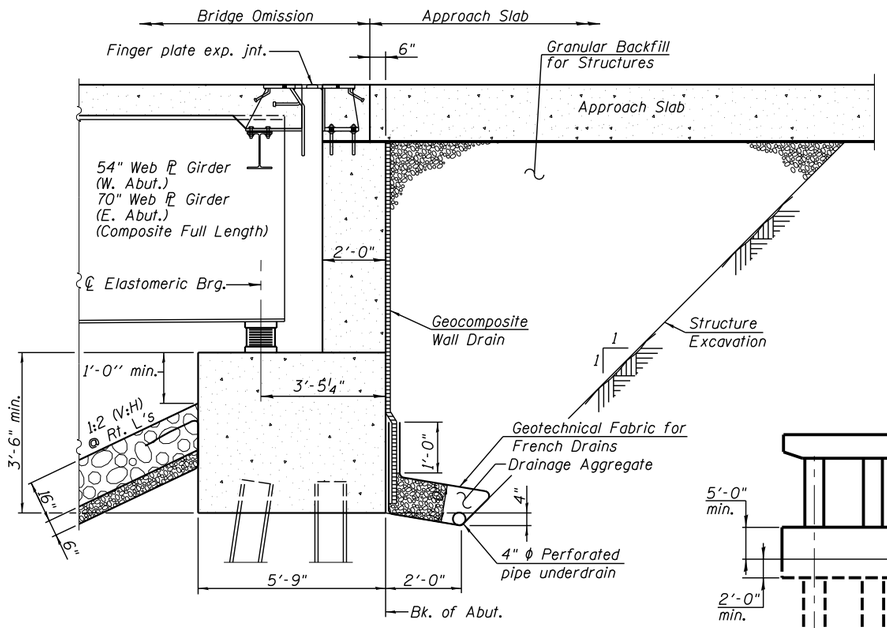
Veenstra & Kimm, Inc.
Springfield, IL. Phone: (217)544-8033

USER NAME = ___	DESIGNED - MAH	REVISED - 10-4-2017	
	CHECKED - KES	REVISED - ___	
PLOT SCALE = ___	DRAWN - JRP	REVISED - ___	
PLOT DATE = ___	CHECKED - MAH	REVISED - ___	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 072-0249
SHEET NO. 1 OF 2 SHEETS

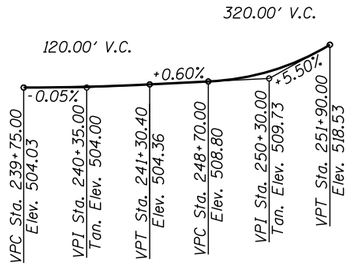
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
669	(10R-VBY)BR	PEORIA	___	___
		CONTRACT NO. 68898		
	ILLINOIS FED. AID PROJECT			



SECTION THRU ABUTMENT

(Horiz. dim. @ Rt. L's)

(East abutment shown, West abutment similar)

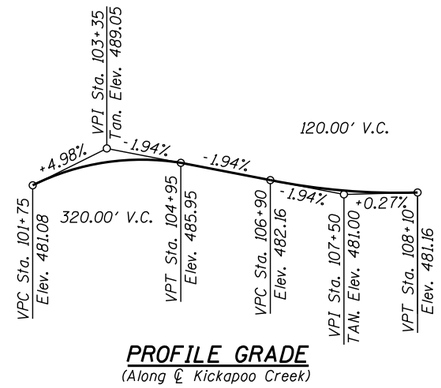


PROFILE GRADE

(Along ℄ IL 116)

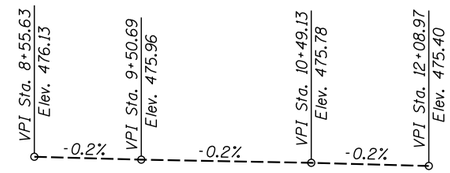
Station Equation:

240+52.60 (Bk.) = 240+88.00 (Ah.)



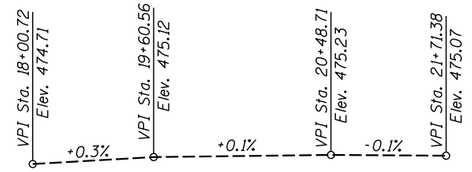
PROFILE GRADE

(Along ℄ Kickapoo Creek)



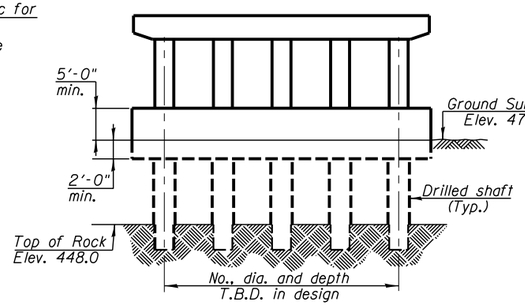
PROFILE GRADE

(Along BNSF Railroad)

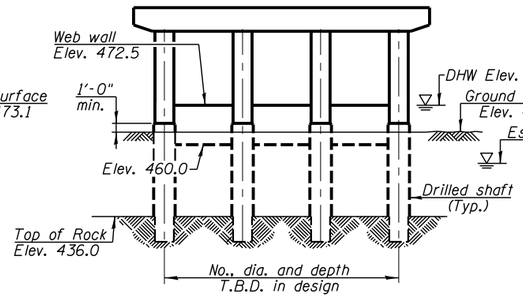


PROFILE GRADE

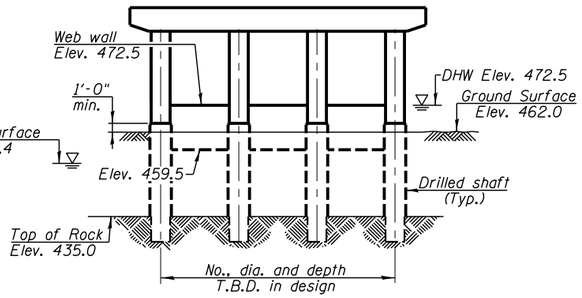
(Along U.P. Railroad)



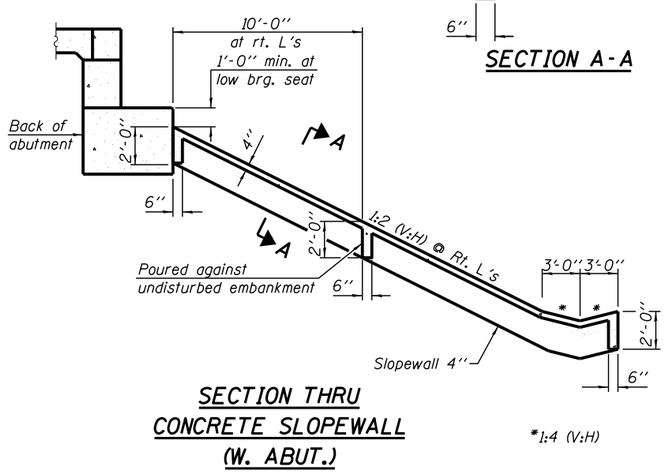
PIER 1 SKETCH



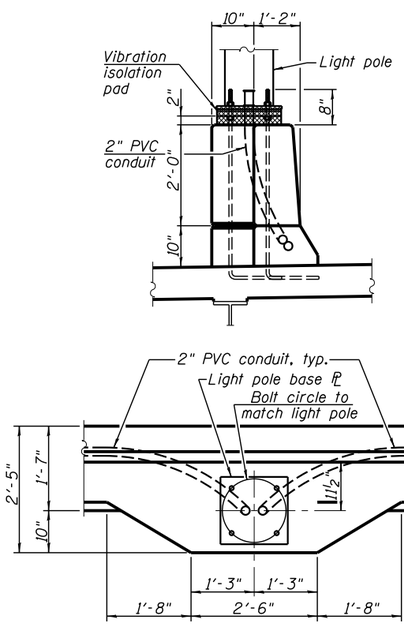
PIER 2 SKETCH



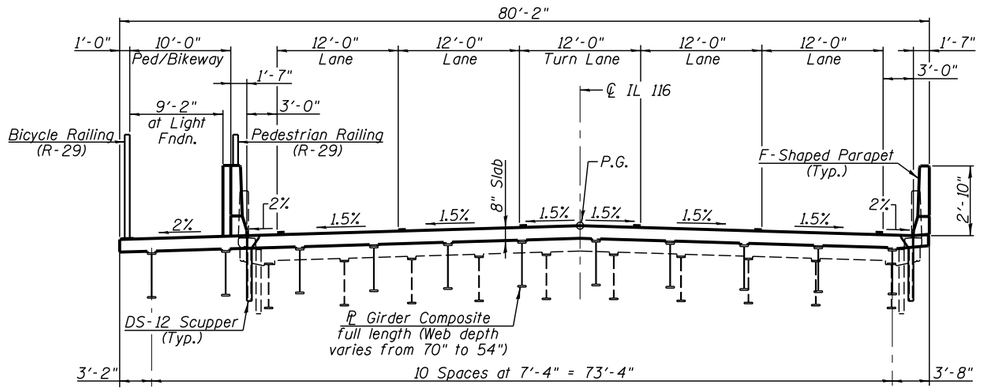
PIER 3 SKETCH



SECTION THRU CONCRETE SLOPEWALL (W. ABUT.)



LIGHT POLE MOUNTED ON PARAPET DETAILS



PROPOSED CROSS SECTION

DETAILS
IL. ROUTE 116 OVER KICKAPOO CREEK, U.P. RAILROAD, BNSF RAILROAD & KICKAPOO CREEK ROAD
F.A.P. RTE. 669 - SEC. (10R-VBY)BR
PEORIA COUNTY
STATION 245+55.76
STRUCTURE NO. 072-0249

Veenstra & Kimm, Inc.
Springfield, IL. Phone: (217)544-8033

USER NAME = ___	DESIGNED - MAH	REVISED - 10-4-2017	
	CHECKED - KES	REVISED - ___	
PLOT SCALE = ___	DRAWN - JRP	REVISED - ___	
PLOT DATE = ___	CHECKED - MAH	REVISED - ___	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 072-0249
SHEET NO. 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
669	(10R-VBY)BR	PEORIA	___	___
		CONTRACT NO. 68898		
	ILLINOIS FED. AID PROJECT			

EXHIBIT C

BORING LOGS

Illinois Department of Transportation

Bridge Foundation Boring Log

Sh. 1 of 1Sh.

PROJECT BHF-669(15) BRIDGE ILL. RTE. 116 OVER Date 12-19-86

ROUTE F.A. 669 KICKAPOO CREEK Bored By R. WARD

SEC. (10R,V,B,Y)-1 STA. PIER #1- 243+06.52 Checked By ROY SAETTLER

COUNTY PEORIA

Boring No. 1
Station 243+30
Offset 31' LT ℄

Surface Water El. —

Groundwater El. at Completion 459.6

After — Hours —

Elevation	N	Qu t/s.f.	w (%)
Ground Surface 482.2 / 0			
MOTTLED SILTY LOAM	3 / 16	2.2 S	17
	2 / 6	0.5 S	19
	1 / 2	0.4 B	25
FREE H_2O ▼ -10	1 / 3	0.3 B	24
	1 / 4	0.8 B	23
467.7			
GRAY SILTY CLAY LOAM -15	1 / 5	2.0 B	20
	1 / 5	0.9 B	31
-20	3 / 7	0.5 B	24
460.7			
CONTINUED NEXT COLUMN			

Elevation	N	Qu t/s.f.	w (%)
BROWN/GRAY SILTY CLAY LOAM	3 / 14	0.9 B	20
SEAM OF SANDY LOAM @ 23' TRACES COAL 24-25.5' -25	3 / 7	0.4 S	25
455.7			
MOTTLED SILTY CLAY LOAM SAND & GRAVEL SEAM	2 / 3	0.3 B	26
442.0			
MOTTLED SHALEY CLAY LOAM -30	4 / 12	1.5 S	21
	7 / 12	-	16
448.2			
GRAY SHALE -35	29 / 100 @5"	4.1 S	13
	29 / 50 @2"	-	13
441.7 -40	29 / 50 @3"	-	17
END OF BORING			
-45			

N-Standard Penetration Test-Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 No. hammer falling 30".

Qu-Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight-%.

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value
P - Penetrometer

BD 137 (Rev. 4-78)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/24/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-1
Station 239+98
Offset 53.0 ft RT
Ground Surface Elev. 504.20 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 470.7 ft ▼
Upon Completion Dry ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
503.5				TOPSOIL: 9"
	6 6 8	3.8 P	19	SILT (fill): Brown, stiff, trace clay
500.7				
-5	4 4 4	3.0 P	20	SILTY CLAY LOAM (fill): Gray-brown, trace iron, trace gravel LL: 32 PL: 17 PI: 15
498.2				
	4 7 9	1.1 B	19	SILTY LOAM (fill): Brown, stiff, some fine sand
495.7				
-10	4 4 7	2.3 P	15	FINE SAND: Brown, medium dense, trace clay, trace iron
493.2				
	5 6 9	>4.5 P	23	WEATHERED SHALE: Brown, gray, black, stiff
-15	7 5 6	>4.5 P	26	becomes brown, stiff, trace iron, trace sand and clay
	4 15 38		16	becomes black, hard
485.7				
-20	27 50/5"		24	COAL: Black, hard, possibly some weathered shale
483.2				COAL: Black, hard, possibly some weathered shale *(continued)*
	50/5"		16	WEATHERED SHALE: black, hard
-25	50/5.5"		11	becomes dark gray
	38 50/4"		12	
-30	35 50/5"		12	
▼				
-35	18 40 50/3"		14	trace sand
466.5	50/3"		2	Spoon sent after Auger Refusal @ 37.5' Gray rock fragment
-40				Boring terminated at 37.8 ft.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/26/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-2
Station 243+78
Offset 106.5 ft RT
Ground Surface Elev. 477.30 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT: Brown, stiff, trace iron, trace clay, trace gravel, trace organics				
		3 6 7	2.0 P	19
becomes black/dark brown, with gravel		7 50/4"		9
472.8				
Boring terminated at 4.7 ft.	-5			
	-10			
	-15			
	-20			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/26/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-2A
Station 244+01
Offset 106.5 ft RT
Ground Surface Elev. 477.30 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Blind drilled to 6'
-5				
471.3				
	5 2 3	1.3 P	17	SILTY LOAM: Brown-orange, medium stiff, trace iron, trace gravel, some silt bands
468.8				
	5 18 40		10	WEATHERED SANDSTONE: Light brown, hard, iron staining, dry
-10				
466.3				
	18 45 50/4"		9	SHALE: Light blue-gray, hard, dry, friable
463.8				
	28 50/6"		8	SANDY SHALE: Brown with some gray, some iron staining
-15				
	9 15 29		10	becomes light brown, trace iron staining
458.8				
	23 37 50/6"		10	SHALE: Light blue-gray, hard, dry, trace iron staining, friable
-20				
				SHALE: Light blue-gray, hard, dry, trace iron staining, friable *(continued)*
	25 50/4"		9	
	29 50/6"		9	
Spoon Refusal @ 24.5' 452.8				
Boring terminated at 24.5 ft.				
-25				
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/25/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-4
Station 245+41
Offset 52.0 ft RT
Ground Surface Elev. 462.00 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 447.5 ft ▼
Upon Completion 447.5 ft ▽
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
461.7				TOPSOIL: 4"
	8 4 5	2.0 P	15	SANDY SILT: Brown, stiff, trace iron, trace clay
-5	4 2 3	0.8 P	16	becomes dark brown, medium stiff, fine sand, trace clay
456.0				
	3 2 2	0.4 B	20	SILTY LOAM: Dark brown, soft, moist, trace iron, trace sand
-10		0.3 P	27	SHELBY TUBE RECOVERY: 21" LL: 26 PL: 18 PI: 8
451.0				
	0 2 2	0.3 P	26	SILTY CLAY LOAM: Brown, soft, moist, trace gravel, trace sand, trace silt LL: 38 PL: 18 PI: 20
448.5				
-15 ▼	6 8 6		23	SAND: Brown, medium dense, moist, fine to medium, trace gravel
	1 1 1		25	very loose
-20	0 4 4		25	loose

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	7 9 8		17	SAND: Brown, medium dense, moist, fine to medium, trace gravel *(continued)* medium dense
438.5				
-25	5 6 5		10	GRAVEL: Multiple colors, medium dense, wet
436.0				
	11 26 50/6"	>4.5 P	14	SHALE: Gray, hard
-30	38 50/5"		15	
427.5	24 50/6"		15	
-35				Borehole continued with rock coring.
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

ROCK CORE LOG

Date 8/25/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **CORING METHOD** Conventional

STRUCT. NO. 072-0037
Station

BORING NO. SB-4
Station 245+41
Offset 52.0 ft RT
Ground Surface Elev. 462.00 ft

CORING BARREL TYPE & SIZE NQ

Core Diameter in
Top of Rock Elev. 436.00 ft
Begin Core Elev. 427.50 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray, fissile	427.50	-35	1	100	92	1.61	8.7
		-40					
		-45	2	96	92	1.96	36.0
		-50					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Kaskaskia Engineering Group, LLC

ROCK CORE LOG

Date 8/25/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **CORING METHOD** Conventional

STRUCT. NO. 072-0037
Station

BORING NO. SB-4
Station 245+41
Offset 52.0 ft RT
Ground Surface Elev. 462.00 ft

CORING BARREL TYPE & SIZE NQ
Core Diameter in
Top of Rock Elev. 436.00 ft
Begin Core Elev. 427.50 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray, fissile *(continued)*	-55	3	82	78	1.8	21.8
	402.50					
End of Boring	-60					
	-65					
	-70					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/26/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-5
Station 245+38
Offset -25.0 ft LT
Ground Surface Elev. 462.50 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 445.5 ft ▼
Upon Completion 432.5 ft ▽
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Rip-Rap
461.5				
	28 17 8		7	Rock and Rip-Rap residuals
459.0				
	8 6 4	3.0 P	19	SILTY LOAM: Green-gray, stiff, trace sand, trace silt bands, rip-rap residual
-5				
	2 1 1	0.3 B	33	becomes dark brown, soft, moist, trace iron, more clay
	2 1 1	0.4 B	28	no iron, trace sand
-10				
		0.3 B	32	SHELBY TUBE RECOVERY: 26.25" LL: 35 PL: 20 PI: 15
449.0				
	1 1 2	0.3 B	34	CLAY: Brown, soft, moist, trace organics, trace silt, trace sand
-15				
445.5 ▼	0 1 3	<0.25 P	33	
				GRAVELLY SANDY LOAM: Dark gray, fine, trace shells and organics, trace gravel, some sandy clay
	0 1 3		17	becomes brown, trace gravel and rock, wet, fine to medium, trace clay
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
441.5				
	3 2 3		21	GRAVEL: Weathered rocks, medium dense, wet, trace brown clay, trace sand
	3 2 4		15	sand is fine to medium
-25				
436.5				
	16 40 50/6"		11	SHALE: Gray, hard, dry
	15 31 45		16	
▽ -30				
428.6	50/5"		16	
				Boring terminated at 33.9 ft.
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/27/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-6
Station 247+27
Offset 19.0 ft RT
Ground Surface Elev. 461.60 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 449.1 ft ▼
Upon Completion N/A ft
After 15 **Hrs.** 450.5 ft ▽

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				SAND: Fine
460.6				
	6 5 3	1.3 P	21	CLAYEY SILT: Dark brown, medium stiff, trace fine sand, trace gravel/rock
				trace iron
-5	2 3 3	0.5 B	20	
455.6				
	2 1 2	0.4 B	31	SILTY CLAY LOAM: Dark brown, soft, moist, trace organics, trace silt LL: 42 PL: 22 PI: 20
453.1				
-10		0.3 P	27	SILTY LOAM: Brown SHELBY TUBE RECOVERY: 24.5" LL: 31 PL: 21 PI: 10
450.6 ▽				
	5 6 5	0.9 B	13	SILTY SAND: Dark gray, stiff, moist, fine sand, trace iron, trace clay
448.1				
	2 2 7		19	GRAVELLY SANDY LOAM: Gray-brown, stiff, moist, fine to medium, trace gravel
-15				
	1 2 4		27	fine sand, with gray clay, wet, trace gravel
	3 5 8		12	becomes brown, fine to medium, trace river gravel, wet
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	5 11 10		6	GRAVELLY SANDY LOAM: Gray-brown, stiff, moist, fine to medium, trace gravel *(continued)* coarse sand and gravel, multiple colors, wet
438.1				
	10 10 7		10	GRAVEL: Coarse, wet, trace sand
-25				
435.1	13 50/4"		13	SHALE: Dark gray, hard, dry, friable
	33 50/5"		14	stopped drilling on 8/27/15, resumed with rock coring on 8/28/2015
432.1				Borehole continued with rock coring.
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

ROCK CORE LOG

Date 8/27/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **CORING METHOD** Conventional

STRUCT. NO. 072-0037
Station

BORING NO. SB-6
Station 247+27
Offset 19.0 ft RT
Ground Surface Elev. 461.60 ft

CORING BARREL TYPE & SIZE NQ
Core Diameter in
Top of Rock Elev. 435.10 ft
Begin Core Elev. 432.10 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray, clayey	432.10	1			2.96	
Core stuck/destroyed in barrel Only 8.5" of core sample recovered at bottom of Run #1	-30					
	427.10	2	70	70	1.16	9.0
hard	-35					
	422.10	3	100	100	1.47	10.0
some interbedded layers of gravel, hard, more clayey, fissile	-40					
	-45					
	412.10					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Kaskaskia Engineering Group, LLC

ROCK CORE LOG

Date 8/27/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **CORING METHOD** Conventional

STRUCT. NO. 072-0037
Station

BORING NO. SB-6
Station 247+27
Offset 19.0 ft RT
Ground Surface Elev. 461.60 ft

CORING BARREL TYPE & SIZE NQ
Core Diameter in
Top of Rock Elev. 435.10 ft
Begin Core Elev. 432.10 ft

DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray	4	71	69	1.32	9.4
-50					
-55					
lost last 3 ft. of Run #4 upon sampler retrieval					
402.10					
End of Boring					
-60					
-65					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 8/31/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-7
Station 247+54
Offset -45.0 ft LT
Ground Surface Elev. 462.60 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 452.6 ft
Upon Completion Dry ft
After 16 **Hrs.** 452.4 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				SAND: fine
461.6				
	5 9 10	1.5 P	16	SANDY SILT: Brown, stiff, gravel, trace fine sand
459.1				
	4 2 2	0.8 B	20	CLAYEY SILT: Brown, soft, trace organics, trace sand
-5				
456.6				
	1 1 2	<0.25 P	26	SILTY LOAM: Brown, soft, slightly moist, trace sand bands of silt and sand
	2 1 1	0.3 B	29	no sand
-10				
		1.3 P	28	SHELBY TUBE RECOVERY: 26" LL: 27 PL: 17 PI: 10
449.1				
	1 1 4	0.4 B	29	CLAY: Gray, medium stiff, moist, trace organics, trace silt, trace sand
-15				
446.6				
	4 10 7		15	GRAVELLY SAND: Multi-color, fine to medium, wet, trace gravel
	2 0 1		32	becomes dark gray, very loose, very moist, fine sand, trace clay, trace gravel
-20				
				(low recovery)
	7 13 10		9	GRAVELLY SAND: Multi-color, fine to medium, wet, trace gravel *(continued)* becomes multi-color, medium dense, medium sand, wet, trace clay
	11 12 13		15	fine to medium, medium dense, wet, with gravel
-25				
436.1				
	26 50/3"		13	SHALE: Gray, hard, breaks easily
	24 50/5"		13	
-30				
	24 50/5.5"		14	
428.1				
-35				Borehole continued with rock coring.
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Kaskaskia Engineering Group, LLC

ROCK CORE LOG

Date 8/31/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **CORING METHOD** Conventional

STRUCT. NO. 072-0037
Station

BORING NO. SB-7
Station 247+54
Offset -45.0 ft LT
Ground Surface Elev. 462.60 ft

CORING BARREL TYPE & SIZE NQ

Core Diameter in
Top of Rock Elev. 437.10 ft
Begin Core Elev. 428.10 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray, some clay	428.10	-35	1	92	77	1.1	3.2
hard		-40	2	97	93	1.3	7.8
		-45					
		-50	3	100	97	1.6	31.3

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Kaskaskia Engineering Group, LLC

ROCK CORE LOG

Date 8/31/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **CORING METHOD** Conventional

STRUCT. NO. 072-0037
Station

BORING NO. SB-7
Station 247+54
Offset -45.0 ft LT
Ground Surface Elev. 462.60 ft

CORING BARREL TYPE & SIZE NQ

Core Diameter in
Top of Rock Elev. 437.10 ft
Begin Core Elev. 428.10 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray, some clay *(continued)*	-55					
	403.10					
End of Boring	-60					
	-65					
	-70					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 9/1/15

ROUTE FAP 669 **DESCRIPTION** IL 116 over Kickapoo Creek and UPRR **LOGGED BY** KEG

SECTION (10R-VBY)BR **LOCATION** Bellevue, IL

COUNTY Peoria **DRILLING METHOD** HSA **HAMMER TYPE** Automatic

STRUCT. NO. 072-0037
Station

BORING NO. SB-8
Station 248+73
Offset -49.0 ft LT
Ground Surface Elev. 475.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND (fill): Fine				
474.4				
SILT: Dark brown, some orange-brown, trace gravel, trace sand, trace clay		7 11 9	2.5 P	14
471.9				
GRAVEL and FINE SAND: Brown, fine to some medium, trace clay, trace silt	-5	12 13 15		9
469.4				
WEATHERED ROCK (Sandstone and Shale): Orange-yellow, with some gray, very dense, friable		11 11 16	>4.5 P	14
becomes light gray with orange staining, hard, friable, some clay	-10	6 13 35		12
464.4				
SHALE: Light gray, hard, trace iron staining, friable		9 44 50/4"		9
highly weathered	-15	22 50/5.5"		8
		34 50/5"		7
some brown, trace orange staining	-20	15 48 50/4"		9

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SHALE: Light gray, hard, trace iron staining, friable *(continued)*				
Spoon Refusal @ 24.3'	451.1	42 50/4"		7
Boring terminated at 24.3 ft.	-25			
	-30			
	-35			
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

EXHIBIT D

SUBSURFACE PROFILE

Elevation (ft)

505 500 495 490 485 480 475 470 465 460 455 450 445 440

SB-1

Top El. 504.2

N	Qu	w%	
14	3.8	19	TOPSOIL: 9"
			SILT (fill): Brown, stiff, trace clay
8	3.0	20	SILTY CLAY LOAM (fill): Gray-brown, trace iron, trace gravel
16	1.1	19	SILTY LOAM (fill): Brown, stiff, some fine sand
11	2.3	15	FINE SAND: Brown, medium dense, trace clay, trace iron
15	>4.5	23	
11	>4.5	26	WEATHERED SHALE: Brown, gray, black, stiff
53	-	16	
50/5"	-	24	COAL: Black, hard, possibly some weathered shale
50/5"	-	16	
50/5.5"	-	11	
50/4"	-	12	
50/5"	-	12	SHALE: black, hard
50/3"	-	14	
50/3"	-	2	Bottom El. 466.5

B-1 (IDOT 1986)

*Not shown in actual location

Top El. 482.2

N	Qu	w%	
16	2.2	17	
6	0.5	19	
2	0.4	25	SILTY LOAM: Mottled
3	0.3	24	
4	0.8	23	
5	2.0	20	
5	0.9	31	SILTY CLAY LOAM: Gray
7	0.5	24	
14	0.9	20	
7	0.4	25	SILTY CLAY LOAM: Brown/Gray
3	0.3	26	SILTY CLAY LOAM: Mottled, sand and gravel seam
12	1.5	21	
12	-	16	SHALEY CLAY LOAM: Mottled
100/5"	4.1	13	
50/2"	-	13	SHALE: Gray
50/3"	-	17	
			Bottom El. 441.7

SB-2

Top El. 477.3

N	Qu	w%	
13	2.0	19	SILT: Brown, stiff, trace iron, trace clay, trace gravel, trace organics
50/4"	-	9	
			Bottom El. 472.8

Kaskaskia Engineering Group, LLC

SUBSURFACE PROFILE: IL 116 over Kickapoo Creek

Route: F.A.P. 669

Section: (10R-VBY) BR

County: Peoria

PRINTERMOD2 11X17 11-1014 SOIL PROFILE KICKAPOO CREEK.GPJ IL_DOT.GDT 10/12/15

Elevation (ft)

480
470
460
450
440
430
420
410
400

SB-2A

N	Qu	w%	
			Top El. 477.3
			Blind drilled to 6'
5	1.3	17	SILTY LOAM: Brown-orange, medium stiff, trace iron, trace gravel, some silt bands
58	-	10	WEATHERED SANDSTONE: Light brown, hard, iron staining, dry
50/4"	-	9	SHALE: Light blue-gray, hard, dry, friable
50/6"	-	8	
44	-	10	SANDY SHALE: Brown with some gray, some iron staining
50/6"	-	10	
50/4"	-	9	SHALE: Light blue-gray, hard, dry, trace iron staining, friable
50/6"	-	9	Bottom El. 452.8

SB-4

N	Qu	w%	
			Top El. 462.0
9	2.0	15	TOPSOIL: 4"
5	0.8	16	SANDY SILT: Brown, stiff, trace iron, trace clay
4	0.4	20	
-	0.3	27	SILTY LOAM: Dark brown, soft, moist, trace iron, trace sand
4	0.3	26	SILTY CLAY LOAM: Brown, soft, moist, trace gravel, trace sand, trace silt
14	-	23	
2	-	25	
8	-	25	SAND: Brown, medium dense, moist, fine to medium, trace gravel
17	-	17	
11	-	10	GRAVEL: Multiple colors, medium dense, wet
50/6"	>4.5	14	
50/5"	-	15	SHALE: Gray, hard
50/6"	-	15	
-	8.7	-	
			SHALE: Gray, fissile
-	36.0	-	
-	21.8	-	
			Bottom El. 402.5

SB-5

N	Qu	w%	
			Top El. 462.5
25	-	7	Rip-Rap
			Rock and Rip-Rap residuals
10	3.0	19	
2	0.3	33	
2	0.4	28	SILTY LOAM: Green-gray, stiff, trace sand, trace silt bands, rip-rap residual
-	0.3	32	
3	0.3	34	
4	<0.25	33	CLAY: Brown, soft, moist, trace organics, trace silt, trace sand
4	-	17	GRAVELLY SANDY LOAM: Dark gray, fine, trace shells and organics, trace gravel, some sandy clay
5	-	21	
6	-	15	GRAVEL: Weathered rocks, medium dense, wet, trace brown clay, trace sand
50/6"	-	11	
76	-	16	SHALE: Gray, hard, dry
50/5"	-	16	
			Bottom El. 428.6

Kaskaskia Engineering Group, LLC

SUBSURFACE PROFILE: IL 116 over Kickapoo Creek

Route: F.A.P. 669

Section: (10R-VBY)BR

County: Peoria

PRINTERMOD2 11X17 11-1014 SOIL PROFILE KICKAPOO CREEK.GPJ IL_DOT.GDT 10/12/15

Elevation (ft)

480
470
460
450
440
430
420
410
400

SB-6

Top El. 461.6

N	Qu	w%	
8	1.3	21	SAND: Fine
6	0.5	20	CLAYEY SILT: Dark brown, medium stiff, trace fine sand, trace gravel/rock
3	0.4	31	SILTY CLAY LOAM: Dark brown, soft, moist, trace organics, trace silt
-	0.3	27	SILTY LOAM: Brown
11	0.9	13	SILTY SAND: Dark gray, stiff, moist, fine sand, trace iron, trace clay
9	-	19	
6	-	27	
13	-	12	GRAVELLY SANDY LOAM: Gray-brown, stiff, moist, fine to medium, trace gravel
21	-	6	
17	-	10	GRAVEL: Coarse, wet, trace sand
50/4"	-	13	SHALE: Dark gray, hard, dry, friable
50/5"	-	14	
	- 9.0 -		SHALE: Gray, clayey
	- 10.0 -		
	- 9.4 -		SHALE: Gray

Bottom El. 402.1

SB-7

Top El. 462.6

N	Qu	w%	
19	1.5	16	SAND: fine
4	0.8	20	SANDY SILT: Brown, stiff, gravel, trace fine sand
3	<0.25	26	CLAYEY SILT: Brown, soft, trace organics, trace sand
2	0.3	29	SILTY LOAM: Brown, soft, slightly moist, trace sand
-	1.3	28	bands of silt and sand
5	0.4	29	CLAY: Gray, medium stiff, moist, trace organics, trace silt, trace sand
17	-	15	
1	-	32	
23	-	9	GRAVELLY SAND: Multi-color, fine to medium, wet, trace gravel
25	-	15	
50/3"	-	13	
50/5"	-	13	SHALE: Gray, hard, breaks easily
50/5.5"	-	14	
	- 3.2 -		
	- 7.8 -		SHALE: Gray, some clay
	- 31.3 -		

Bottom El. 403.1

SB-8

Top El. 475.4

N	Qu	w%	
20	2.5	14	SAND (fill): Fine
28	-	9	SILT: Dark brown, some orange-brown, trace gravel, trace sand, trace clay
27	>4.5	14	GRAVEL and FINE SAND: Brown, fine to some medium, trace clay, trace silt
48	-	12	WEATHERED ROCK (Sandstone and Shale): Orange-yellow, with some gray, very dense, friable
50/4"	-	9	
50/5.5"	-	8	
50/5"	-	7	
50/4"	-	9	SHALE: Light gray, hard, trace iron staining, friable
50/4"	-	7	

Bottom El. 451.1

Kaskaskia Engineering Group, LLC

SUBSURFACE PROFILE: IL 116 over Kickapoo Creek

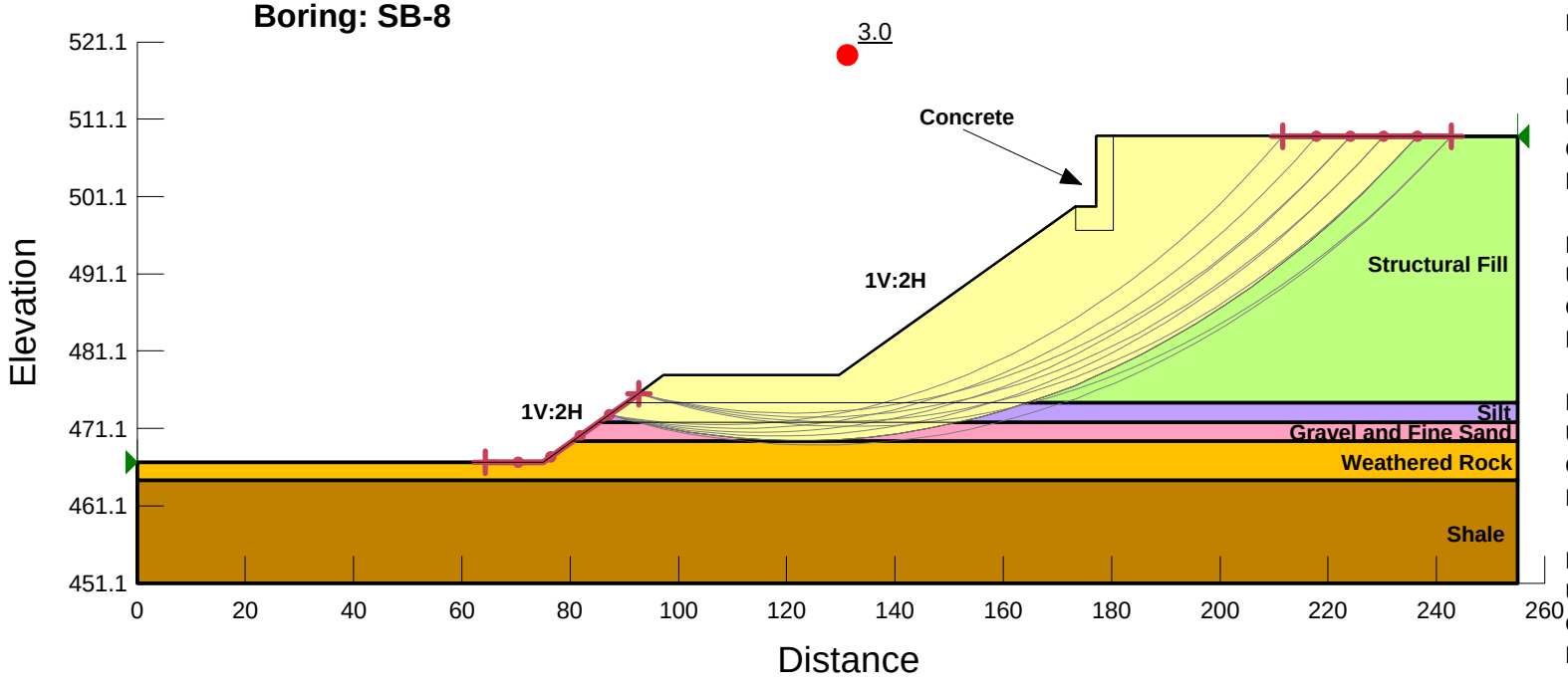
Route: F.A.P. 669
Section: (10R-VBY)BR
County: Peoria

PRINTERMOD2 11X17 11-1014 SOIL PROFILE KICKAPOO CREEK.GPJ IL_DOT.GDT 10/12/15

EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Full Slope
EOC Analysis
Boring: SB-8



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °

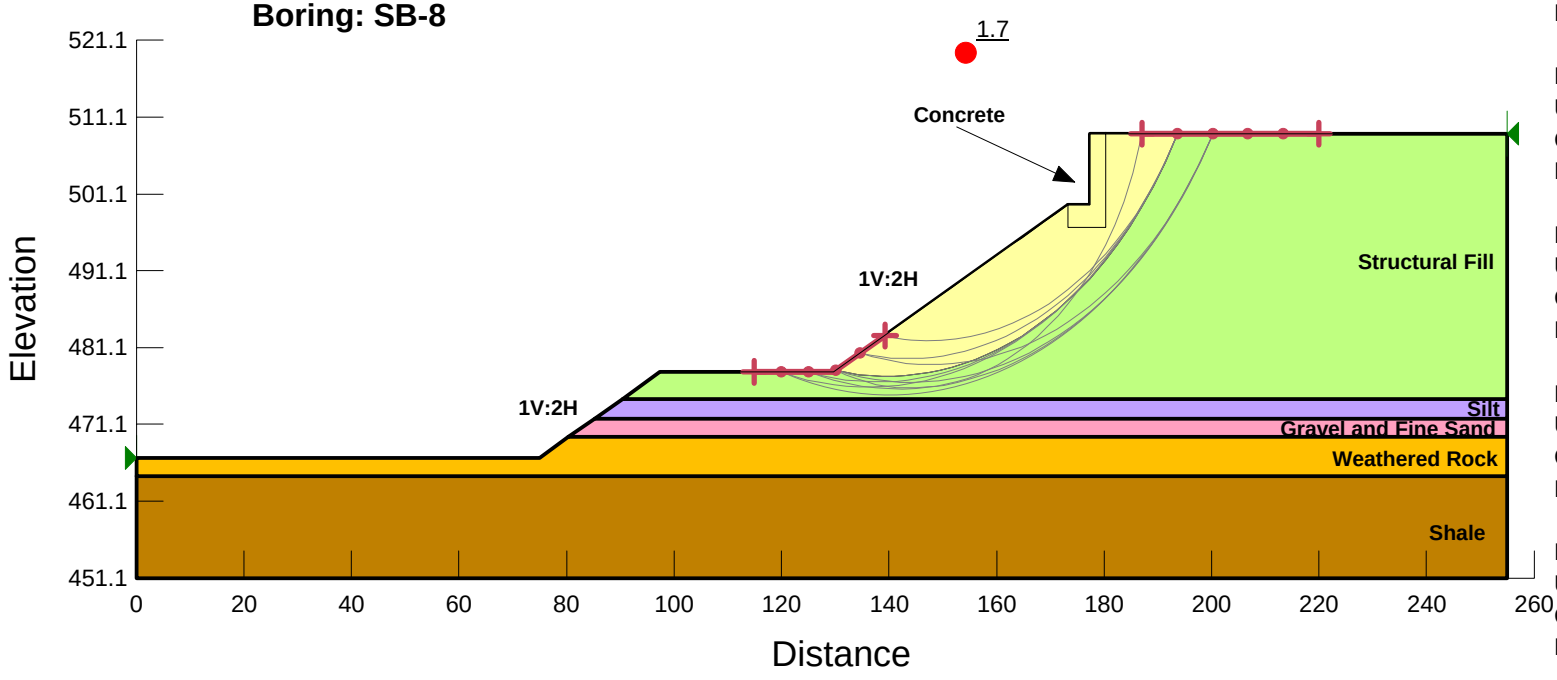
Name: Silt
Unit Weight: 115 pcf
Cohesion': 2,500 psf
Phi': 0 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Full Slope
LT Analysis
Boring: SB-8



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °

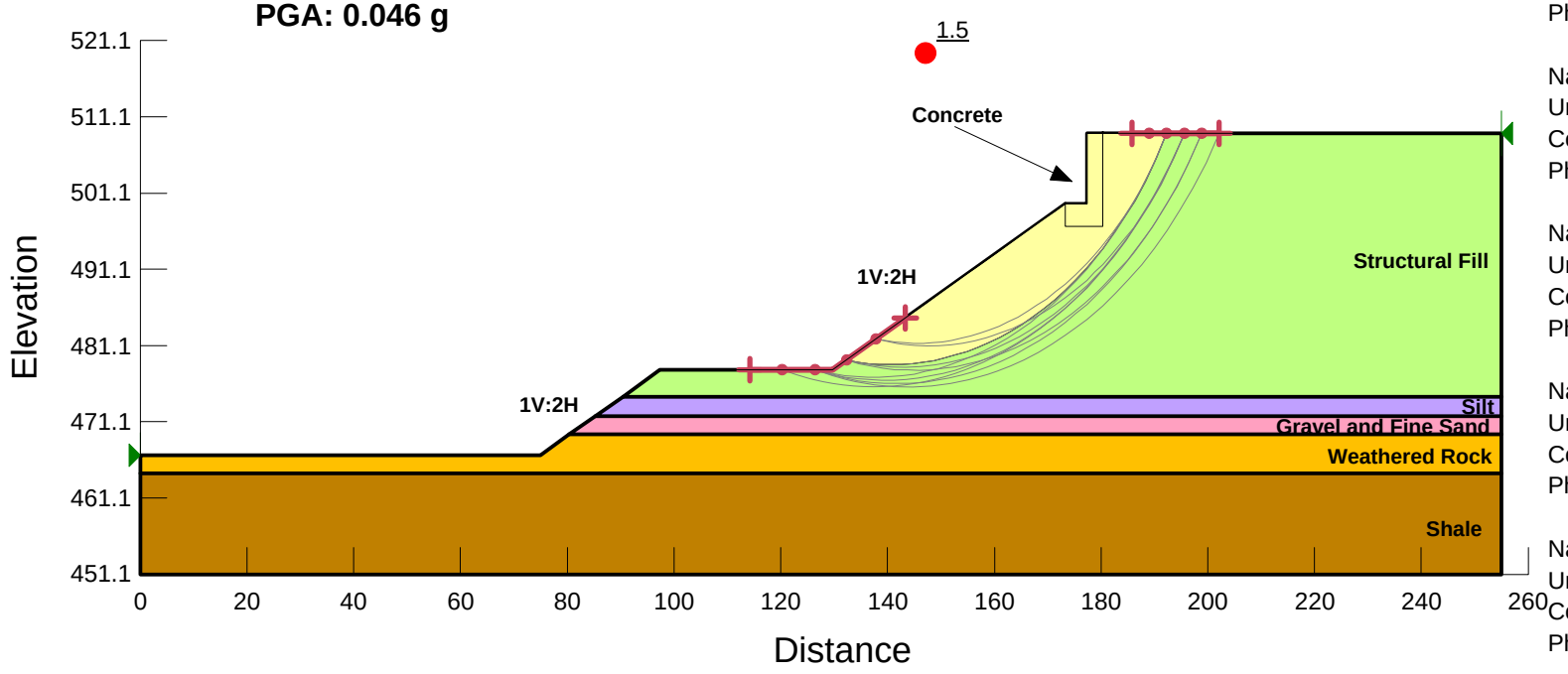
Name: Silt
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Full Slope
Seismic Analysis
Boring: SB-8
PGA: 0.046 g



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °

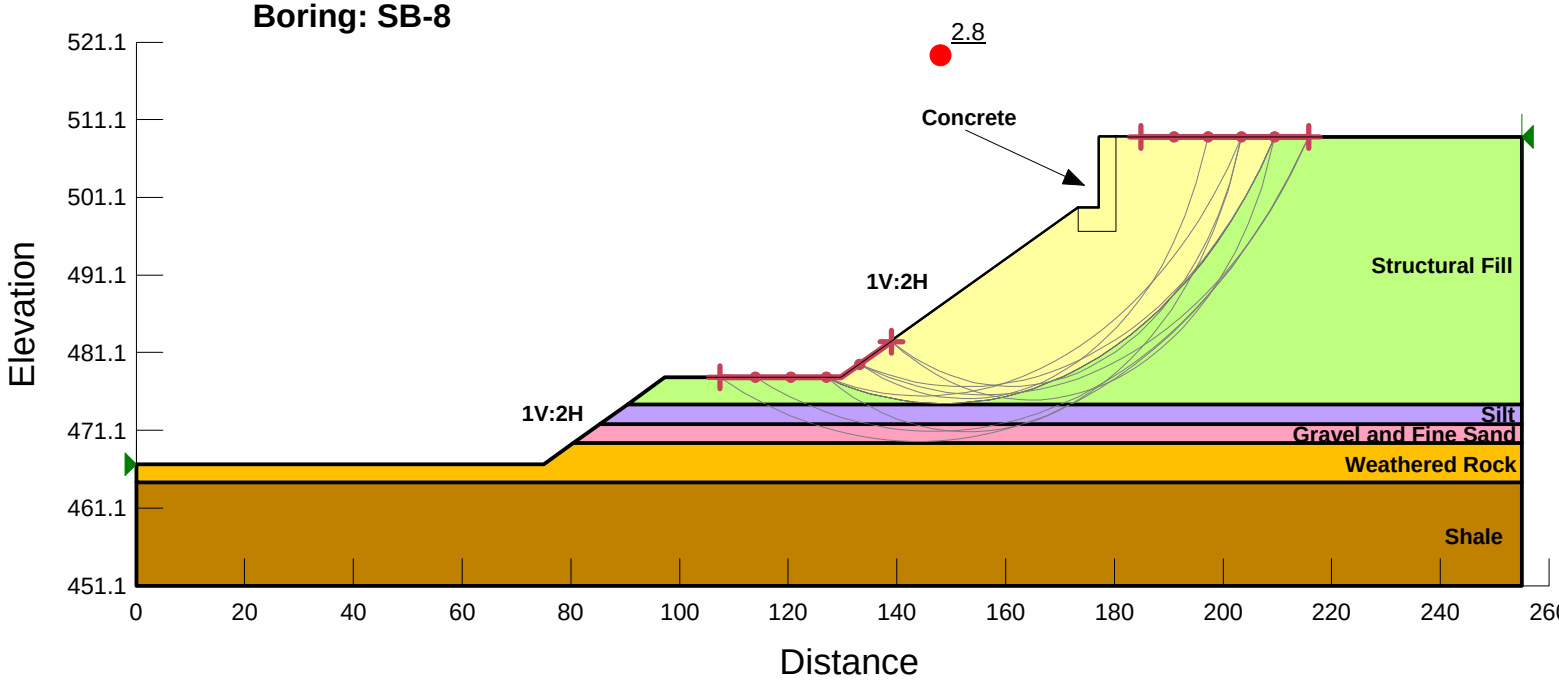
Name: Silt
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Top Slope
EOC Analysis
Boring: SB-8



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °

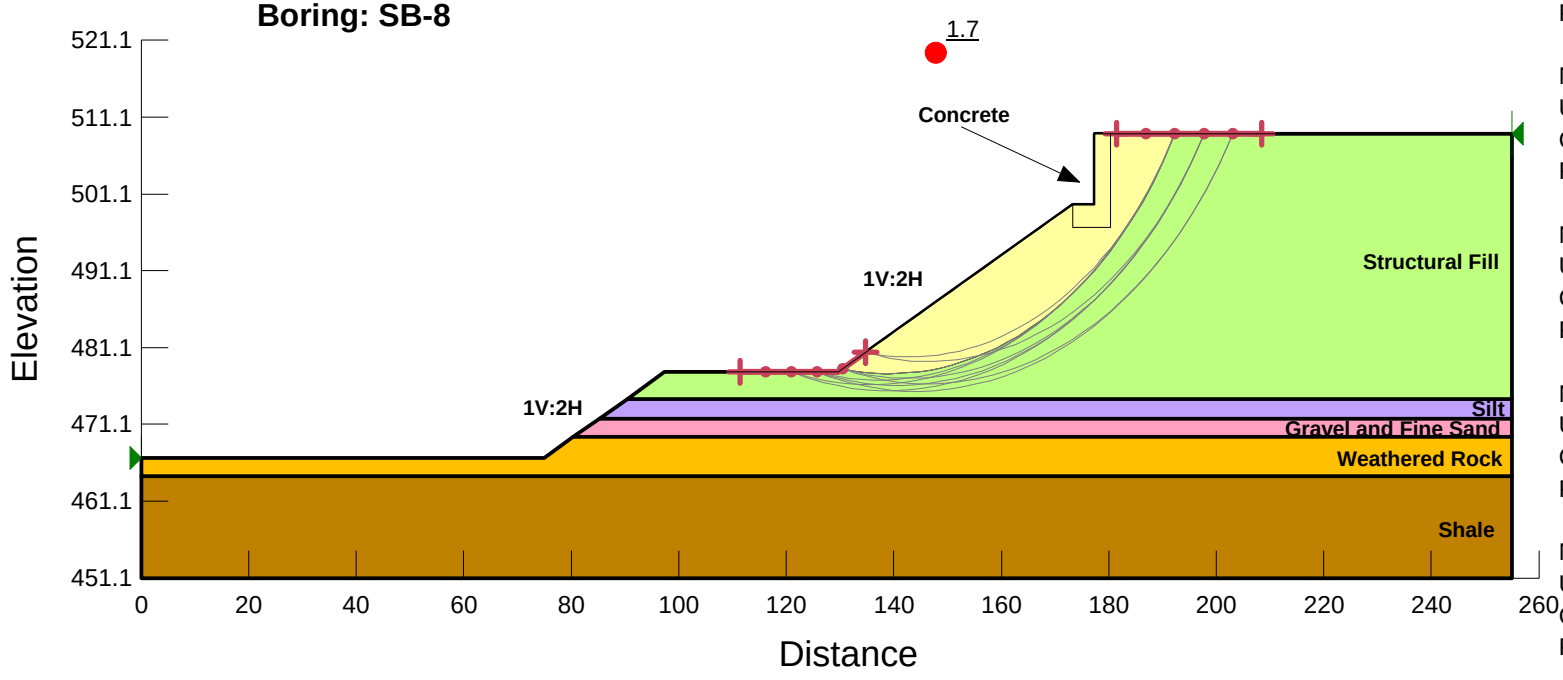
Name: Silt
Unit Weight: 115 pcf
Cohesion': 2,500 psf
Phi': 0 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Top Slope
LT Analysis
Boring: SB-8



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °

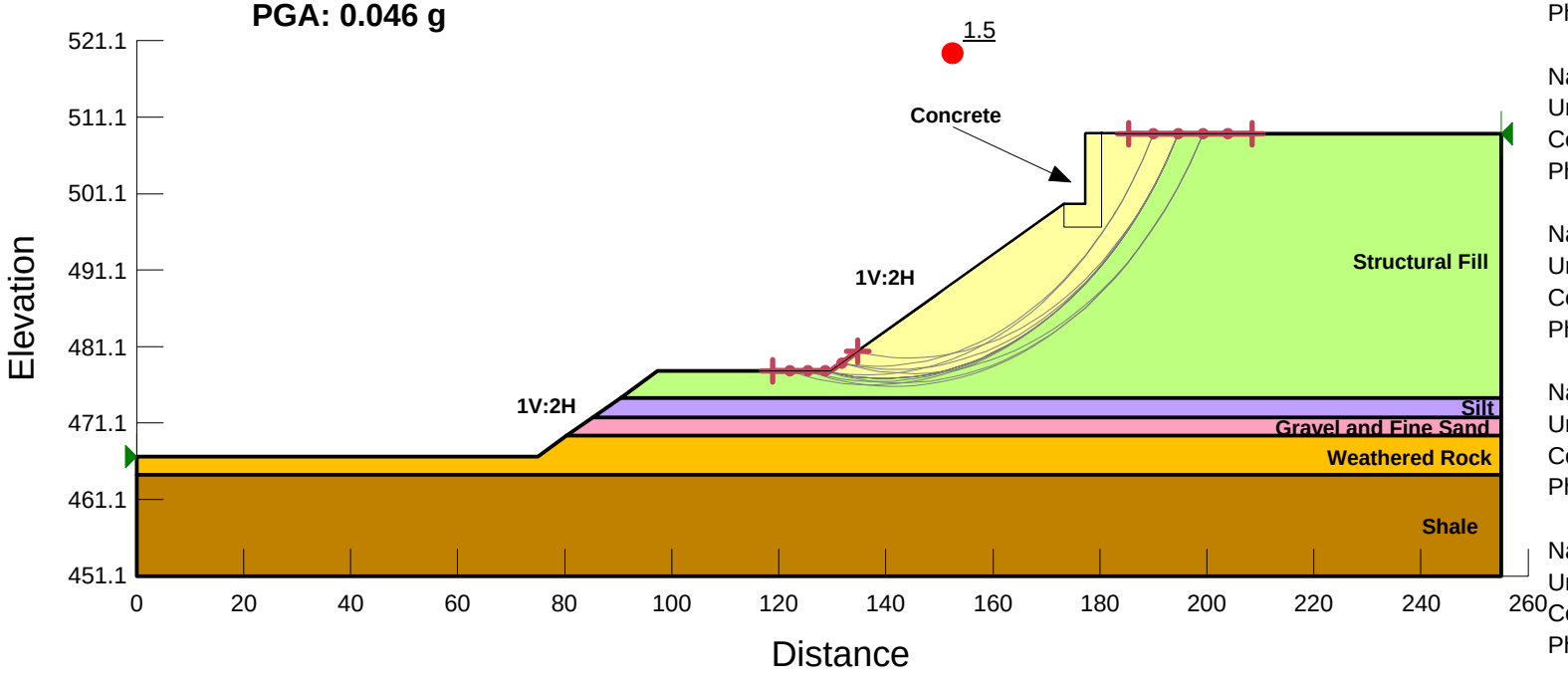
Name: Silt
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Top Slope
Seismic Analysis
Boring: SB-8
PGA: 0.046 g



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °

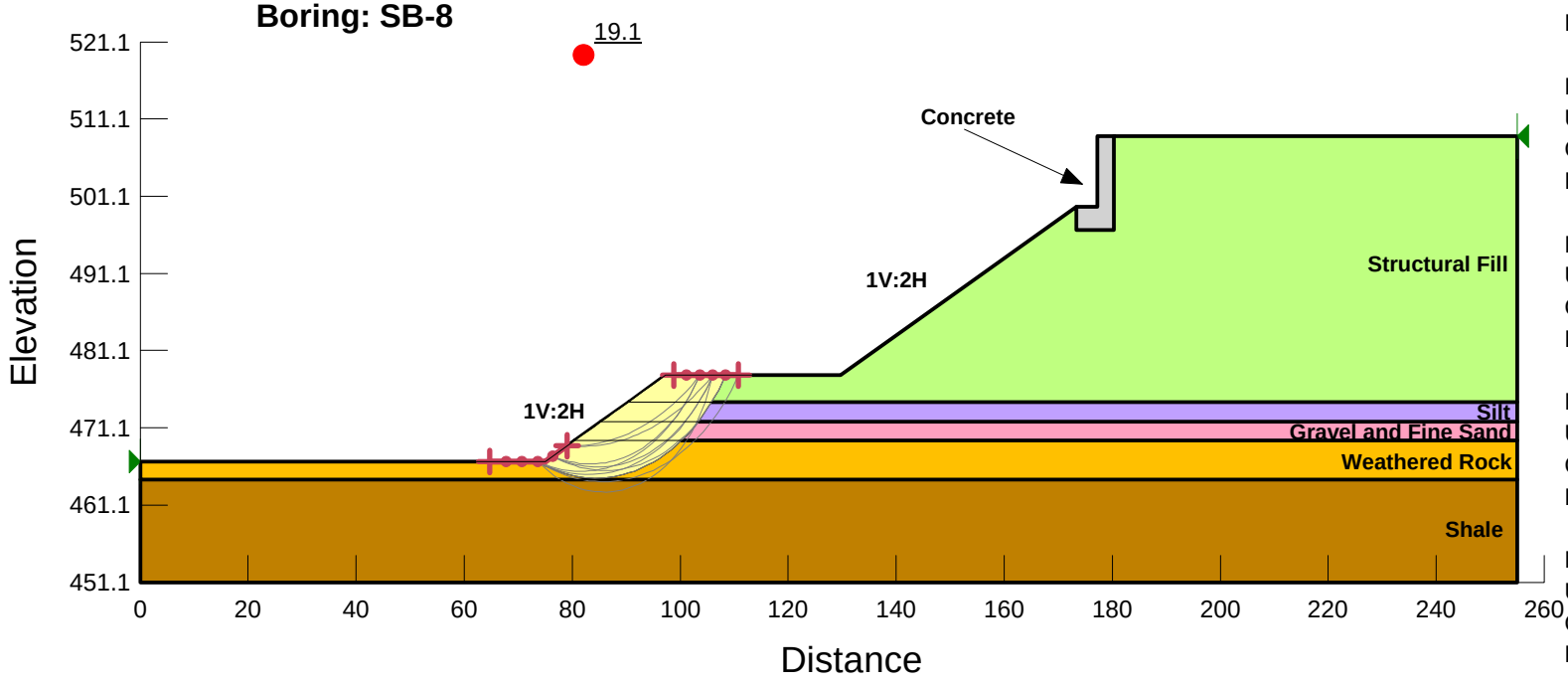
Name: Silt
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Bottom Slope
EOC Analysis
Boring: SB-8



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °

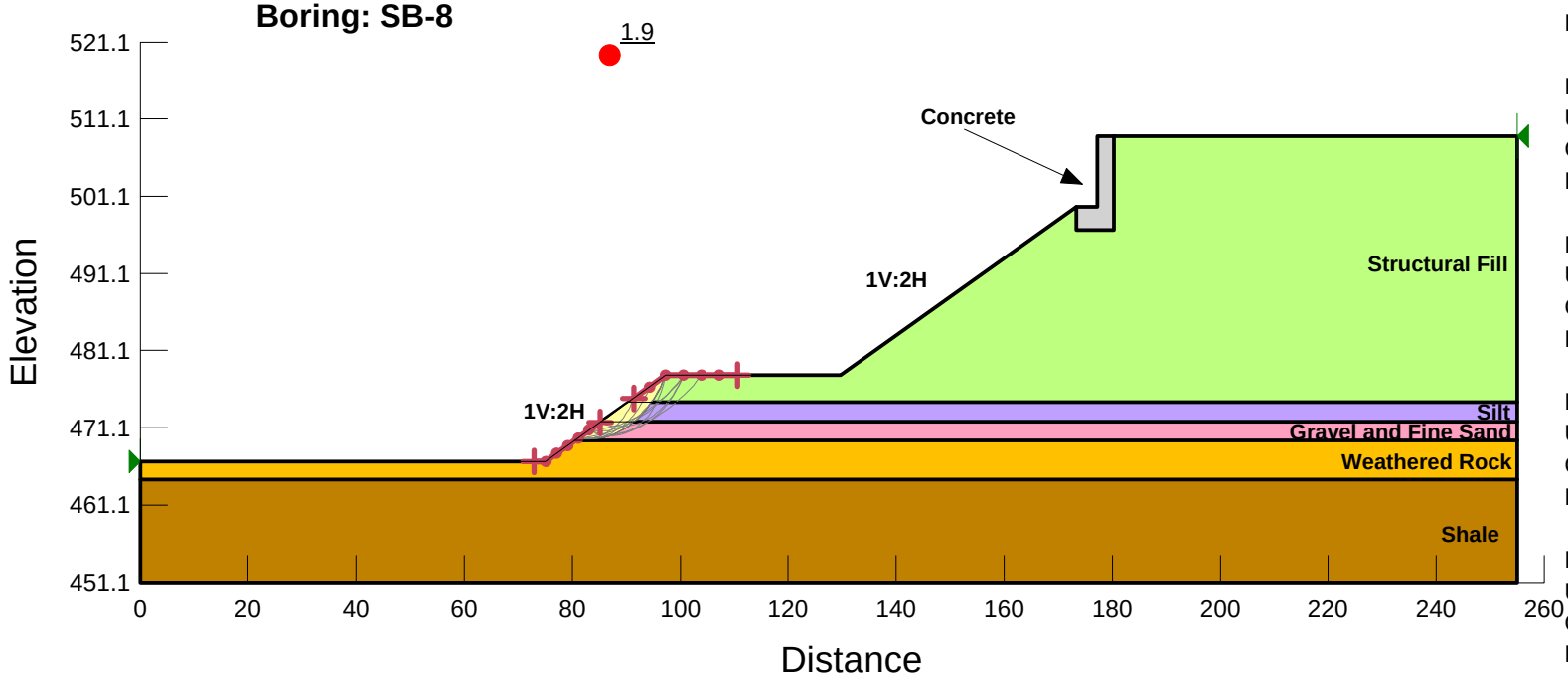
Name: Silt
Unit Weight: 115 pcf
Cohesion': 2,500 psf
Phi': 0 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Bottom Slope
LT Analysis
Boring: SB-8



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

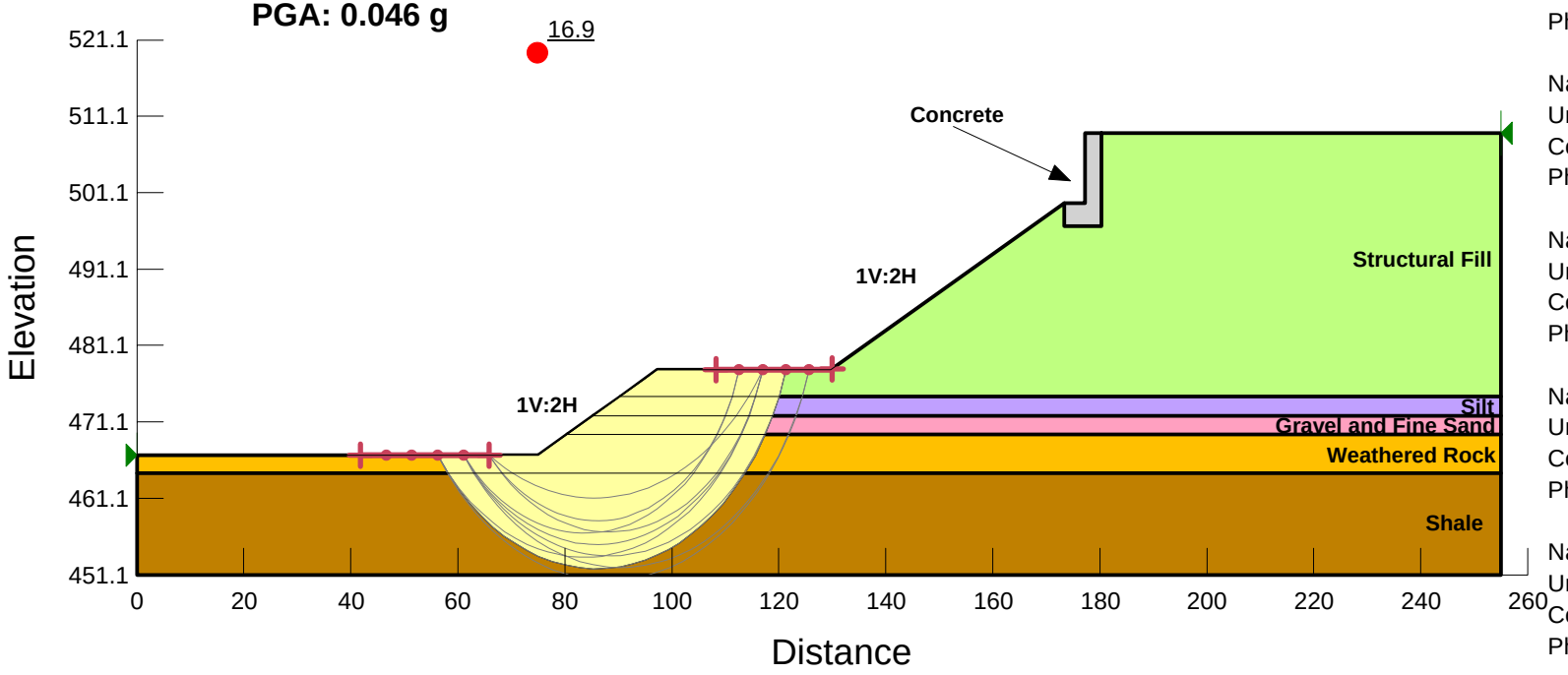
Name: Silt
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Abutment - Bottom Slope
Seismic Analysis
Boring: SB-8
PGA: 0.046 g



Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

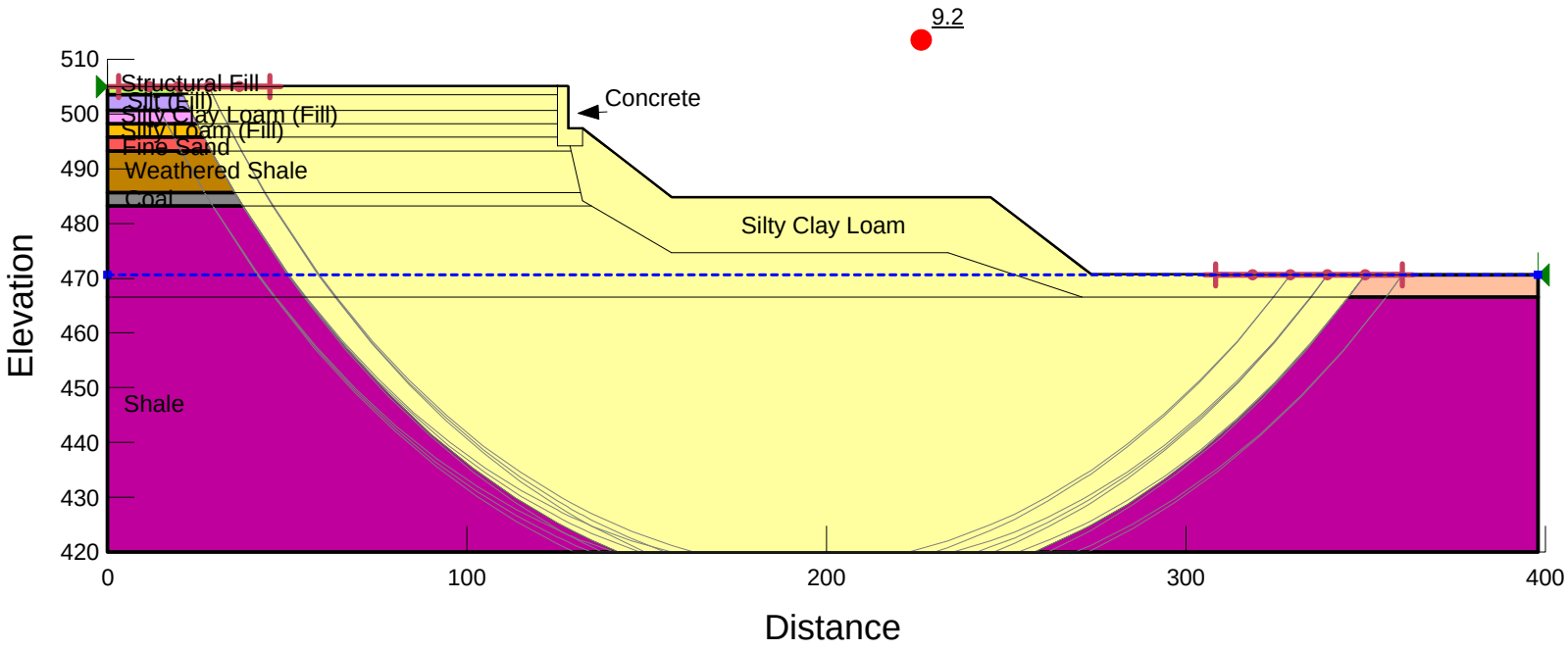
Name: Silt
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Gravel and Fine Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Rock
Unit Weight: 130 pcf
Cohesion': 4,500 psf
Phi': 12 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Full Slope
EOC Analysis
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 3,800 psf
Phi': 0 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 3,000 psf
Phi': 0 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 1,100 psf
Phi': 0 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

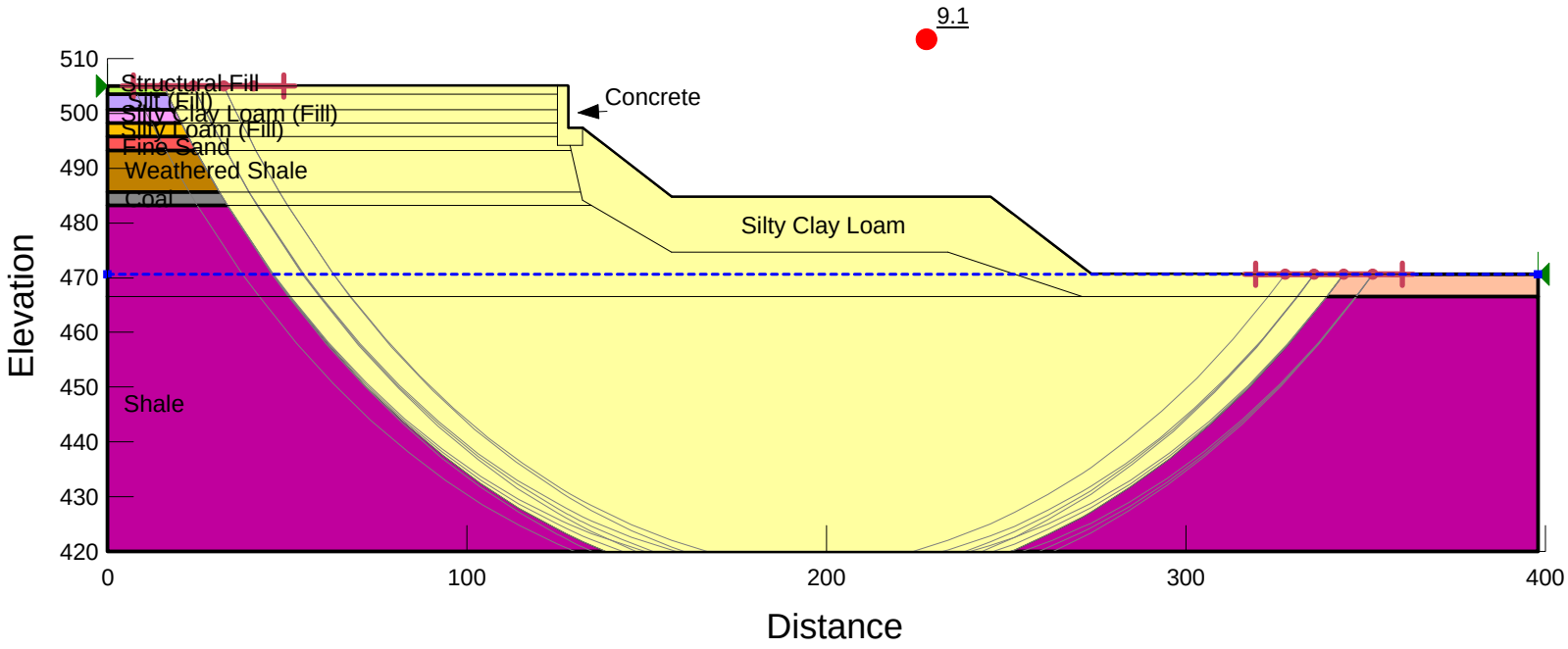
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Full Slope
LT Analysis
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

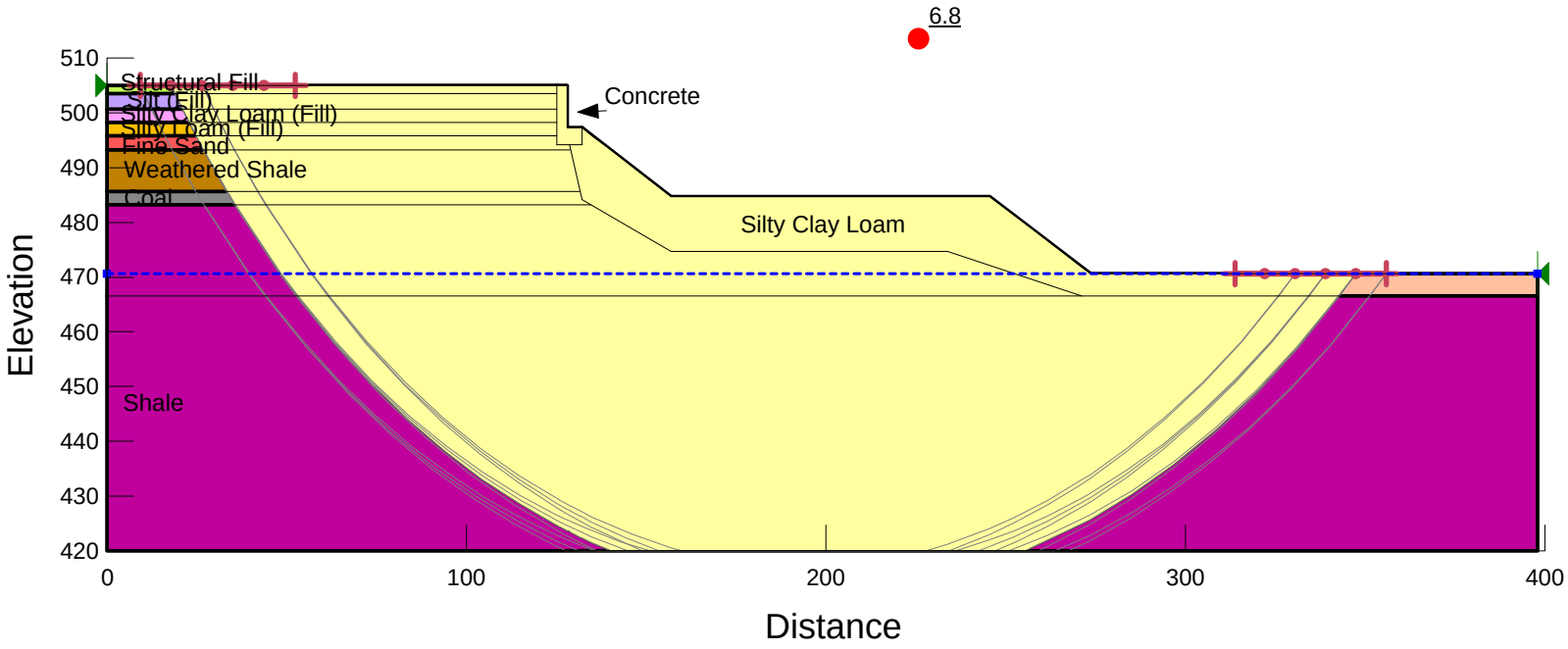
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Full Slope
Seismic Analysis
PGA: 0.046 g
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

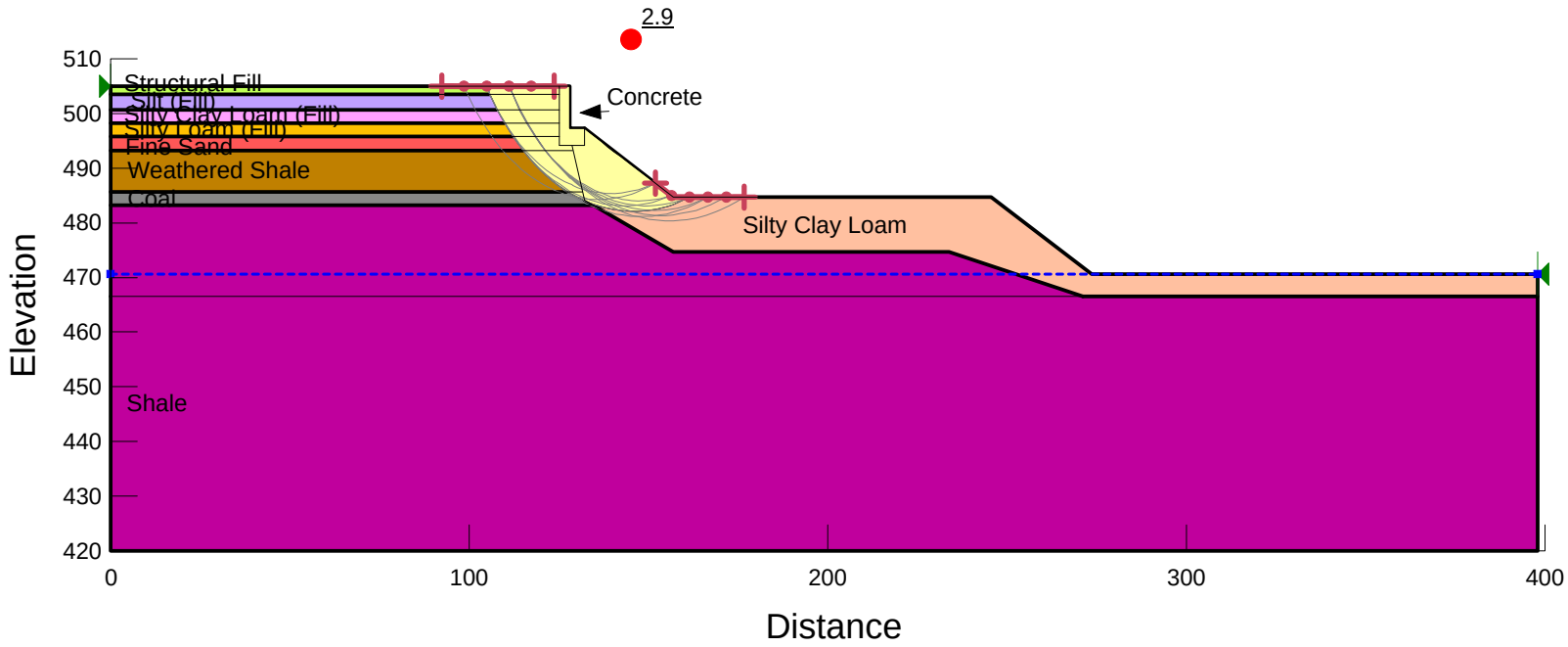
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Top Slope
EOC Analysis
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 3,800 psf
Phi': 0 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 3,000 psf
Phi': 0 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 1,100 psf
Phi': 0 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

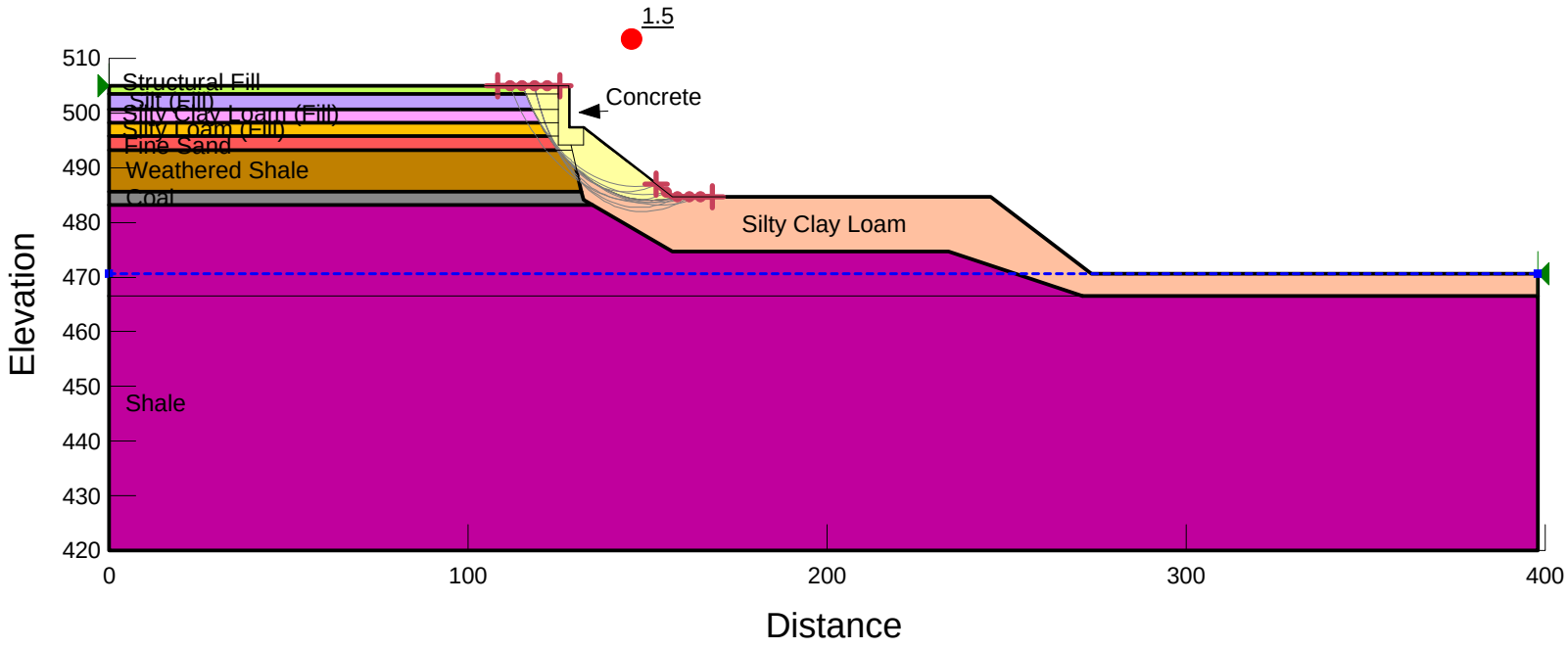
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Top Slope
LT Analysis
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi': 26 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

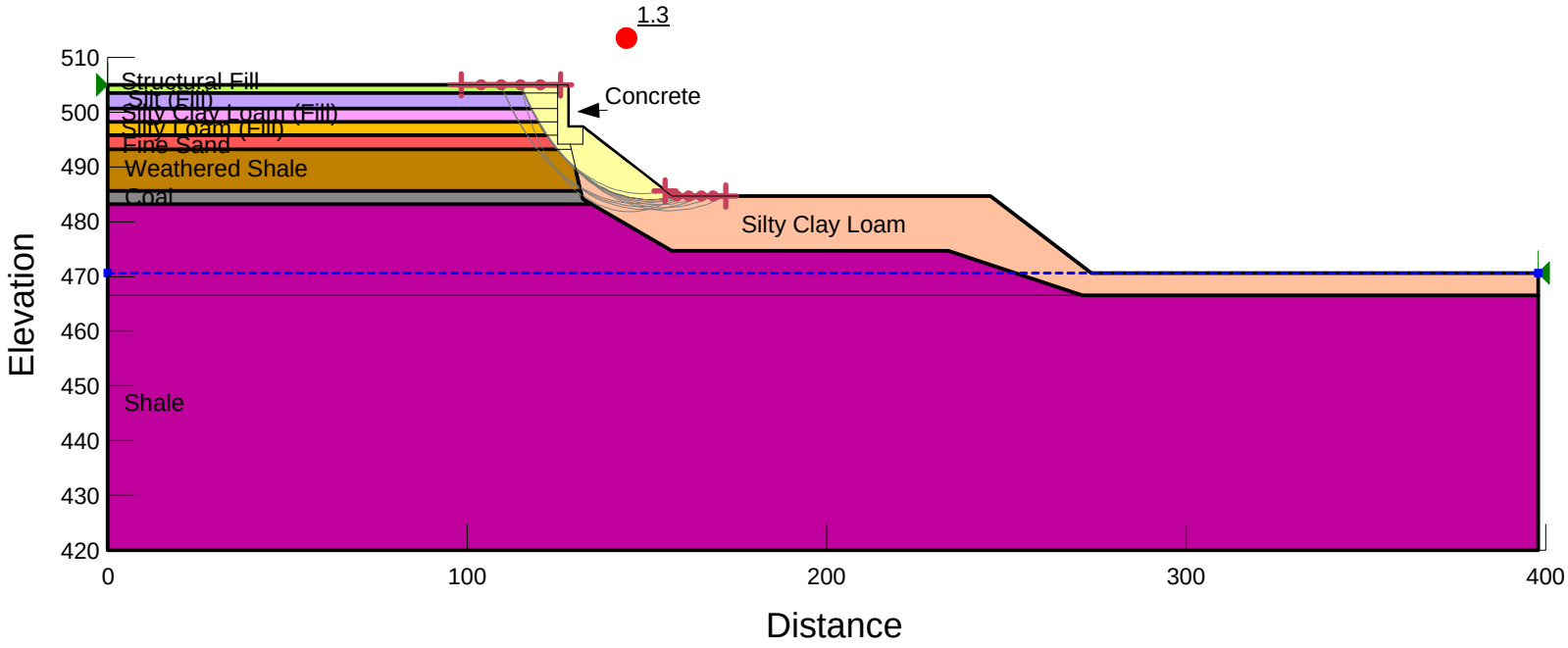
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Top Slope
Seismic Analysis
PGA: 0.046 g
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 250 psf
Phi': 26 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 250 psf
Phi': 28 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

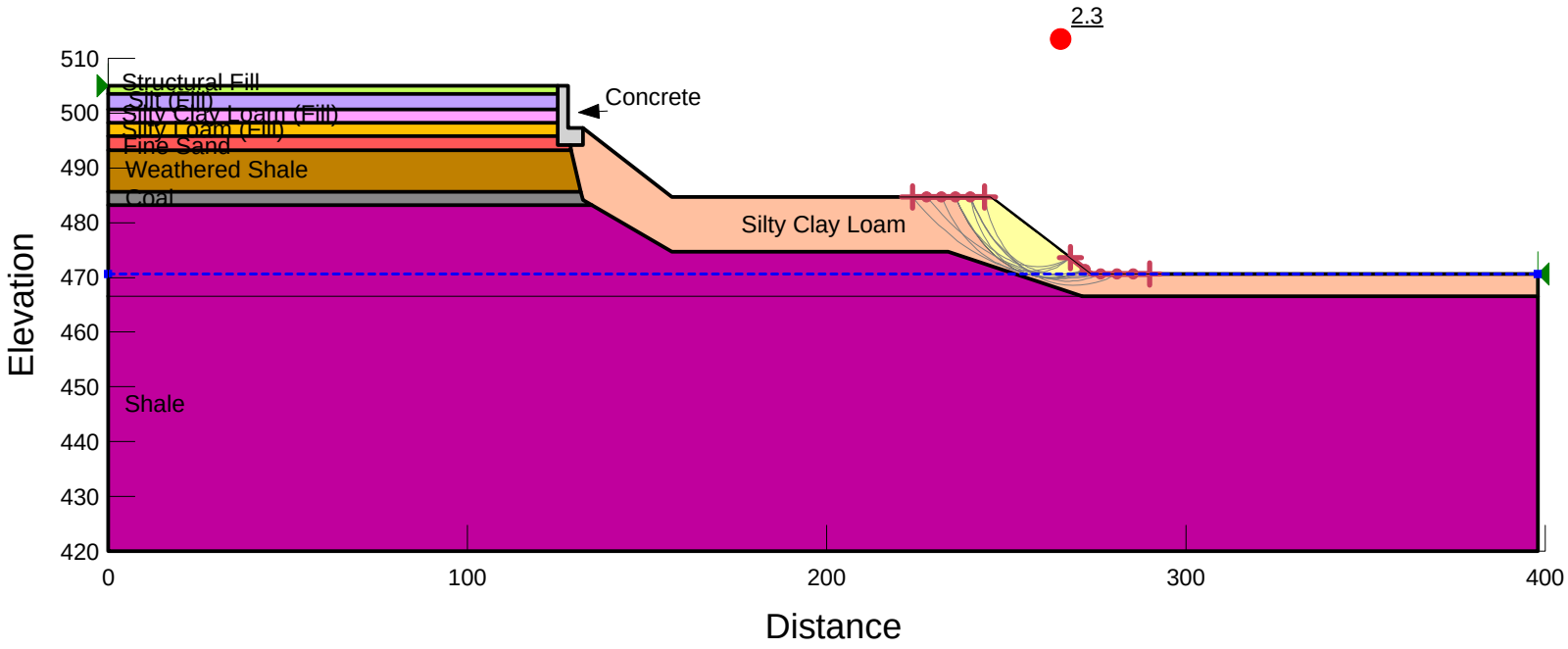
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Bottom Slope
EOC Analysis
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 3,800 psf
Phi': 0 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 3,000 psf
Phi': 0 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 1,100 psf
Phi': 0 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

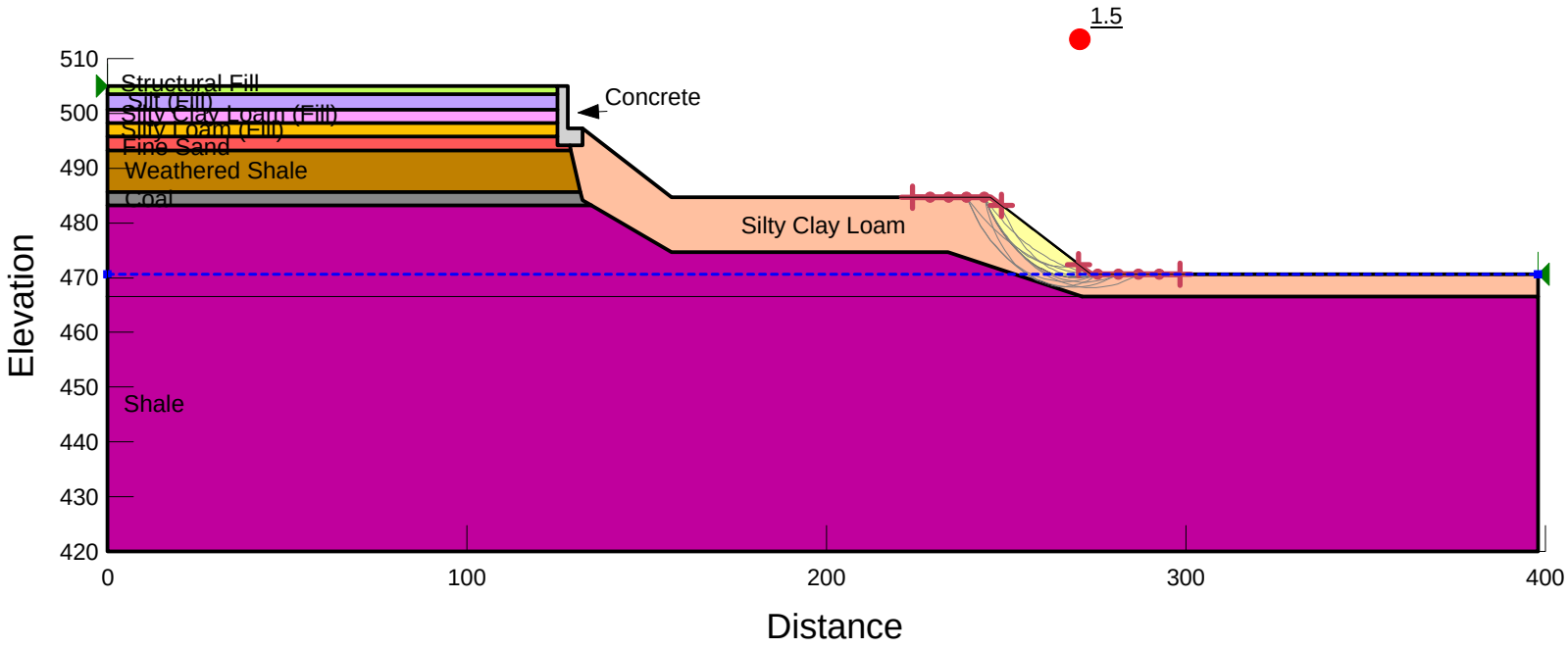
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Bottom Slope
LT Analysis
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

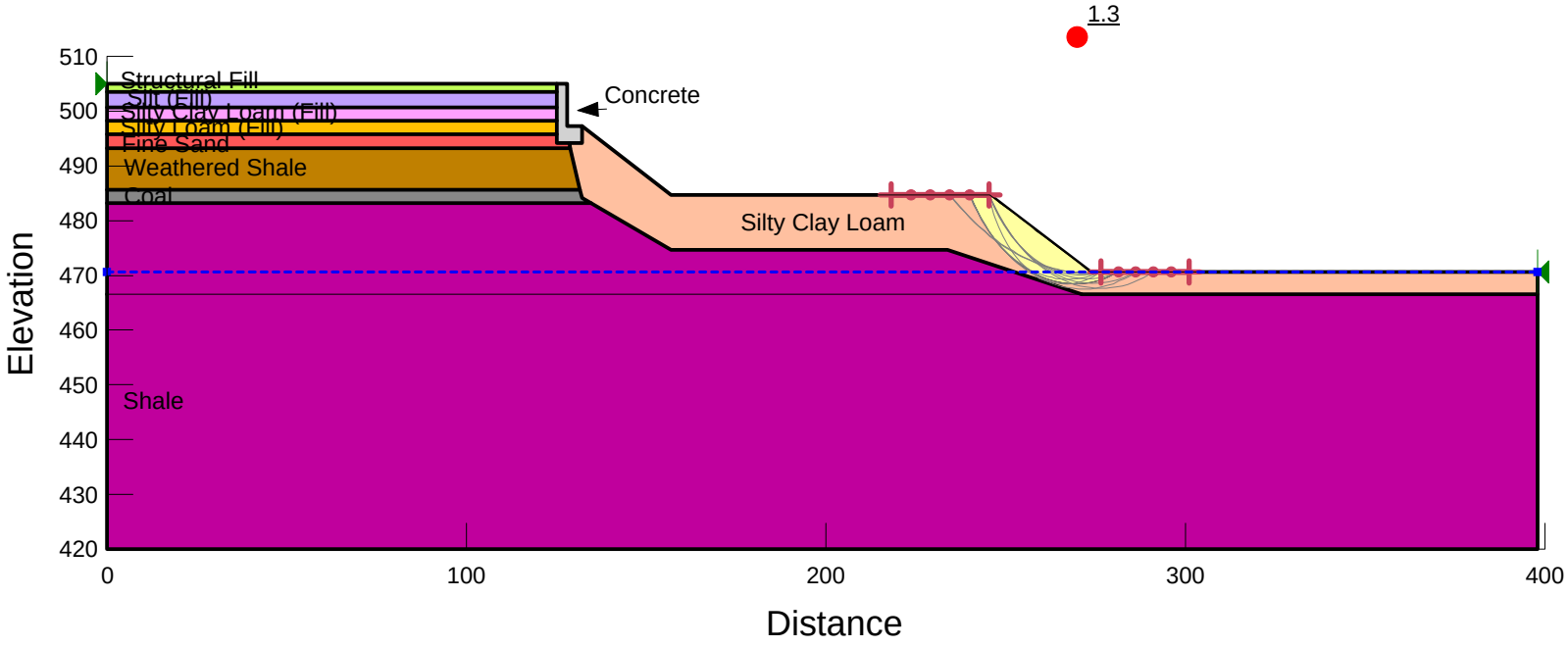
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Abutment - Bottom Slope
Seismic Analysis
PGA: 0.046 g
Boring: SB-1 and B-1



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silt (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Silty Clay Loam (Fill)
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silty Loam (Fill)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Fine Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Weathered Shale
Unit Weight: 125 pcf
Cohesion': 500 psf
Phi': 12 °

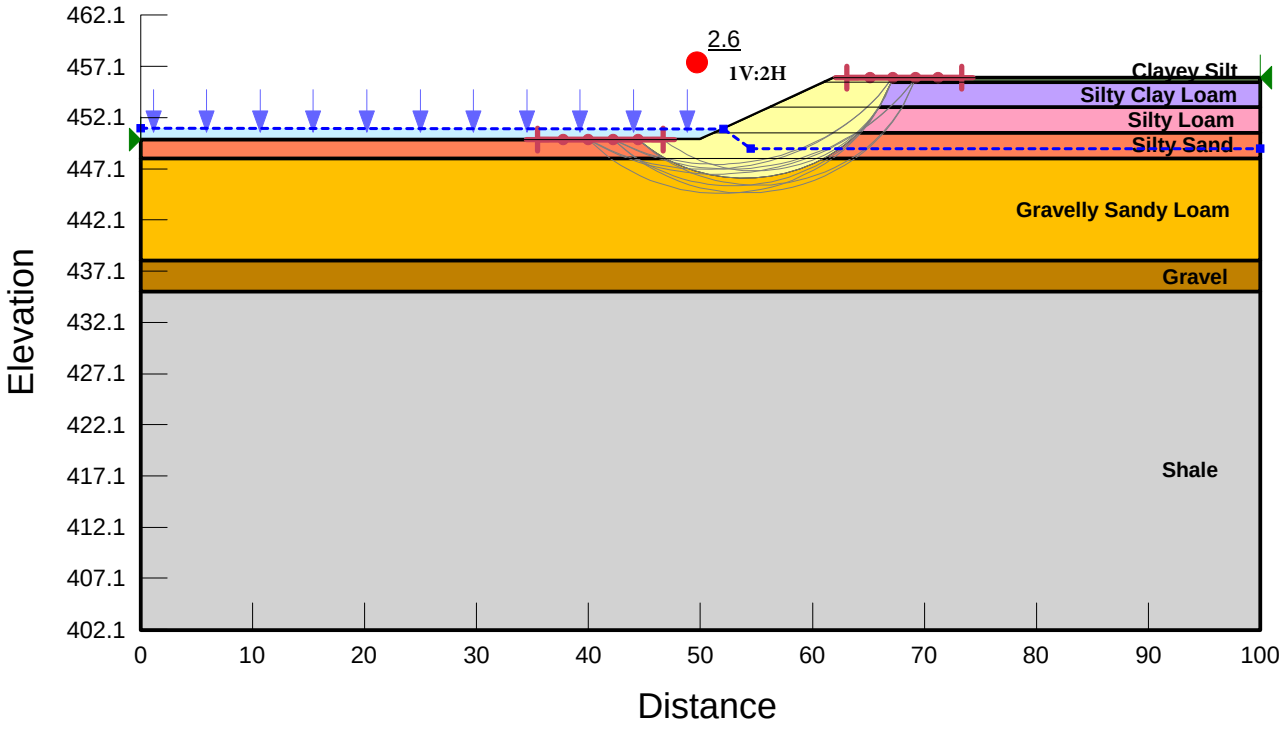
Name: Coal
Unit Weight: 94 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Concrete
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 45 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Bank of Kickapoo Creek
EOC Analysis
Boring: SB-6



Name: Clayey Silt
Unit Weight: 115 pcf
Cohesion': 900 psf
Phi': 0 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 400 psf
Phi': 0 °

Name: Silty Loam
Unit Weight: 115 pcf
Cohesion': 300 psf
Phi': 0 °

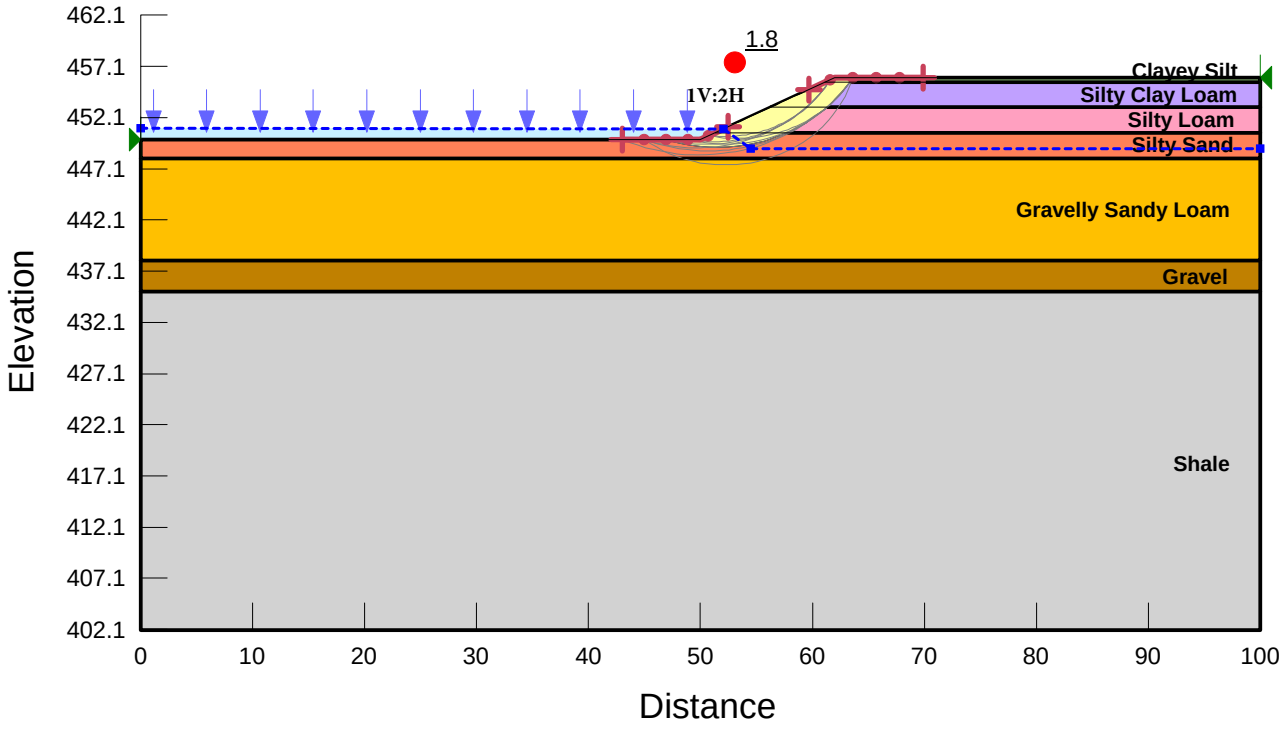
Name: Silty Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Gravelly Sandy Loam
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 28 °

Name: Gravel
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Bank of Kickapoo Creek
LT Analysis
Boring: SB-6



Name: Clayey Silt
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Silty Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

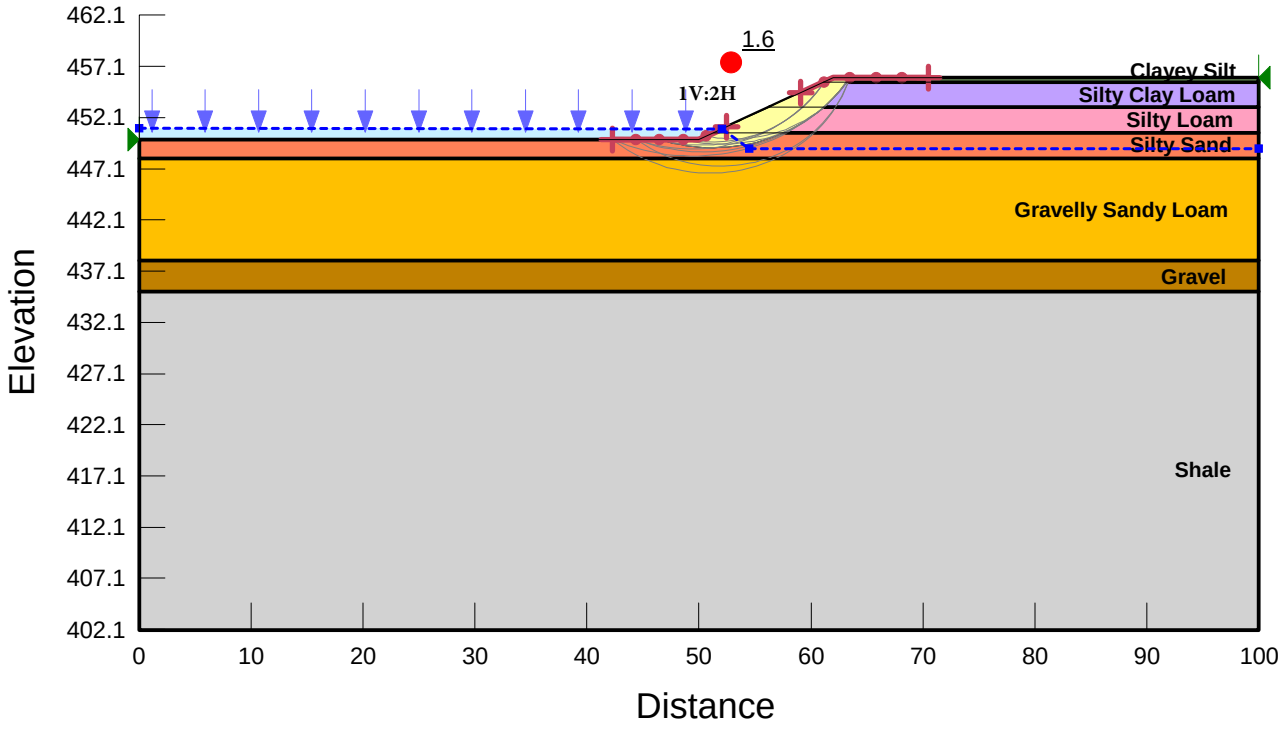
Name: Silty Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Gravelly Sandy Loam
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 28 °

Name: Gravel
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
East Bank of Kickapoo Creek
Seismic Analysis
Boring: SB-6
PGA: 0.046 g



Name: Clayey Silt
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Silty Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

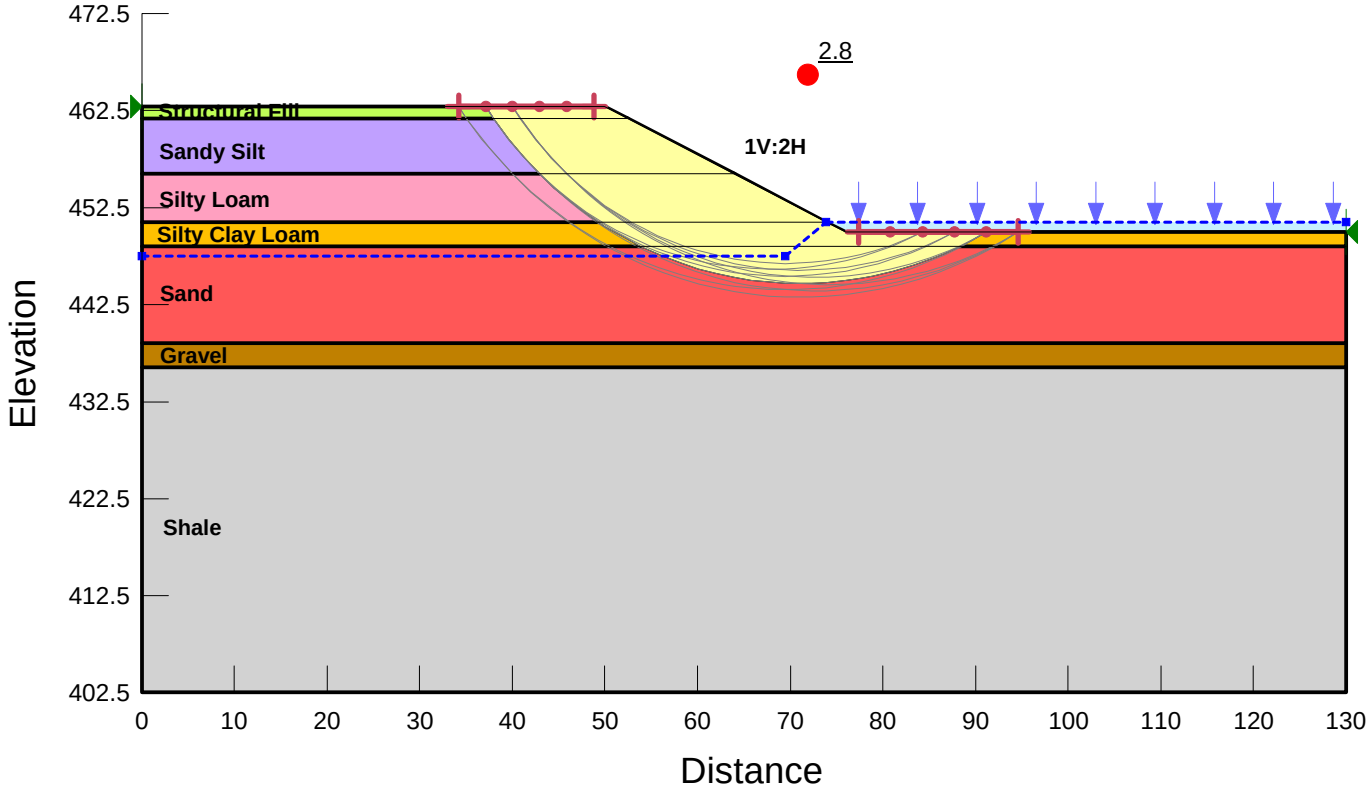
Name: Silty Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °

Name: Gravelly Sandy Loam
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 28 °

Name: Gravel
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Bank of Kickapoo Creek
EOC Analysis
Boring: SB-4



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Piezometric Line: 1

Name: Sandy Silt
Unit Weight: 115 pcf
Cohesion': 1,400 psf
Phi': 0 °
Piezometric Line: 1

Name: Silty Loam
Unit Weight: 115 pcf
Cohesion': 350 psf
Phi': 0 °
Piezometric Line: 1

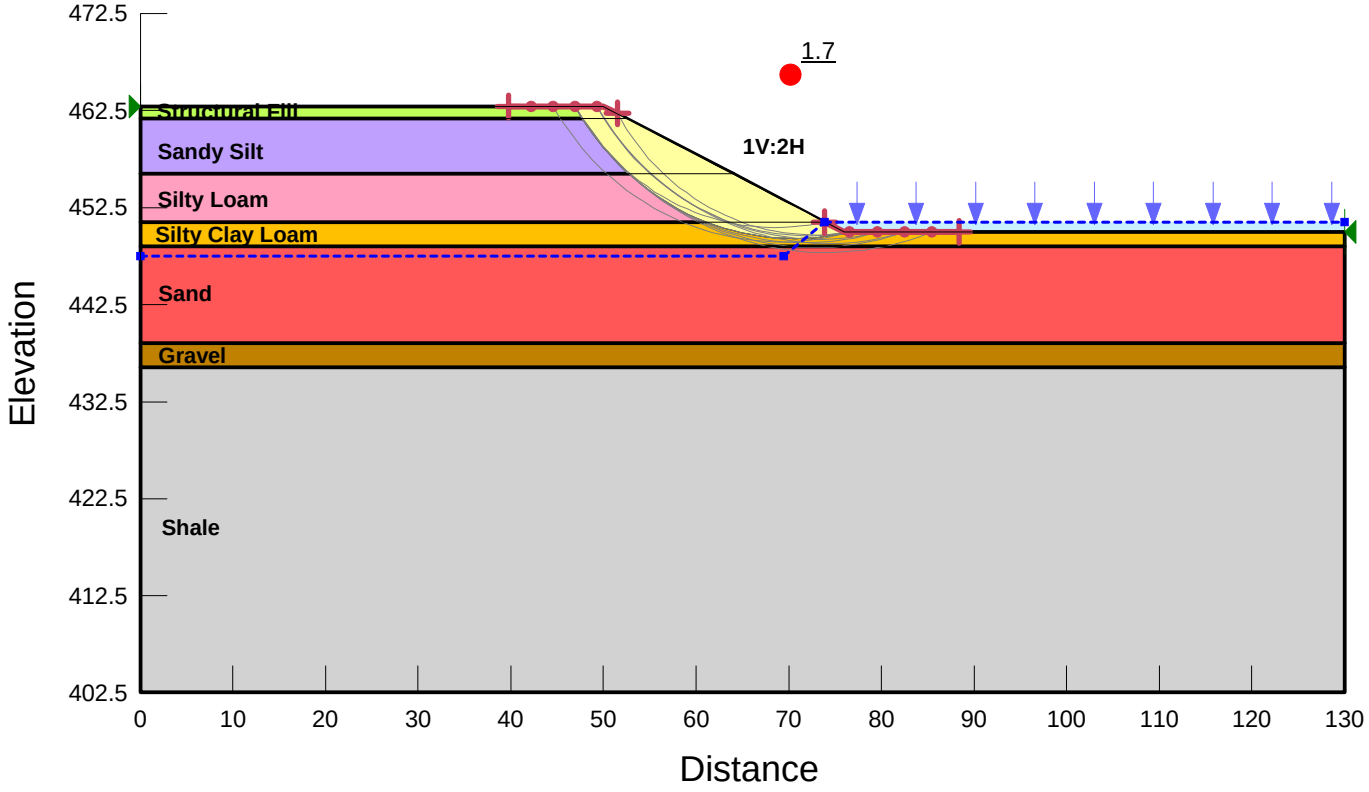
Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 300 psf
Phi': 0 °
Piezometric Line: 1

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Gravel
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Piezometric Line: 1

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °
Piezometric Line: 1

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Bank of Kickapoo Creek
LT Analysis
Boring: SB-4



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Sandy Silt
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

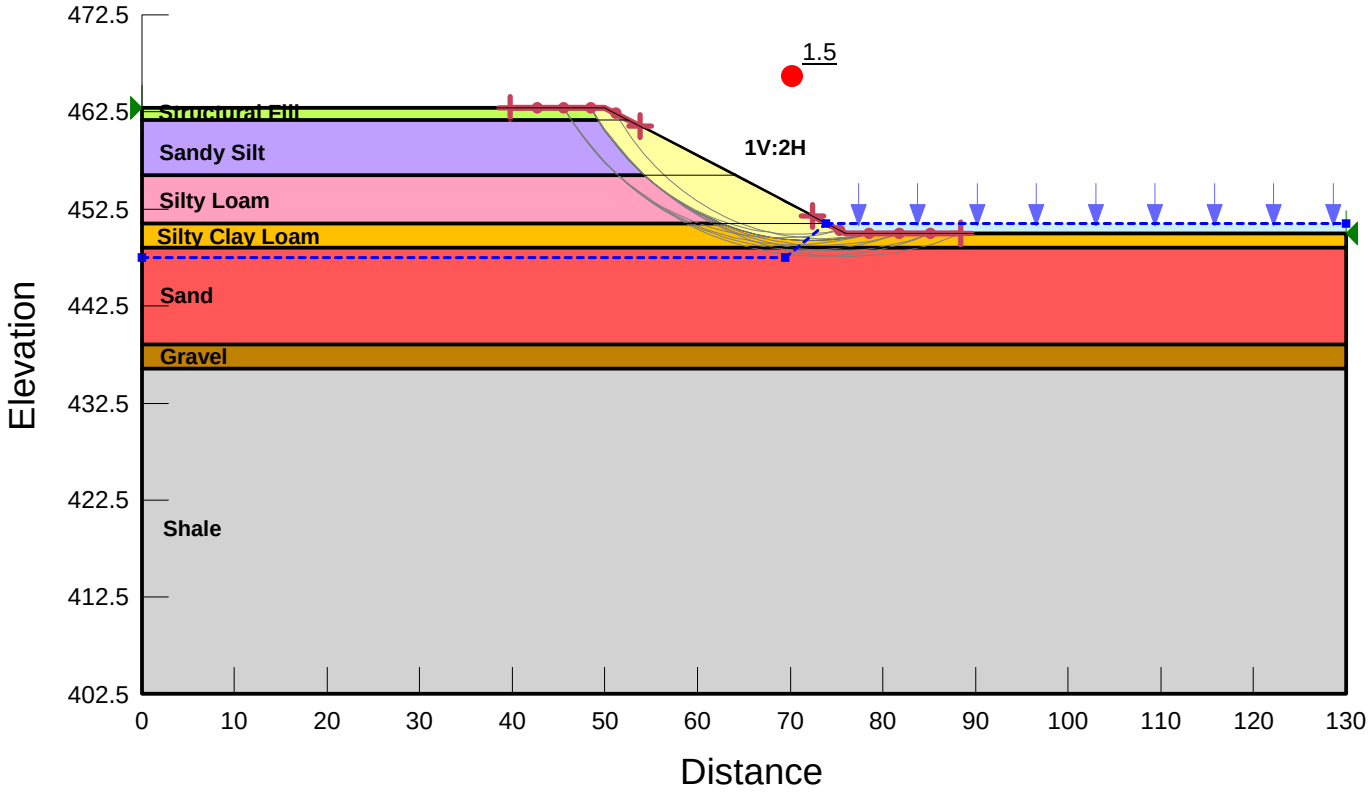
Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Gravel
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Piezometric Line: 1

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °
Piezometric Line: 1

IL 116 over Kickapoo Creek, UPRR, and Kickapoo Creek Road
West Bank of Kickapoo Creek
Seismic Analysis
Boring: SB-4
PGA: 0.046 g



Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Sandy Silt
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Gravel
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Piezometric Line: 1

Name: Shale
Unit Weight: 125 pcf
Cohesion': 5,000 psf
Phi': 12 °
Piezometric Line: 1

EXHIBIT F

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 495.70 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 492.70 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 ========== 3048 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 152.40 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 57.15 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
589 KIPS	**589** KIPS	**324** KIPS	**54** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========== 0.151 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.)
491.70	1.00	1.50			3.9		25.4	5.7		***8.9***	9	0	0	5	4
490.70	1.00	1.50			3.9	21.5	29.3	5.7	3.2	***14.5***	15	0	0	8	5
489.70	1.00	1.50			3.9	21.5	33.2	5.7	3.2	***20.2***	20	0	0	11	6
488.70	1.00	1.50			3.9	21.5	37.1	5.7	3.2	***25.9***	26	0	0	14	7
487.70	1.00	1.50			3.9	21.5	41.0	5.7	3.2	***31.6***	32	0	0	17	8
486.70	1.00	1.50			3.9	21.5	44.9	5.7	3.2	***37.3***	37	0	0	21	9
485.70	1.00	1.50			3.9	21.5	48.8	5.7	3.2	***43.0***	43	0	0	24	10
484.70	1.00	1.50			3.9	21.5	52.7	5.7	3.2	***48.6***	49	0	0	27	11
483.70	1.00	1.50			3.9	21.5	56.6	5.7	3.2	***54.3***	54	0	0	30	12
482.70	1.00	1.50			3.9	21.5	70.6	5.7	3.2	***61.5***	61	0	0	34	13
479.70	3.00	2.20	16		15.0	31.6	***61.2***	21.9	4.7	79.8	61	0	0	34	16
477.20	2.50	0.50	6		3.9	7.2	***63.7***	5.8	1.1	85.4	64	0	0	35	19
474.70	2.50	0.40	2		3.2	5.7	***65.5***	4.7	0.8	89.8	65	0	0	36	21
472.20	2.50	0.30	3		2.5	4.3	***75.1***	3.6	0.6	94.5	75	0	0	41	24
469.70	2.50	0.80	4		6.0	11.5	***98.3***	8.7	1.7	105.7	98	0	0	54	26
468.20	1.50	2.00	5		7.1	28.7	***105.4***	10.3	4.2	116.1	105	0	0	58	28
466.20	2.00	2.00	5		9.4	28.7	***99.0***	13.8	4.2	127.5	99	0	0	54	30
463.70	2.50	0.90	5		6.6	12.9	***99.9***	9.6	1.9	136.3	100	0	0	55	32
461.20	2.50	0.50	7		3.9	7.2	***109.6***	5.8	1.1	142.9	110	0	0	60	35
458.70	2.50	0.90	14		6.6	12.9	***109.0***	9.6	1.9	151.4	109	0	0	60	37
456.20	2.50	0.40	7		3.2	5.7	***114.1***	4.7	0.8	156.4	114	0	0	63	40
453.70	2.50		3	Sandy Gravel	0.7	7.7	***128.7***	1.0	1.1	159.5	129	0	0	71	42
451.20	2.50	1.50	12		9.7	21.5	***138.4***	14.2	3.2	173.7	138	0	0	76	45
448.70	2.50	1.50	12		9.7	21.5	254.3	14.2	3.2	***203.6***	204	0	0	112	47
448.20	0.50			Shale	25.2	127.7	279.6	36.8	18.9	***240.4***	240	0	0	132	47.5
447.70	0.50			Shale	25.2	127.7	304.8	36.8	18.9	***277.2***	277	0	0	152	48
447.20	0.50			Shale	25.2	127.7	330.0	36.8	18.9	***314.0***	314	0	0	173	48.5
446.70	0.50			Shale	25.2	127.7	355.2	36.8	18.9	***350.8***	351	0	0	193	49
446.20	0.50			Shale	25.2	127.7	***380.5***	36.8	18.9	387.6	380	0	0	209	49.5
445.70	0.50			Shale	25.2	127.7	***405.7***	36.8	18.9	424.4	406	0	0	223	50
444.70	1.00			Shale	50.5	127.7	***456.1***	73.6	18.9	498.0	456	0	0	251	51
443.70	1.00			Shale	50.5	127.7	***506.6***	73.6	18.9	571.6	507	0	0	279	52
442.70	1.00			Shale	50.5	127.7	***557.0***	73.6	18.9	645.2	557	0	0	306	53
441.70	1.00			Shale	50.5	127.7	***607.5***	73.6	18.9	718.8	~~607~~	~~0~~	~~0~~	~~334~~	~~54~~
440.70	1.00			Shale	50.5	127.7	***657.9***	73.6	18.9	792.4	~~658~~	~~0~~	~~0~~	~~362~~	~~55~~
439.70	1.00			Shale		127.7			18.9						

Pile Design Table for West Abutment utilizing Boring #B-1

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
102	56	26
110	61	28
112	62	30
117	64	32
125	69	35
129	71	37
144	79	40
145	80	42
157	86	45
Metal Shell 12"Φ w/.25" walls		
102	56	26
110	61	28
112	62	30
117	64	32
125	69	35
129	71	37
144	79	40
145	80	42
157	86	45
Metal Shell 14"Φ w/.25" walls		
99	55	24
122	67	26
132	73	28
132	73	30
137	75	32
147	81	35
151	83	37
171	94	40
172	94	42
185	102	45
Metal Shell 14"Φ w/.312" walls		
99	55	24
122	67	26
132	73	28
132	73	30
137	75	32
147	81	35
151	83	37
171	94	40
172	94	42
185	102	45
Steel HP 8 X 36		
87	48	45
131	72	47
286	157	52
Steel HP 10 X 42		
102	56	42
110	60	45
163	89	47
335	184	51

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
104	57	42
112	62	45
167	92	47
454	250	54
Steel HP 12 X 53		
98	54	32
107	59	37
112	61	40
126	69	42
135	74	45
195	107	47
418	230	51
Steel HP 12 X 63		
99	54	32
108	59	37
113	62	40
127	70	42
136	75	45
200	110	47
497	273	52
Steel HP 12 X 74		
100	55	32
109	60	37
114	63	40
129	71	42
138	76	45
204	112	47
589	324	54
Steel HP 12 X 84		
101	56	32
110	61	37
116	64	40
131	72	42
140	77	45
207	114	47
664	365	55

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
89	49	24
117	64	32
128	70	37
134	74	40
153	84	42
165	91	45
237	130	47
578	318	52
Steel HP 14 X 89		
90	50	24
119	65	32
129	71	37
135	74	40
155	85	42
167	92	45
242	133	47
705	388	54
Steel HP 14 X 102		
92	50	24
120	66	32
130	72	37
137	75	40
157	86	42
169	93	45
247	136	47
810	445	56
Steel HP 14 X 117		
93	51	24
121	67	32
132	73	37
138	76	40
159	88	42
171	94	45
252	139	47
929	511	56
Precast 14"x 14"		
103	57	13
105	58	16
110	61	19
115	63	21
127	70	24
155	85	26
168	92	28
169	93	30
175	96	32
188	103	35
192	106	37
218	120	40
219	120	42
236	130	45
Timber Pile		
99	54	28
107	59	30
114	63	32
120	66	35
127	70	37
134	74	40
136	75	42
148	82	45

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== B-1
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 472.10 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 471.10 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 458.70 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 6642 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 332.09 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 124.53 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========= 0.151 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
589 KIPS	**586** KIPS	**306** KIPS	**30** 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.)
469.70	1.40	0.80	4		3.3		32.1	4.9		***9.1***	9	2	0	3	2
467.70	2.00	2.00	5		9.4	28.7	25.7	13.8	4.2	***20.5***	21	7	0	4	4
465.20	2.50	0.90	5		6.6	12.9	***26.6***	9.6	1.9	29.3	27	11	0	4	7
462.70	2.50	0.50	7		3.9	7.2	36.3	5.8	1.1	***35.9***	36	13	0	7	9
460.20	2.50	0.90	14		6.6	12.9	***35.7***	9.6	1.9	44.5	36	16	0	3	12
457.70	2.50	0.40	7		3.2	5.7	***37.4***	4.7	0.8	49.0	37	16	0	4	14
455.20	2.50	0.30	3		2.5	4.3	57.1	3.6	0.6	***55.1***	55	16	0	14	17
452.70	2.50	1.50	12		9.7	21.5	***66.9***	14.2	3.2	69.3	67	16	0	20	19
450.20	2.50	1.50	12		9.7	21.5	182.8	14.2	3.2	***99.2***	99	16	0	38	22
449.70	0.50			Shale	25.2	127.7	208.0	36.8	18.9	***136.0***	136	16	0	58	22.4
449.20	0.50			Shale	25.2	127.7	233.2	36.8	18.9	***172.8***	173	16	0	79	22.9
448.70	0.50			Shale	25.2	127.7	258.4	36.8	18.9	***209.6***	210	16	0	99	23.4
448.20	0.50			Shale	25.2	127.7	283.7	36.8	18.9	***246.4***	246	16	0	119	23.9
447.70	0.50			Shale	25.2	127.7	308.9	36.8	18.9	***283.2***	283	16	0	139	24.4
447.20	0.50			Shale	25.2	127.7	334.1	36.8	18.9	***320.0***	320	16	0	160	24.9
446.70	0.50			Shale	25.2	127.7	359.4	36.8	18.9	***356.8***	357	16	0	180	25.4
446.20	0.50			Shale	25.2	127.7	***384.6***	36.8	18.9	393.6	385	16	0	195	25.9
445.70	0.50			Shale	25.2	127.7	***409.8***	36.8	18.9	430.4	410	16	0	209	26.4
445.20	0.50			Shale	25.2	127.7	***435.0***	36.8	18.9	467.2	435	16	0	223	26.9
444.70	0.50			Shale	25.2	127.7	***460.3***	36.8	18.9	504.0	460	16	0	237	27.4
444.20	0.50			Shale	25.2	127.7	***485.5***	36.8	18.9	540.8	485	16	0	251	27.9
443.70	0.50			Shale	25.2	127.7	***510.7***	36.8	18.9	577.6	511	16	0	264	28.4
443.20	0.50			Shale	25.2	127.7	***535.9***	36.8	18.9	614.4	536	16	0	278	28.9
442.70	0.50			Shale	25.2	127.7	***561.2***	36.8	18.9	651.2	561	16	0	292	29.4
442.20	0.50			Shale	25.2	127.7	***586.4***	36.8	18.9	688.0	586	16	0	306	29.9
441.70	0.50			Shale	25.2	127.7	***611.6***	36.8	18.9	724.8	~~612~~	~~16~~	~~0~~	~~320~~	~~30.4~~
441.20	0.50			Shale	25.2	127.7	***636.8***	36.8	18.9	761.6	~~637~~	~~16~~	~~0~~	~~334~~	~~30.9~~
440.70	0.50			Shale	25.2	127.7	***662.1***	36.8	18.9	798.4	~~662~~	~~16~~	~~0~~	~~348~~	~~31.4~~
440.20	0.50			Shale	25.2	127.7	***687.3***	36.8	18.9	835.2	~~687~~	~~16~~	~~0~~	~~362~~	~~31.9~~
439.70	0.50			Shale	25.2	127.7	***712.5***	36.8	18.9	872.0	~~713~~	~~16~~	~~0~~	~~375~~	~~32.4~~
439.20	0.50			Shale	25.2	127.7	***737.7***	36.8	18.9	908.8	~~738~~	~~16~~	~~0~~	~~389~~	~~32.9~~
438.70	0.50			Shale	25.2	127.7	***763.0***	36.8	18.9	945.6	~~763~~	~~16~~	~~0~~	~~403~~	~~33.4~~
438.20	0.50			Shale	25.2	127.7	***788.2***	36.8	18.9	982.4	~~788~~	~~16~~	~~0~~	~~417~~	~~33.9~~
437.70	0.50			Shale		127.7			18.9						

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

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
68	17	19
Metal Shell 12"Φ w/.25" walls		
68	17	19
314	153	22
Metal Shell 14"Φ w/.25" walls		
82	22	19
Metal Shell 14"Φ w/.312" walls		
82	22	19
414	205	22
Steel HP 8 X 36		
278	142	27
Steel HP 10 X 42		
315	160	26

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
448	233	29
Steel HP 12 X 53		
399	203	26
Steel HP 12 X 63		
478	247	28
Steel HP 12 X 74		
586	306	30
Steel HP 12 X 84		
646	339	31

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
558	288	27
Steel HP 14 X 89		
684	357	29
Steel HP 14 X 102		
783	411	31
Steel HP 14 X 117		
914	483	33
Precast 14"x 14"		
104	28	19
Timber Pile		
151	63	22

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2 Westbound
REFERENCE BORING ========== SB-5
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 461.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 460.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 448.10 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 10002 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 500.10 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 187.54 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
589 KIPS	**588** KIPS	**307** KIPS	**33** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========= 0.151 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.)
456.50	3.50	3.00			21.7		***26.0***	31.6		32.3	26	12	0	2	5
454.00	2.50	0.30			2.5	4.3	***29.9***	3.6	0.6	36.1	30	13	0	3	7
451.50	2.50	0.40			3.2	5.7	***31.7***	4.7	0.8	40.5	32	15	0	2	10
449.00	2.50	0.30			2.5	4.3	***34.1***	3.6	0.6	44.1	34	16	0	2	12
446.50	2.50	0.30			2.5	4.3	***33.7***	3.6	0.6	47.3	34	16	0	2	15
445.50	1.00	0.10			0.3	1.4	***40.3***	0.5	0.2	48.7	40	16	0	6	16
441.50	4.00		4	Very Fine Silty Sand	1.0	7.7	***46.4***	1.5	1.1	50.9	46	16	0	9	20
439.00	2.50		5	Sandy Gravel	1.2	12.8	***50.1***	1.7	1.9	53.0	50	16	0	11	22
436.50	2.50		6	Sandy Gravel	1.4	15.3	163.9	2.1	2.3	***71.7***	72	16	0	23	25
436.00	0.50			Shale	25.2	127.7	189.1	36.8	18.9	***108.5***	108	16	0	43	25
435.50	0.50			Shale	25.2	127.7	214.4	36.8	18.9	***145.3***	145	16	0	64	25.5
435.00	0.50			Shale	25.2	127.7	239.6	36.8	18.9	***182.1***	182	16	0	84	26
434.50	0.50			Shale	25.2	127.7	264.8	36.8	18.9	***218.9***	219	16	0	104	26.5
434.00	0.50			Shale	25.2	127.7	290.0	36.8	18.9	***255.7***	256	16	0	124	27
433.50	0.50			Shale	25.2	127.7	315.3	36.8	18.9	***292.5***	292	16	0	144	27.5
433.00	0.50			Shale	25.2	127.7	340.5	36.8	18.9	***329.3***	329	16	0	165	28
432.50	0.50			Shale	25.2	127.7	***365.7***	36.8	18.9	366.1	366	16	0	185	28.5
432.00	0.50			Shale	25.2	127.7	***390.9***	36.8	18.9	402.9	391	16	0	199	29
431.50	0.50			Shale	25.2	127.7	***416.2***	36.8	18.9	439.7	416	16	0	212	29.5
431.00	0.50			Shale	25.2	127.7	***441.4***	36.8	18.9	476.5	441	16	0	226	30
430.50	0.50			Shale	25.2	127.7	***466.6***	36.8	18.9	513.3	467	16	0	240	30.5
430.00	0.50			Shale	25.2	127.7	***491.8***	36.8	18.9	550.1	492	16	0	254	31
429.50	0.50			Shale	25.2	127.7	***517.1***	36.8	18.9	586.9	517	16	0	268	31.5
429.00	0.50			Shale	25.2	127.7	***542.3***	36.8	18.9	623.7	542	16	0	282	32
428.60	0.40			Shale	20.2	127.7	***562.5***	29.4	18.9	653.1	562	16	0	293	32.4
428.10	0.50			Shale	25.2	127.7	***587.7***	36.8	18.9	689.9	588	16	0	307	32.9
427.60	0.50			Shale	25.2	127.7	***612.9***	36.8	18.9	726.7	~~613~~	~~16~~	~~0~~	~~321~~	~~33.4~~
427.10	0.50			Shale	25.2	127.7	***638.2***	36.8	18.9	763.5	~~638~~	~~16~~	~~0~~	~~335~~	~~33.9~~
426.60	0.50			Shale	25.2	127.7	***663.4***	36.8	18.9	800.3	~~663~~	~~16~~	~~0~~	~~348~~	~~34.4~~
426.10	0.50			Shale	25.2	127.7	***688.6***	36.8	18.9	837.1	~~689~~	~~16~~	~~0~~	~~362~~	~~34.9~~
425.60	0.50			Shale	25.2	127.7	***713.8***	36.8	18.9	873.9	~~714~~	~~16~~	~~0~~	~~376~~	~~35.4~~
425.10	0.50			Shale	25.2	127.7	***739.1***	36.8	18.9	910.7	~~739~~	~~16~~	~~0~~	~~390~~	~~35.9~~
424.60	0.50			Shale	25.2	127.7	***764.3***	36.8	18.9	947.5	~~764~~	~~16~~	~~0~~	~~404~~	~~36.4~~
424.10	0.50			Shale	25.2	127.7	***789.5***	36.8	18.9	984.3	~~790~~	~~16~~	~~0~~	~~418~~	~~36.9~~
423.60	0.50			Shale	25.2	127.7	***814.7***	36.8	18.9	1021.1	~~815~~	~~16~~	~~0~~	~~432~~	~~37.4~~
423.10	0.50			Shale	25.2	127.7	***840.0***	36.8	18.9	1057.9	~~840~~	~~16~~	~~0~~	~~446~~	~~37.9~~
422.60	0.50			Shale		127.7			18.9						

Pile Design Table for Pier 2 Westbound utilizing Boring #SB-5

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
78	23	22
Metal Shell 12"Φ w/.25" walls		
301	146	25
Metal Shell 14"Φ w/.25" walls		
97	30	22
399	196	25
Metal Shell 14"Φ w/.312" walls		
97	30	22
399	196	25
Steel HP 8 X 36		
282	144	31
Steel HP 10 X 42		
320	163	30

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
449	234	32
Steel HP 12 X 53		
405	207	30
Steel HP 12 X 63		
484	250	31
Steel HP 12 X 74		
588	307	33
Steel HP 12 X 84		
648	340	34

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
565	292	31
Steel HP 14 X 89		
685	358	32
Steel HP 14 X 102		
784	412	34
Steel HP 14 X 117		
915	484	36
Precast 14"x 14"		
123	38	22
Timber Pile		
138	56	25

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2 Eastbound
REFERENCE BORING ========== SB-4
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 461.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 460.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 448.10 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 10002 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 500.08 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 187.53 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
589 KIPS	**563** KIPS	**298** KIPS	**33** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========= 0.151 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.)
458.50	1.50	2.00			7.1		18.6	10.3		***12.0***	12	4	0	3	3
456.00	2.50	0.80			6.0	11.5	***18.8***	8.7	1.7	19.9	19	7	0	3	5
453.50	2.50	0.40			3.2	5.7	***20.6***	4.7	0.8	24.4	21	9	0	2	8
451.00	2.50	0.30			2.5	4.3	***23.0***	3.6	0.6	27.9	23	10	0	2	10
448.50	2.50	0.30			2.5	4.3	56.9	3.6	0.6	***36.2***	36	12	0	8	13
446.00	2.50		14	Medium Sand	2.6	35.8	***28.9***	3.8	5.3	35.4	29	12	0	4	15
443.50	2.50		2	Medium Sand	0.4	5.1	44.6	0.5	0.8	***38.2***	38	12	0	9	18
441.00	2.50		8	Medium Sand	1.5	20.4	69.0	2.2	3.0	***43.8***	44	12	0	12	20
438.50	2.50		17	Medium Sand	3.1	43.4	56.8	4.6	6.4	***46.1***	46	12	0	14	23
436.00	2.50		11	Sandy Gravel	2.6	28.1	159.0	3.8	4.1	***64.6***	65	12	0	24	25
435.00	1.00			Shale	50.5	127.7	209.5	73.6	18.9	***138.2***	138	12	0	64	26
434.00	1.00			Shale	50.5	127.7	259.9	73.6	18.9	***211.8***	212	12	0	105	27
433.00	1.00			Shale	50.5	127.7	310.4	73.6	18.9	***285.4***	285	12	0	145	28
432.00	1.00			Shale	50.5	127.7	360.8	73.6	18.9	***359.0***	359	12	0	186	29
431.00	1.00			Shale	50.5	127.7	***411.3***	73.6	18.9	432.6	411	12	0	215	30
430.00	1.00			Shale	50.5	127.7	***461.7***	73.6	18.9	506.2	462	12	0	242	31
429.00	1.00			Shale	50.5	127.7	***512.2***	73.6	18.9	579.8	512	12	0	270	32
428.00	1.00			Shale	50.5	127.7	***562.6***	73.6	18.9	653.4	563	12	0	298	33
427.00	1.00			Shale	50.5	127.7	***613.1***	73.6	18.9	727.0	~~613~~	~~12~~	~~0~~	~~326~~	~~34~~
426.00	1.00			Shale	50.5	127.7	***663.5***	73.6	18.9	800.6	~~664~~	~~12~~	~~0~~	~~353~~	~~35~~
425.00	1.00			Shale	50.5	127.7	***714.0***	73.6	18.9	874.2	~~714~~	~~12~~	~~0~~	~~381~~	~~36~~
424.00	1.00			Shale	50.5	127.7	***764.5***	73.6	18.9	947.8	~~764~~	~~12~~	~~0~~	~~409~~	~~37~~
423.00	1.00			Shale	50.5	127.7	***814.9***	73.6	18.9	1021.4	~~815~~	~~12~~	~~0~~	~~437~~	~~38~~
422.00	1.00			Shale	50.5	127.7	***865.4***	73.6	18.9	1095.0	~~865~~	~~12~~	~~0~~	~~464~~	~~39~~
421.00	1.00			Shale	50.5	127.7	***915.8***	73.6	18.9	1168.6	~~916~~	~~12~~	~~0~~	~~492~~	~~40~~
420.00	1.00			Shale	50.5	127.7	***966.3***	73.6	18.9	1242.2	~~966~~	~~12~~	~~0~~	~~520~~	~~41~~
419.00	1.00			Shale	50.5	127.7	***1016.7***	73.6	18.9	1315.8	~~1017~~	~~12~~	~~0~~	~~548~~	~~42~~
418.00	1.00			Shale	50.5	127.7	***1067.2***	73.6	18.9	1389.4	~~1067~~	~~12~~	~~0~~	~~575~~	~~43~~
417.00	1.00			Shale	50.5	127.7	***1117.6***	73.6	18.9	1463.0	~~1118~~	~~12~~	~~0~~	~~603~~	~~44~~
416.00	1.00			Shale	50.5	127.7	***1168.1***	73.6	18.9	1536.6	~~1168~~	~~12~~	~~0~~	~~631~~	~~45~~
415.00	1.00			Shale	50.5	127.7	***1218.5***	73.6	18.9	1610.2	~~1219~~	~~12~~	~~0~~	~~659~~	~~46~~
414.00	1.00			Shale	50.5	127.7	***1269.0***	73.6	18.9	1683.8	~~1269~~	~~12~~	~~0~~	~~686~~	~~47~~
413.00	1.00			Shale	50.5	127.7	***1319.4***	73.6	18.9	1757.4	~~1319~~	~~12~~	~~0~~	~~714~~	~~48~~
412.00	1.00			Shale	50.5	127.7	***1369.9***	73.6	18.9	1831.0	~~1370~~	~~12~~	~~0~~	~~742~~	~~49~~
411.00	1.00			Shale	50.5	127.7	***1420.3***	73.6	18.9	1904.6	~~1420~~	~~12~~	~~0~~	~~770~~	~~50~~
410.00	1.00			Shale	50.5	127.7	***1470.8***	73.6	18.9	1978.2	~~1471~~	~~12~~	~~0~~	~~797~~	~~51~~
409.00	1.00			Shale	50.5	127.7	***1521.2***	73.6	18.9	2051.8	~~1521~~	~~12~~	~~0~~	~~825~~	~~52~~
408.00	1.00			Shale		127.7			18.9						

Pile Design Table for Pier 2 Eastbound utilizing Boring #SB-4

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
110	46	23
Metal Shell 12"Φ w/.25" walls		
313	158	25
Metal Shell 14"Φ w/.25" walls		
139	60	23
413	211	25
Metal Shell 14"Φ w/.312" walls		
139	60	23
413	211	25
Steel HP 8 X 36		
279	146	31
Steel HP 10 X 42		
316	164	30

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
450	238	33
Steel HP 12 X 53		
400	209	30
Steel HP 12 X 63		
454	238	31
Steel HP 12 X 74		
563	298	33
Steel HP 12 X 84		
622	330	34

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
559	294	31
Steel HP 14 X 89		
686	363	33
Steel HP 14 X 102		
755	401	34
Steel HP 14 X 117		
885	473	36
Precast 14"x 14"		
176	76	23
Timber Pile		
150	68	25

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 3 Westbound
REFERENCE BORING ========== SB-7
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 460.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 459.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 437.80 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 11512 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 575.60 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 215.85 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
589 KIPS	**571** KIPS	**296** KIPS	**32** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========= 0.151 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.)
459.10	0.40	1.50			1.6		13.1	2.3		***4.0***	4	1	0	1	1
456.60	2.50	0.80			6.0	11.5	***9.0***	8.7	1.7	11.2	9	4	0	1	4
454.10	2.50	0.10			0.8	1.4	***12.7***	1.2	0.2	12.9	13	5	0	2	6
451.60	2.50	0.30			2.5	4.3	29.5	3.6	0.6	***18.6***	19	6	0	4	9
449.10	2.50	1.30			8.8	18.7	***25.4***	12.8	2.8	29.5	25	11	0	3	11
446.60	2.50	0.40			3.2	5.7	66.3	4.7	0.8	***39.8***	40	13	0	9	14
444.10	2.50		17	Sandy Gravel	4.0	43.4	***29.4***	5.9	6.4	39.6	29	15	0	1	16
441.60	2.50		1	Sandy Gravel	0.2	2.6	85.9	0.3	0.4	***48.2***	48	15	0	12	19
439.10	2.50		23	Sandy Gravel	5.5	58.7	96.4	8.0	8.7	***57.0***	57	18	0	13	21
436.10	3.00		25	Sandy Gravel	7.3	63.9	167.6	10.7	9.4	***77.1***	77	18	0	24	24
435.10	1.00			Shale	50.5	127.7	218.1	73.6	18.9	***150.7***	151	18	0	65	25.4
434.10	1.00			Shale	50.5	127.7	268.5	73.6	18.9	***224.3***	224	18	0	105	26.4
433.10	1.00			Shale	50.5	127.7	319.0	73.6	18.9	***297.9***	298	18	0	146	27.4
432.10	1.00			Shale	50.5	127.7	***369.4***	73.6	18.9	371.5	369	18	0	185	28.4
431.10	1.00			Shale	50.5	127.7	***419.9***	73.6	18.9	445.1	420	18	0	213	29.4
430.10	1.00			Shale	50.5	127.7	***470.3***	73.6	18.9	518.7	470	18	0	241	30.4
429.10	1.00			Shale	50.5	127.7	***520.8***	73.6	18.9	592.3	521	18	0	268	31.4
428.10	1.00			Shale	50.5	127.7	***571.2***	73.6	18.9	665.9	571	18	0	296	32.4
427.10	1.00			Shale	50.5	127.7	***621.7***	73.6	18.9	739.5	~~622~~	~~18~~	~~0~~	~~324~~	~~33.4~~
426.10	1.00			Shale	50.5	127.7	***672.1***	73.6	18.9	813.1	~~672~~	~~18~~	~~0~~	~~352~~	~~34.4~~
425.10	1.00			Shale	50.5	127.7	***722.6***	73.6	18.9	886.7	~~723~~	~~18~~	~~0~~	~~379~~	~~35.4~~
424.10	1.00			Shale	50.5	127.7	***773.0***	73.6	18.9	960.3	~~773~~	~~18~~	~~0~~	~~407~~	~~36.4~~
423.10	1.00			Shale	50.5	127.7	***823.5***	73.6	18.9	1033.9	~~823~~	~~18~~	~~0~~	~~435~~	~~37.4~~
422.10	1.00			Shale	50.5	127.7	***873.9***	73.6	18.9	1107.5	~~874~~	~~18~~	~~0~~	~~463~~	~~38.4~~
421.10	1.00			Shale	50.5	127.7	***924.4***	73.6	18.9	1181.1	~~924~~	~~18~~	~~0~~	~~490~~	~~39.4~~
420.10	1.00			Shale	50.5	127.7	***974.8***	73.6	18.9	1254.7	~~975~~	~~18~~	~~0~~	~~518~~	~~40.4~~
419.10	1.00			Shale	50.5	127.7	***1025.3***	73.6	18.9	1328.3	~~1025~~	~~18~~	~~0~~	~~546~~	~~41.4~~
418.10	1.00			Shale	50.5	127.7	***1075.7***	73.6	18.9	1401.9	~~1076~~	~~18~~	~~0~~	~~574~~	~~42.4~~
417.10	1.00			Shale	50.5	127.7	***1126.2***	73.6	18.9	1475.5	~~1126~~	~~18~~	~~0~~	~~601~~	~~43.4~~
416.10	1.00			Shale	50.5	127.7	***1176.6***	73.6	18.9	1549.1	~~1177~~	~~18~~	~~0~~	~~629~~	~~44.4~~
415.10	1.00			Shale	50.5	127.7	***1227.1***	73.6	18.9	1622.7	~~1227~~	~~18~~	~~0~~	~~657~~	~~45.4~~
414.10	1.00			Shale	50.5	127.7	***1277.5***	73.6	18.9	1696.3	~~1278~~	~~18~~	~~0~~	~~685~~	~~46.4~~
413.10	1.00			Shale	50.5	127.7	***1328.0***	73.6	18.9	1769.9	~~1328~~	~~18~~	~~0~~	~~712~~	~~47.4~~
412.10	1.00			Shale	50.5	127.7	***1378.4***	73.6	18.9	1843.5	~~1378~~	~~18~~	~~0~~	~~740~~	~~48.4~~
411.10	1.00			Shale	50.5	127.7	***1428.9***	73.6	18.9	1917.1	~~1429~~	~~18~~	~~0~~	~~768~~	~~49.4~~
410.10	1.00			Shale	50.5	127.7	***1479.3***	73.6	18.9	1990.7	~~1479~~	~~18~~	~~0~~	~~796~~	~~50.4~~
409.10	1.00			Shale	50.5	127.7	***1529.8***	73.6	18.9	2064.3	~~1530~~	~~18~~	~~0~~	~~823~~	~~51.4~~
408.10	1.00			Shale		127.7			18.9						

Pile Design Table for Pier 3 Westbound utilizing Boring #SB-7

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls	190	68	21
Metal Shell 12"Φ w/.25" walls	342	152	24
Metal Shell 14"Φ w/.25" walls	245	93	21
Metal Shell 14"Φ w/.312" walls	447	203	24
Steel HP 8 X 36	285	145	30
Steel HP 10 X 42	323	163	29

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57	415	213	31
Steel HP 12 X 53	409	207	29
Steel HP 12 X 63	463	237	30
Steel HP 12 X 74	571	296	32
Steel HP 12 X 84	631	329	33

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73	569	292	30
Steel HP 14 X 89	696	362	32
Steel HP 14 X 102	765	399	33
Steel HP 14 X 117	895	471	35
Precast 14"x 14"	263	108	19
Timber Pile	108	23	21

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 3 Eastbound
REFERENCE BORING ========== SB-6
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 460.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 459.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 437.80 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 11512 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 575.60 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 215.85 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
589 KIPS	**569** KIPS	**295** KIPS	**33** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========== 0.151 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.)
458.10	1.40	1.30			4.9		12.1	7.2		***8.3***	8	3	0	2	2
455.60	2.50	0.50			3.9	7.2	14.6	5.8	1.1	***13.8***	14	5	0	3	5
453.10	2.50	0.40			3.2	5.7	***16.4***	4.7	0.8	18.3	16	7	0	2	7
450.60	2.50	0.30			2.5	4.3	27.5	3.6	0.6	***23.1***	23	8	0	5	10
448.10	2.50	0.90			6.6	12.9	44.1	9.6	1.9	***34.2***	34	12	0	7	12
445.60	2.50		9	Sandy Gravel	2.1	23.0	38.6	3.1	3.4	***36.2***	36	13	0	7	15
443.10	2.50		6	Sandy Gravel	1.4	15.3	57.9	2.1	2.3	***40.9***	41	14	0	9	17
440.60	2.50		13	Sandy Gravel	3.1	33.2	81.4	4.5	4.9	***48.4***	48	15	0	11	20
438.10	2.50		21	Sandy Gravel	5.0	53.6	76.2	7.2	7.9	***54.2***	54	18	0	12	22
435.10	3.00		17	Sandy Gravel	4.8	43.4	165.3	7.0	6.4	***73.6***	74	18	0	23	25
434.10	1.00			Shale	50.5	127.7	215.7	73.6	18.9	***147.3***	147	18	0	63	26.4
433.10	1.00			Shale	50.5	127.7	266.2	73.6	18.9	***220.9***	221	18	0	103	27.4
432.10	1.00			Shale	50.5	127.7	316.6	73.6	18.9	***294.5***	294	18	0	144	28.4
431.10	1.00			Shale	50.5	127.7	***367.1***	73.6	18.9	368.1	367	18	0	184	29.4
430.10	1.00			Shale	50.5	127.7	***417.5***	73.6	18.9	441.7	418	18	0	212	30.4
429.10	1.00			Shale	50.5	127.7	***468.0***	73.6	18.9	515.3	468	18	0	239	31.4
428.10	1.00			Shale	50.5	127.7	***518.4***	73.6	18.9	588.9	518	18	0	267	32.4
427.10	1.00			Shale	50.5	127.7	***568.9***	73.6	18.9	662.5	569	18	0	295	33.4
426.10	1.00			Shale	50.5	127.7	***619.3***	73.6	18.9	736.1	~~619~~	~~18~~	~~0~~	~~323~~	~~34.4~~
425.10	1.00			Shale	50.5	127.7	***669.8***	73.6	18.9	809.7	~~670~~	~~18~~	~~0~~	~~350~~	~~35.4~~
424.10	1.00			Shale	50.5	127.7	***720.2***	73.6	18.9	883.3	~~720~~	~~18~~	~~0~~	~~378~~	~~36.4~~
423.10	1.00			Shale	50.5	127.7	***770.7***	73.6	18.9	956.9	~~771~~	~~18~~	~~0~~	~~406~~	~~37.4~~
422.10	1.00			Shale	50.5	127.7	***821.1***	73.6	18.9	1030.5	~~821~~	~~18~~	~~0~~	~~434~~	~~38.4~~
421.10	1.00			Shale	50.5	127.7	***871.6***	73.6	18.9	1104.1	~~872~~	~~18~~	~~0~~	~~461~~	~~39.4~~
420.10	1.00			Shale	50.5	127.7	***922.0***	73.6	18.9	1177.7	~~922~~	~~18~~	~~0~~	~~489~~	~~40.4~~
419.10	1.00			Shale	50.5	127.7	***972.5***	73.6	18.9	1251.3	~~972~~	~~18~~	~~0~~	~~517~~	~~41.4~~
418.10	1.00			Shale	50.5	127.7	***1022.9***	73.6	18.9	1324.9	~~1023~~	~~18~~	~~0~~	~~545~~	~~42.4~~
417.10	1.00			Shale	50.5	127.7	***1073.4***	73.6	18.9	1398.5	~~1073~~	~~18~~	~~0~~	~~572~~	~~43.4~~
416.10	1.00			Shale	50.5	127.7	***1123.8***	73.6	18.9	1472.1	~~1124~~	~~18~~	~~0~~	~~600~~	~~44.4~~
415.10	1.00			Shale	50.5	127.7	***1174.3***	73.6	18.9	1545.7	~~1174~~	~~18~~	~~0~~	~~628~~	~~45.4~~
414.10	1.00			Shale	50.5	127.7	***1224.7***	73.6	18.9	1619.3	~~1225~~	~~18~~	~~0~~	~~656~~	~~46.4~~
413.10	1.00			Shale	50.5	127.7	***1275.2***	73.6	18.9	1692.9	~~1275~~	~~18~~	~~0~~	~~683~~	~~47.4~~
412.10	1.00			Shale	50.5	127.7	***1325.6***	73.6	18.9	1766.5	~~1326~~	~~18~~	~~0~~	~~711~~	~~48.4~~
411.10	1.00			Shale	50.5	127.7	***1376.1***	73.6	18.9	1840.1	~~1376~~	~~18~~	~~0~~	~~739~~	~~49.4~~
410.10	1.00			Shale	50.5	127.7	***1426.5***	73.6	18.9	1913.7	~~1427~~	~~18~~	~~0~~	~~767~~	~~50.4~~
409.10	1.00			Shale	50.5	127.7	***1477.0***	73.6	18.9	1987.3	~~1477~~	~~18~~	~~0~~	~~794~~	~~51.4~~
408.10	1.00			Shale	50.5	127.7	***1527.4***	73.6	18.9	2060.9	~~1527~~	~~18~~	~~0~~	~~822~~	~~52.4~~
407.10	1.00			Shale		127.7			18.9						

Pile Design Table for Pier 3 Eastbound utilizing Boring #SB-6

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls	155	46	22
Metal Shell 12"Φ w/.25" walls	337	146	25
Metal Shell 14"Φ w/.25" walls	197	63	22
Metal Shell 14"Φ w/.312" walls	441	197	25
Steel HP 8 X 36	283	144	31
Steel HP 10 X 42	321	162	30

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57	413	212	32
Steel HP 12 X 53	406	206	30
Steel HP 12 X 63	461	236	31
Steel HP 12 X 74	569	295	33
Steel HP 12 X 84	629	327	34

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73	567	291	31
Steel HP 14 X 89	693	360	33
Steel HP 14 X 102	762	398	34
Steel HP 14 X 117	893	469	36
Precast 14"x 14"	251	80	22
Timber Pile	100	16	22

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== SB-8
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 498.30 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 495.30 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 3943 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 80.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 197.14 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 73.93 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
589 KIPS	**589** KIPS	**324** KIPS	**36** FT.

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter========== 4.050 FT. Unplugged Pile Perimeter========== 5.908 FT.
Plugged Pile End Bearing Area========== 1.025 SQFT. Unplugged Pile End Bearing Area========= 0.151 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.)
475.00	20.30	1.50			79.1		***115.0***	115.4		120.7	115	0	0	63	23
472.50	2.50	2.50			13.6	35.9	164.2	19.9	5.3	***145.8***	146	0	0	80	26
470.00	2.50		28	Sandy Gravel	7.2	71.5	227.6	10.5	10.6	***164.7***	165	0	0	91	28
469.50	0.50			Shale	25.2	127.7	252.9	36.8	18.9	***201.5***	201	0	0	111	28.8
469.00	0.50			Shale	25.2	127.7	278.1	36.8	18.9	***238.3***	238	0	0	131	29.3
468.50	0.50			Shale	25.2	127.7	303.3	36.8	18.9	***275.1***	275	0	0	151	29.8
468.00	0.50			Shale	25.2	127.7	328.5	36.8	18.9	***311.9***	312	0	0	172	30.3
467.50	0.50			Shale	25.2	127.7	353.8	36.8	18.9	***348.7***	349	0	0	192	30.8
467.00	0.50			Shale	25.2	127.7	***379.0***	36.8	18.9	385.5	379	0	0	208	31.3
466.50	0.50			Shale	25.2	127.7	***404.2***	36.8	18.9	422.3	404	0	0	222	31.8
466.00	0.50			Shale	25.2	127.7	***429.5***	36.8	18.9	459.1	429	0	0	236	32.3
465.50	0.50			Shale	25.2	127.7	***454.7***	36.8	18.9	495.9	455	0	0	250	32.8
465.00	0.50			Shale	25.2	127.7	***479.9***	36.8	18.9	532.7	480	0	0	264	33.3
464.50	0.50			Shale	25.2	127.7	***505.1***	36.8	18.9	569.5	505	0	0	278	33.8
464.00	0.50			Shale	25.2	127.7	***530.4***	36.8	18.9	606.3	530	0	0	292	34.3
463.50	0.50			Shale	25.2	127.7	***555.6***	36.8	18.9	643.1	556	0	0	306	34.8
463.00	0.50			Shale	25.2	127.7	***580.8***	36.8	18.9	679.9	581	0	0	319	35.3
462.50	0.50			Shale	25.2	127.7	***606.0***	36.8	18.9	716.7	~~606~~	~~0~~	~~0~~	~~333~~	~~35.8~~
462.00	0.50			Shale	25.2	127.7	***631.3***	36.8	18.9	753.5	~~631~~	~~0~~	~~0~~	~~347~~	~~36.3~~
461.50	0.50			Shale	25.2	127.7	***656.5***	36.8	18.9	790.3	~~656~~	~~0~~	~~0~~	~~361~~	~~36.8~~
461.00	0.50			Shale	25.2	127.7	***681.7***	36.8	18.9	827.1	~~682~~	~~0~~	~~0~~	~~375~~	~~37.3~~
460.50	0.50			Shale	25.2	127.7	***706.9***	36.8	18.9	863.9	~~707~~	~~0~~	~~0~~	~~389~~	~~37.8~~
460.00	0.50			Shale	25.2	127.7	***732.2***	36.8	18.9	900.7	~~732~~	~~0~~	~~0~~	~~403~~	~~38.3~~
459.50	0.50			Shale	25.2	127.7	***757.4***	36.8	18.9	937.5	~~757~~	~~0~~	~~0~~	~~417~~	~~38.8~~
459.00	0.50			Shale	25.2	127.7	***782.6***	36.8	18.9	974.3	~~783~~	~~0~~	~~0~~	~~430~~	~~39.3~~
458.50	0.50			Shale	25.2	127.7	***807.8***	36.8	18.9	1011.1	~~808~~	~~0~~	~~0~~	~~444~~	~~39.8~~
458.00	0.50			Shale	25.2	127.7	***833.1***	36.8	18.9	1047.9	~~833~~	~~0~~	~~0~~	~~458~~	~~40.3~~
457.50	0.50			Shale	25.2	127.7	***858.3***	36.8	18.9	1084.7	~~858~~	~~0~~	~~0~~	~~472~~	~~40.8~~
457.00	0.50			Shale	25.2	127.7	***883.5***	36.8	18.9	1121.5	~~884~~	~~0~~	~~0~~	~~486~~	~~41.3~~
456.50	0.50			Shale	25.2	127.7	***908.7***	36.8	18.9	1158.3	~~909~~	~~0~~	~~0~~	~~500~~	~~41.8~~
456.00	0.50			Shale	25.2	127.7	***934.0***	36.8	18.9	1195.1	~~934~~	~~0~~	~~0~~	~~514~~	~~42.3~~
455.50	0.50			Shale	25.2	127.7	***959.2***	36.8	18.9	1231.9	~~959~~	~~0~~	~~0~~	~~528~~	~~42.8~~
455.00	0.50			Shale	25.2	127.7	***984.4***	36.8	18.9	1268.7	~~984~~	~~0~~	~~0~~	~~541~~	~~43.3~~
454.50	0.50			Shale	25.2	127.7	***1009.6***	36.8	18.9	1305.5	~~1010~~	~~0~~	~~0~~	~~555~~	~~43.8~~
454.00	0.50			Shale	25.2	127.7	***1034.9***	36.8	18.9	1342.3	~~1035~~	~~0~~	~~0~~	~~569~~	~~44.3~~
453.50	0.50			Shale	25.2	127.7	***1060.1***	36.8	18.9	1379.1	~~1060~~	~~0~~	~~0~~	~~583~~	~~44.8~~
453.00	0.50			Shale	25.2	127.7	***1085.3***	36.8	18.9	1415.9	~~1085~~	~~0~~	~~0~~	~~597~~	~~45.3~~
452.50	0.50			Shale		127.7			18.9						

Pile Design Table for East Abutment utilizing Boring #SB-8

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
118	65	23
251	138	26
Metal Shell 12"Φ w/.25" walls		
118	65	23
251	138	26
Metal Shell 14"Φ w/.25" walls		
141	78	23
320	176	26
Metal Shell 14"Φ w/.312" walls		
141	78	23
320	176	26
501	275	28
Steel HP 8 X 36		
274	151	33
Steel HP 10 X 42		
331	182	32

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
120	66	26
135	74	28
454	250	35
Steel HP 12 X 53		
112	62	23
140	77	26
157	86	28
418	230	33
Steel HP 12 X 63		
113	62	23
144	79	26
161	89	28
497	273	34
Steel HP 12 X 74		
115	63	23
146	80	26
165	91	28
589	324	36
Steel HP 12 X 84		
117	64	23
148	81	26
168	92	28
664	365	37

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
140	77	23
170	94	26
191	105	28
578	318	33
Steel HP 14 X 89		
142	78	23
174	96	26
196	108	28
705	388	35
Steel HP 14 X 102		
144	79	23
176	97	26
200	110	28
810	445	37
Steel HP 14 X 117		
146	80	23
180	99	26
205	113	28
929	511	39
Precast 14"x 14"		
180	99	23
Timber Pile		
103	57	23

EXHIBIT G

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table for East Abutment - SB-8

Estimated Top of Shale Elevation: 464.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	463	18	128	146	73	30	0.08	60	0.19
2	462	36	143	179	90	40	0.08	80	0.19
3	461	54	158	213	106	50	0.09	90	0.17
4	460	72	155	227	114	50	0.08	100	0.17
5	459	90	160	250	125	60	0.08	110	0.16
6	458	109	163	272	136	60	0.07	110	0.14
7	457	127	166	293	146	70	0.08	120	0.14
8	456	145	168	313	156	70	0.07	130	0.14
9	455	163	170	332	166	80	0.08	140	0.14
10	454	181	171	352	176	80	0.07	150	0.14
11	453	199	172	371	186	90	0.08	150	0.13
12	452	217	173	390	195	90	0.07	160	0.13
13	451	235	174	409	205	100	0.08	170	0.13
14	450	253	175	428	214	100	0.07	180	0.14
15	449	271	175	447	223	110	0.08	180	0.13
16	448	290	176	465	233	110	0.07	190	0.13
17	447	308	176	484	242	120	0.08	200	0.13
18	446	326	177	502	251	120	0.07	210	0.13
19	445	344	177	521	260	130	0.08	210	0.13
20	444	362	177	539	270	130	0.07	220	0.13
21	443	380	178	558	279	130	0.07	230	0.13
22	442	398	178	576	288	140	0.08	240	0.13
23	441	416	178	594	297	140	0.07	240	0.13
24	440	434	179	613	306	150	0.08	250	0.13
25	439	452	179	631	316	150	0.07	275	0.14
26	438	470	179	649	325	160	0.08	275	0.13
27	437	489	179	668	334	160	0.07	275	0.13
28	436	507	179	686	343	170	0.08	275	0.13
29	435	525	179	704	352	170	0.08	300	0.14
30	434	543	180	723	361	180	0.08	300	0.13
42 in. Diameter Drilled Shaft									
1	463	21	172	193	96	40	0.10	80	0.22
2	462	42	189	231	116	50	0.10	100	0.22
3	461	63	207	270	135	60	0.10	110	0.19
4	460	84	206	291	145	70	0.10	120	0.19
5	459	106	213	319	159	70	0.09	130	0.18
6	458	127	218	345	172	80	0.09	140	0.17
7	457	148	222	370	185	90	0.10	150	0.17
8	456	169	225	394	197	90	0.09	160	0.17
9	455	190	228	418	209	100	0.09	170	0.16
10	454	211	230	441	221	110	0.09	180	0.16
11	453	232	232	464	232	110	0.09	190	0.16
12	452	253	233	487	243	120	0.09	200	0.16
13	451	274	234	509	254	120	0.09	210	0.16
14	450	296	236	531	266	130	0.09	220	0.16
15	449	317	237	553	277	130	0.09	230	0.16
16	448	338	237	575	288	140	0.09	240	0.16
17	447	359	238	597	299	140	0.09	240	0.15
18	446	380	239	619	309	150	0.09	250	0.15
19	445	401	239	641	320	160	0.09	275	0.16
20	444	422	240	662	331	160	0.09	275	0.15
21	443	443	240	684	342	170	0.09	275	0.15
22	442	464	241	705	353	170	0.09	300	0.16
23	441	486	241	727	363	180	0.09	300	0.15
24	440	507	242	748	374	180	0.09	300	0.15
25	439	528	242	770	385	190	0.09	325	0.15

Drilled Shaft Design Table for East Abutment - SB-8

Estimated Top of Shale Elevation: 464.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
26	438	549	242	791	396	190	0.09	325	0.15
27	437	570	243	813	406	200	0.09	350	0.16
28	436	591	243	834	417	200	0.09	350	0.15
29	435	612	243	855	428	210	0.09	350	0.15
48 in. Diameter Drilled Shaft									
1	463	24	221	245	123	60	0.14	100	0.25
2	462	48	241	290	145	70	0.13	120	0.24
3	461	72	261	334	167	80	0.12	140	0.23
4	460	97	281	378	189	90	0.12	160	0.23
5	459	121	273	394	197	90	0.11	160	0.21
6	458	145	280	425	212	100	0.11	170	0.20
7	457	169	286	455	227	110	0.11	190	0.20
8	456	193	290	483	242	120	0.11	200	0.20
9	455	217	294	511	255	120	0.10	210	0.19
10	454	241	297	538	269	130	0.11	220	0.19
11	453	265	299	565	282	140	0.11	230	0.18
12	452	290	302	591	296	140	0.10	240	0.18
13	451	314	303	617	309	150	0.10	250	0.18
14	450	338	305	643	321	160	0.11	275	0.19
15	449	362	306	668	334	160	0.10	275	0.18
16	448	386	308	694	347	170	0.10	300	0.19
17	447	410	309	719	359	170	0.10	300	0.18
18	446	434	310	744	372	180	0.10	300	0.17
19	445	458	311	769	385	190	0.10	325	0.18
20	444	483	312	794	397	190	0.10	325	0.17
21	443	507	312	819	409	200	0.10	350	0.18
22	442	531	313	844	422	210	0.10	350	0.18
23	441	555	314	868	434	210	0.10	350	0.17
24	440	579	314	893	447	220	0.10	375	0.18
25	439	603	315	918	459	220	0.10	375	0.17
26	438	627	315	942	471	230	0.10	400	0.18
27	437	651	316	967	484	240	0.10	400	0.17
28	436	676	316	992	496	240	0.10	400	0.17
54 in. Diameter Drilled Shaft									
1	463	27	277	304	152	70	0.14	130	0.31
2	462	54	300	354	177	80	0.13	150	0.28
3	461	81	322	404	202	100	0.14	170	0.27
4	460	109	345	454	227	110	0.14	190	0.25
5	459	136	340	475	238	110	0.12	200	0.25
6	458	163	349	512	256	120	0.12	210	0.23
7	457	190	356	546	273	130	0.12	220	0.22
8	456	217	362	579	290	140	0.12	240	0.22
9	455	244	367	611	306	150	0.12	250	0.22
10	454	271	371	643	321	160	0.13	275	0.23
11	453	299	375	673	337	160	0.12	275	0.21
12	452	326	378	704	352	170	0.12	300	0.22
13	451	353	380	733	367	180	0.12	300	0.21
14	450	380	383	763	381	190	0.12	325	0.21
15	449	407	385	792	396	190	0.12	325	0.20
16	448	434	386	821	410	200	0.12	350	0.21
17	447	461	388	849	425	210	0.12	350	0.20
18	446	489	389	878	439	210	0.11	375	0.21
19	445	516	391	906	453	220	0.11	375	0.20
20	444	543	392	935	467	230	0.12	375	0.19
21	443	570	393	963	481	240	0.12	400	0.20
22	442	597	394	991	495	240	0.11	400	0.19
23	441	624	395	1019	509	250	0.11	425	0.20

Drilled Shaft Design Table for East Abutment - SB-8

Estimated Top of Shale Elevation: 464.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
24	440	651	395	1047	523	250	0.11	425	0.19
25	439	679	396	1075	537	250	0.11	450	0.20
26	438	706	397	1103	551	275	0.12	450	0.19
27	437	733	398	1130	565	275	0.11	475	0.20
72 in. Diameter Drilled Shaft									
1	463	36	483	519	259	120	0.20	210	0.39
2	462	72	513	585	293	140	0.19	240	0.37
3	461	109	543	651	326	160	0.19	275	0.37
4	460	145	573	718	359	170	0.18	300	0.35
5	459	181	603	784	392	190	0.18	325	0.34
6	458	217	633	850	425	210	0.18	350	0.33
7	457	253	608	862	431	210	0.18	350	0.31
8	456	290	620	910	455	220	0.17	375	0.31
9	455	326	630	956	478	230	0.17	400	0.31
10	454	362	639	1001	500	250	0.17	425	0.31
11	453	398	646	1044	522	250	0.16	425	0.29
12	452	434	653	1087	544	250	0.16	450	0.29
13	451	470	658	1129	564	275	0.16	475	0.30
14	450	507	663	1170	585	275	0.16	475	0.28
15	449	543	668	1211	605	300	0.16	500	0.28
16	448	579	672	1251	625	300	0.16	550	0.30
17	447	615	675	1290	645	300	0.15	550	0.29
18	446	651	678	1330	665	325	0.16	550	0.28
19	445	688	681	1369	684	325	0.15	550	0.27
20	444	724	684	1408	704	350	0.16	600	0.28
21	443	760	686	1446	723	350	0.15	600	0.27
22	442	796	688	1485	742	350	0.15	600	0.27
23	441	832	690	1523	761	375	0.16	650	0.28
24	440	869	692	1561	780	375	0.15	650	0.27

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table: Unit Resistances for East Abutment - SB-8

Estimated Top of Shale Elevation: 464.00

LAYER ELEVATIONS (FT)	UNIT SIDE RESISTANCE		UNIT TIP RESISTANCE AT BASE OF LAYER									
			DRILLED SHAFT ϕ									
			36"		42"		48"		54"		72"	
	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)
464.00 - 463.00	1.9	1.0	18.1	9.1	17.8	8.9	17.6	8.8	17.4	8.7	17.1	8.5
463.00 - 462.00	1.9	1.0	20.3	10.1	19.7	9.8	19.2	9.6	18.8	9.4	18.1	9.1
462.00 - 461.00	1.9	1.0	22.4	11.2	21.5	10.7	20.8	10.4	20.3	10.1	19.2	9.6
461.00 - 460.00	1.9	1.0	21.9	11.0	21.5	10.7	22.4	11.2	21.7	10.8	20.3	10.1
460.00 - 459.00	1.9	1.0	22.6	11.3	22.1	11.1	21.7	10.9	21.4	10.7	21.3	10.7
459.00 - 458.00	1.9	1.0	23.1	11.5	22.7	11.3	22.3	11.1	21.9	11.0	22.4	11.2
458.00 - 457.00	1.9	1.0	23.5	11.7	23.1	11.5	22.7	11.4	22.4	11.2	21.5	10.8
457.00 - 456.00	1.9	1.0	23.8	11.9	23.4	11.7	23.1	11.5	22.8	11.4	21.9	11.0
456.00 - 455.00	1.9	1.0	24.0	12.0	23.7	11.8	23.4	11.7	23.1	11.5	22.3	11.1
455.00 - 454.00	1.9	1.0	24.2	12.1	23.9	11.9	23.6	11.8	23.3	11.7	22.6	11.3
454.00 - 453.00	1.9	1.0	24.3	12.2	24.1	12.0	23.8	11.9	23.6	11.8	22.9	11.4
453.00 - 452.00	1.9	1.0	24.5	12.2	24.2	12.1	24.0	12.0	23.8	11.9	23.1	11.5
452.00 - 451.00	1.9	1.0	24.6	12.3	24.4	12.2	24.1	12.1	23.9	12.0	23.3	11.6
451.00 - 450.00	1.9	1.0	24.7	12.4	24.5	12.2	24.3	12.1	24.1	12.0	23.5	11.7
450.00 - 449.00	1.9	1.0	24.8	12.4	24.6	12.3	24.4	12.2	24.2	12.1	23.6	11.8
449.00 - 448.00	1.9	1.0	24.9	12.4	24.7	12.3	24.5	12.2	24.3	12.1	23.8	11.9
448.00 - 447.00	1.9	1.0	24.9	12.5	24.8	12.4	24.6	12.3	24.4	12.2	23.9	11.9
447.00 - 446.00	1.9	1.0	25.0	12.5	24.8	12.4	24.7	12.3	24.5	12.2	24.0	12.0
446.00 - 445.00	1.9	1.0	25.1	12.5	24.9	12.4	24.7	12.4	24.6	12.3	24.1	12.0
445.00 - 444.00	1.9	1.0	25.1	12.6	24.9	12.5	24.8	12.4	24.6	12.3	24.2	12.1
444.00 - 443.00	1.9	1.0	25.1	12.6	25.0	12.5	24.8	12.4	24.7	12.4	24.3	12.1
443.00 - 442.00	1.9	1.0	25.2	12.6	25.0	12.5	24.9	12.5	24.8	12.4	24.3	12.2
442.00 - 441.00	1.9	1.0	25.2	12.6	25.1	12.5	25.0	12.5	24.8	12.4	24.4	12.2
441.00 - 440.00	1.9	1.0	25.3	12.6	25.1	12.6	25.0	12.5	24.9	12.4	24.5	12.2
440.00 - 439.00	1.9	1.0	25.3	12.6	25.2	12.6	25.0	12.5	24.9	12.5		
439.00 - 438.00	1.9	1.0	25.3	12.7	25.2	12.6	25.1	12.5	25.0	12.5		
438.00 - 437.00	1.9	1.0	25.3	12.7	25.2	12.6	25.1	12.6	25.0	12.5		
437.00 - 436.00	1.9	1.0	25.4	12.7	25.3	12.6	25.1	12.6				
436.00 - 435.00	1.9	1.0	25.4	12.7	25.3	12.6						
435.00 - 434.00	1.9	1.0	25.4	12.7								
434.00 - 433.00	1.9	1.0										
433.00 - 432.00	1.9	1.0										
432.00 - 431.00	1.9	1.0										
431.00 - 430.00	1.9	1.0										
430.00 - 429.00	1.9	1.0										
429.00 - 428.00	1.9	1.0										

Drilled Shaft Design Table for Pier 1 - B-1 & SB-4

Estimated Top of Shale Elevation: 448.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	447	23	164	187	94	40	0.08	80	0.20
2	446	46	184	230	115	50	0.08	100	0.18
3	445	70	203	272	136	60	0.08	110	0.16
4	444	93	199	291	146	70	0.09	120	0.16
5	443	116	205	321	160	80	0.09	130	0.15
6	442	139	209	348	174	80	0.08	140	0.14
7	441	162	212	375	187	90	0.08	150	0.14
8	440	185	215	401	200	100	0.08	170	0.15
9	439	209	217	426	213	100	0.08	180	0.14
10	438	232	219	451	225	110	0.08	190	0.14
11	437	255	221	476	238	110	0.07	200	0.14
12	436	278	222	500	250	120	0.08	200	0.13
13	435	301	223	524	262	130	0.08	210	0.13
14	434	325	224	548	274	130	0.07	220	0.13
15	433	348	266	614	307	150	0.08	250	0.13
16	432	371	309	680	340	170	0.08	275	0.14
17	431	394	353	747	373	180	0.08	300	0.14
18	430	417	396	813	407	200	0.08	350	0.15
19	429	441	439	880	440	210	0.08	375	0.15
20	428	464	482	946	473	230	0.09	400	0.15
21	427	513	483	996	498	240	0.08	400	0.15
22	426	562	484	1046	523	250	0.08	425	0.15
23	425	611	485	1096	548	250	0.08	450	0.15
24	424	660	485	1146	573	275	0.08	475	0.15
42 in. Diameter Drilled Shaft									
1	447	27	220	247	123	60	0.12	100	0.22
2	446	54	242	296	148	70	0.11	120	0.20
3	445	81	265	346	173	80	0.10	140	0.19
4	444	108	264	373	186	90	0.10	150	0.18
5	443	135	273	408	204	100	0.10	170	0.18
6	442	162	279	442	221	110	0.10	180	0.17
7	441	189	285	474	237	110	0.09	190	0.17
8	440	216	289	505	253	120	0.09	210	0.17
9	439	243	292	535	268	130	0.09	220	0.17
10	438	270	295	565	283	140	0.09	230	0.16
11	437	298	297	594	297	140	0.09	240	0.16
12	436	325	299	623	312	150	0.09	250	0.16
13	435	352	300	652	326	160	0.09	275	0.16
14	434	379	350	729	364	180	0.09	300	0.16
15	433	406	400	806	403	200	0.10	325	0.16
16	432	433	450	883	442	220	0.10	375	0.17
17	431	460	501	961	480	240	0.10	400	0.17
18	430	487	551	1038	519	250	0.10	425	0.17
19	429	514	602	1116	558	275	0.10	450	0.17
20	428	541	652	1193	597	275	0.09	500	0.18
21	427	598	654	1252	626	300	0.10	550	0.19
22	426	656	655	1311	655	325	0.10	550	0.18
23	425	713	656	1369	685	325	0.10	550	0.17
48 in. Diameter Drilled Shaft									
1	447	31	283	314	157	70	0.12	130	0.26
2	446	62	309	371	185	90	0.13	150	0.23
3	445	93	335	428	214	100	0.12	180	0.23
4	444	124	361	484	242	120	0.12	200	0.22
5	443	155	350	505	252	120	0.11	210	0.21
6	442	185	359	544	272	130	0.11	220	0.20
7	441	216	366	582	291	140	0.11	240	0.20

Drilled Shaft Design Table for Pier 1 - B-1 & SB-4

Estimated Top of Shale Elevation: 448.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
8	440	247	372	619	310	150	0.11	250	0.19
9	439	278	376	655	327	160	0.11	275	0.20
10	438	309	380	689	345	170	0.11	300	0.20
11	437	340	384	724	362	180	0.11	300	0.19
12	436	371	386	757	379	180	0.10	325	0.19
13	435	402	443	845	423	210	0.11	350	0.19
14	434	433	500	933	467	230	0.11	375	0.19
15	433	464	558	1022	511	250	0.11	425	0.19
16	432	495	615	1110	555	275	0.11	450	0.19
17	431	526	673	1199	599	275	0.11	500	0.20
18	430	556	731	1287	644	300	0.11	550	0.21
19	429	587	789	1376	688	325	0.11	600	0.21
20	428	618	847	1465	733	350	0.11	600	0.20
21	427	684	849	1533	766	375	0.11	650	0.21
22	426	749	851	1600	800	400	0.12	650	0.20
54 in. Diameter Drilled Shaft									
1	447	35	355	390	195	90	0.14	160	0.29
2	446	70	384	454	227	110	0.14	190	0.28
3	445	104	413	517	259	120	0.13	210	0.25
4	444	139	442	581	291	140	0.13	240	0.25
5	443	174	435	609	305	150	0.13	250	0.24
6	442	209	447	656	328	160	0.13	275	0.24
7	441	243	456	700	350	170	0.13	300	0.24
8	440	278	464	742	371	180	0.13	300	0.22
9	439	313	470	783	392	190	0.12	325	0.22
10	438	348	476	824	412	200	0.12	350	0.22
11	437	383	480	863	431	210	0.12	350	0.21
12	436	417	544	962	481	240	0.13	400	0.22
13	435	452	609	1061	531	250	0.12	425	0.21
14	434	487	674	1161	580	275	0.12	475	0.22
15	433	522	739	1260	630	300	0.12	550	0.24
16	432	556	804	1360	680	325	0.12	550	0.22
17	431	591	869	1460	730	350	0.13	600	0.23
18	430	626	934	1560	780	375	0.13	650	0.23
19	429	661	1000	1661	830	400	0.13	700	0.24
20	428	696	1065	1761	880	425	0.13	750	0.24
21	427	769	1068	1837	919	450	0.13	750	0.23
72 in. Diameter Drilled Shaft									
1	447	46	618	665	332	160	0.20	275	0.40
2	446	93	657	750	375	180	0.20	300	0.36
3	445	139	696	835	417	200	0.19	350	0.37
4	444	185	734	920	460	220	0.18	375	0.34
5	443	232	773	1005	502	250	0.19	425	0.35
6	442	278	811	1090	545	250	0.17	450	0.33
7	441	325	780	1104	552	275	0.18	450	0.31
8	440	371	795	1166	583	275	0.17	475	0.31
9	439	417	883	1300	650	325	0.18	550	0.32
10	438	464	972	1435	718	350	0.17	600	0.32
11	437	510	1060	1570	785	375	0.17	650	0.31
12	436	556	1149	1706	853	425	0.18	700	0.31
13	435	603	1238	1841	920	450	0.17	750	0.31
14	434	649	1327	1976	988	475	0.17	800	0.31
15	433	696	1416	2111	1056	500	0.17	850	0.31
16	432	742	1504	2246	1123	550	0.18	900	0.30
17	431	788	1593	2381	1191	550	0.17	1000	0.32
18	430	835	1682	2517	1258	600	0.17	1100	0.34

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table: Unit Resistances for Pier 1 - B-1 & SB-4

Estimated Top of Shale Elevation: 448.00

LAYER ELEVATIONS (FT)	UNIT SIDE RESISTANCE		UNIT TIP RESISTANCE AT BASE OF LAYER									
			DRILLED SHAFT ϕ									
			36"		42"		48"		54"		72"	
	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)
448.00 - 447.00	2.5	1.2	23.2	11.6	22.8	11.4	22.6	11.3	22.3	11.2	21.9	10.9
447.00 - 446.00	2.5	1.2	26.0	13.0	25.2	12.6	24.6	12.3	24.1	12.1	23.2	11.6
446.00 - 445.00	2.5	1.2	28.7	14.4	27.5	13.8	26.7	13.3	26.0	13.0	24.6	12.3
445.00 - 444.00	2.5	1.2	28.1	14.1	27.5	13.7	28.7	14.4	27.8	13.9	26.0	13.0
444.00 - 443.00	2.5	1.2	28.9	14.5	28.4	14.2	27.8	13.9	27.4	13.7	27.3	13.7
443.00 - 442.00	2.5	1.2	29.6	14.8	29.1	14.5	28.6	14.3	28.1	14.1	28.7	14.4
442.00 - 441.00	2.5	1.2	30.1	15.0	29.6	14.8	29.1	14.6	28.7	14.3	27.6	13.8
441.00 - 440.00	2.5	1.2	30.4	15.2	30.0	15.0	29.6	14.8	29.2	14.6	28.1	14.1
440.00 - 439.00	2.5	1.2	30.7	15.4	30.3	15.2	30.0	15.0	29.6	14.8	31.2	15.6
439.00 - 438.00	2.5	1.2	31.0	15.5	30.6	15.3	30.3	15.1	29.9	15.0	34.4	17.2
438.00 - 437.00	2.5	1.2	31.2	15.6	30.9	15.4	30.5	15.3	30.2	15.1	37.5	18.8
437.00 - 436.00	2.5	1.2	31.4	15.7	31.1	15.5	30.7	15.4	34.2	17.1	40.6	20.3
436.00 - 435.00	2.5	1.2	31.5	15.8	31.2	15.6	35.3	17.6	38.3	19.1	43.8	21.9
435.00 - 434.00	2.5	1.2	31.6	15.8	36.4	18.2	39.8	19.9	42.4	21.2	46.9	23.5
434.00 - 433.00	2.5	1.2	37.7	18.9	41.6	20.8	44.4	22.2	46.4	23.2	50.1	25.0
433.00 - 432.00	2.5	1.2	43.8	21.9	46.8	23.4	49.0	24.5	50.5	25.3	53.2	26.6
432.00 - 431.00	2.5	1.2	49.9	24.9	52.0	26.0	53.6	26.8	54.6	27.3	56.3	28.2
431.00 - 430.00	2.5	1.2	56.0	28.0	57.3	28.6	58.2	29.1	58.7	29.4	59.5	29.7
430.00 - 429.00	2.5	1.2	62.1	31.1	62.6	31.3	62.8	31.4	62.9	31.4		
429.00 - 428.00	2.5	1.2	68.2	34.1	67.8	33.9	67.4	33.7	67.0	33.5		
428.00 - 427.00	5.2	2.6	68.4	34.2	68.0	34.0	67.6	33.8	67.2	33.6		
427.00 - 426.00	5.2	2.6	68.5	34.2	68.1	34.0	67.7	33.9				
426.00 - 425.00	5.2	2.6	68.6	34.3	68.2	34.1						
425.00 - 424.00	5.2	2.6	68.7	34.3								
424.00 - 423.00	5.2	2.6										
423.00 - 422.00	5.2	2.6										
422.00 - 421.00	5.2	2.6										
421.00 - 420.00	5.2	2.6										
420.00 - 419.00	5.2	2.6										
419.00 - 418.00	5.2	2.6										

Drilled Shaft Design Table for Pier 2 - SB-4

Estimated Top of Shale Elevation: 436.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	435	49	348	398	199	90	0.09	160	0.18
2	434	98	389	488	244	120	0.09	200	0.17
3	433	148	430	578	289	140	0.09	240	0.17
4	432	197	422	618	309	150	0.09	250	0.15
5	431	246	434	680	340	170	0.09	275	0.15
6	430	295	444	739	369	180	0.08	300	0.15
7	429	344	451	795	398	190	0.08	325	0.14
8	428	394	457	850	425	210	0.08	350	0.14
9	427	443	461	904	452	220	0.08	375	0.14
10	426	492	465	957	478	230	0.08	400	0.14
11	425	541	468	1009	505	250	0.08	425	0.14
12	424	590	471	1061	530	250	0.08	425	0.14
13	423	640	473	1112	556	275	0.08	450	0.14
14	422	689	723	1412	706	350	0.09	600	0.16
15	421	738	975	1713	856	425	0.09	700	0.16
16	420	787	1228	2015	1007	500	0.10	850	0.18
17	419	836	1482	2318	1159	550	0.10	950	0.18
18	418	886	1737	2622	1311	650	0.11	1100	0.19
19	417	935	1992	2927	1463	700	0.11	1200	0.20
20	416	1138	1996	3134	1567	750	0.11	1300	0.20
21	415	1342	2000	3341	1671	800	0.11	1400	0.20
22	414	1545	2003	3548	1774	850	0.11	1500	0.21
23	413	1749	2006	3755	1877	900	0.12	1600	0.21
24	412	1953	1876	3829	1915	950	0.12	1600	0.21
42 in. Diameter Drilled Shaft									
1	435	57	466	524	262	130	0.12	210	0.21
2	434	115	514	629	314	150	0.11	275	0.22
3	433	172	562	734	367	180	0.11	300	0.19
4	432	230	561	791	395	190	0.10	325	0.19
5	431	287	579	866	433	210	0.10	350	0.18
6	430	344	593	937	469	230	0.10	375	0.17
7	429	402	604	1006	503	250	0.10	425	0.18
8	428	459	612	1072	536	250	0.09	450	0.17
9	427	517	619	1136	568	275	0.10	475	0.17
10	426	574	625	1199	600	275	0.09	500	0.17
11	425	631	630	1261	631	300	0.09	550	0.18
12	424	689	634	1323	661	325	0.10	550	0.17
13	423	746	923	1669	835	400	0.10	700	0.18
14	422	804	1215	2018	1009	500	0.11	850	0.19
15	421	861	1508	2369	1184	550	0.10	950	0.19
16	420	918	1803	2721	1361	650	0.11	1100	0.20
17	419	976	2099	3075	1537	750	0.12	1300	0.22
18	418	1033	2396	3429	1714	850	0.13	1400	0.22
19	417	1091	2694	3784	1892	900	0.13	1600	0.24
20	416	1328	2700	4028	2014	1000	0.13	1700	0.23
21	415	1566	2706	4271	2136	1000	0.12	1800	0.23
22	414	1803	2711	4514	2257	1100	0.13	1900	0.23
23	413	2041	2562	4603	2301	1100	0.13	1900	0.22
48 in. Diameter Drilled Shaft									
1	435	66	601	667	333	160	0.13	275	0.26
2	434	131	656	787	394	190	0.13	325	0.24
3	433	197	711	907	454	220	0.12	375	0.23
4	432	262	765	1028	514	250	0.12	425	0.22
5	431	328	743	1071	535	250	0.11	450	0.22
6	430	394	762	1155	578	275	0.11	475	0.21
7	429	459	777	1236	618	300	0.11	500	0.20

Drilled Shaft Design Table for Pier 2 - SB-4

Estimated Top of Shale Elevation: 436.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
8	428	525	789	1313	657	325	0.11	550	0.20
9	427	590	799	1389	695	325	0.11	600	0.21
10	426	656	807	1463	731	350	0.11	600	0.19
11	425	722	814	1535	768	375	0.11	650	0.20
12	424	787	1141	1928	964	475	0.12	800	0.20
13	423	853	1472	2325	1162	550	0.12	950	0.21
14	422	918	1805	2723	1362	650	0.12	1100	0.22
15	421	984	2140	3124	1562	750	0.13	1300	0.23
16	420	1050	2477	3527	1763	850	0.13	1500	0.25
17	419	1115	2815	3931	1965	950	0.14	1600	0.24
18	418	1181	3155	4336	2168	1000	0.13	1800	0.25
19	417	1246	3495	4742	2371	1100	0.14	1900	0.25
20	416	1518	3505	5022	2511	1200	0.14	2100	0.26
21	415	1789	3513	5302	2651	1300	0.15	2200	0.26
22	414	2061	3347	5407	2704	1300	0.14	2200	0.25
54 in. Diameter Drilled Shaft									
1	435	74	753	827	414	200	0.15	350	0.30
2	434	148	815	962	481	240	0.15	400	0.28
3	433	221	876	1098	549	250	0.13	450	0.26
4	432	295	938	1233	617	300	0.14	500	0.25
5	431	369	924	1293	646	300	0.13	550	0.25
6	430	443	948	1391	696	325	0.12	600	0.25
7	429	517	968	1485	742	350	0.12	600	0.23
8	428	590	985	1575	788	375	0.12	650	0.23
9	427	664	998	1662	831	400	0.12	700	0.23
10	426	738	1010	1747	874	425	0.12	700	0.21
11	425	812	1374	2186	1093	500	0.12	900	0.23
12	424	886	1744	2629	1315	650	0.14	1100	0.24
13	423	959	2116	3076	1538	750	0.14	1300	0.26
14	422	1033	2492	3525	1762	850	0.14	1500	0.27
15	421	1107	2869	3976	1988	950	0.14	1600	0.26
16	420	1181	3249	4429	2215	1100	0.15	1800	0.27
17	419	1255	3630	4884	2442	1200	0.16	2000	0.28
18	418	1328	4012	5340	2670	1300	0.16	2200	0.28
19	417	1402	4395	5797	2899	1400	0.16	2400	0.29
20	416	1707	4408	6116	3058	1500	0.16	2500	0.28
21	415	2013	4226	6239	3119	1500	0.16	2500	0.27
72 in. Diameter Drilled Shaft									
1	435	98	1312	1410	705	350	0.21	600	0.42
2	434	197	1394	1591	795	375	0.19	650	0.37
3	433	295	1476	1771	886	425	0.19	750	0.37
4	432	394	1558	1951	976	475	0.19	800	0.34
5	431	492	1640	2132	1066	500	0.18	900	0.35
6	430	590	1722	2312	1156	550	0.18	950	0.33
7	429	689	1654	2343	1171	550	0.17	950	0.31
8	428	787	2127	2914	1457	700	0.18	1200	0.33
9	427	886	2610	3495	1748	850	0.18	1400	0.32
10	426	984	3099	4083	2042	1000	0.19	1700	0.34
11	425	1082	3595	4677	2339	1100	0.18	1900	0.34
12	424	1181	4095	5276	2638	1300	0.19	2200	0.36
13	423	1279	4598	5878	2939	1400	0.19	2400	0.35
14	422	1378	5105	6482	3241	1600	0.20	2600	0.35
15	421	1476	5614	7089	3545	1700	0.20	2900	0.36
16	420	1574	6124	7698	3849	1900	0.21	3100	0.36
17	419	1673	6636	8309	4155	2000	0.20	3400	0.37
18	418	1771	6899	8670	4335	2100	0.21	3500	0.37

Drilled Shaft Design Table: Unit Resistances for Pier 2 - SB-4

Estimated Top of Shale Elevation: 436.00

LAYER ELEVATIONS (FT)	UNIT SIDE RESISTANCE		UNIT TIP RESISTANCE AT BASE OF LAYER									
			DRILLED SHAFT ϕ									
			36"		42"		48"		54"		72"	
	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)
436.00 - 435.00	5.2	2.6	49.3	24.7	48.5	24.2	47.9	23.9	47.4	23.7	46.4	23.2
435.00 - 434.00	5.2	2.6	55.1	27.6	53.4	26.7	52.2	26.1	51.2	25.6	49.3	24.7
434.00 - 433.00	5.2	2.6	60.9	30.5	58.4	29.2	56.6	28.3	55.1	27.6	52.2	26.1
433.00 - 432.00	5.2	2.6	59.6	29.8	58.3	29.2	60.9	30.5	59.0	29.5	55.1	27.6
432.00 - 431.00	5.2	2.6	61.4	30.7	60.2	30.1	59.1	29.5	58.1	29.0	58.0	29.0
431.00 - 430.00	5.2	2.6	62.8	31.4	61.6	30.8	60.6	30.3	59.6	29.8	60.9	30.5
430.00 - 429.00	5.2	2.6	63.8	31.9	62.8	31.4	61.8	30.9	60.9	30.4	58.5	29.3
429.00 - 428.00	5.2	2.6	64.6	32.3	63.7	31.8	62.8	31.4	61.9	31.0	75.2	37.6
428.00 - 427.00	5.2	2.6	65.2	32.6	64.4	32.2	63.6	31.8	62.8	31.4	92.3	46.1
427.00 - 426.00	5.2	2.6	65.8	32.9	65.0	32.5	64.2	32.1	63.5	31.7	109.6	54.8
426.00 - 425.00	5.2	2.6	66.2	33.1	65.5	32.7	64.8	32.4	86.4	43.2	127.1	63.6
425.00 - 424.00	5.2	2.6	66.6	33.3	65.9	32.9	90.8	45.4	109.6	54.8	144.8	72.4
424.00 - 423.00	5.2	2.6	66.9	33.4	96.0	48.0	117.1	58.6	133.1	66.5	162.6	81.3
423.00 - 422.00	5.2	2.6	102.3	51.1	126.3	63.1	143.6	71.8	156.7	78.3	180.5	90.3
422.00 - 421.00	5.2	2.6	137.9	68.9	156.7	78.4	170.3	85.2	180.4	90.2	198.5	99.3
421.00 - 420.00	5.2	2.6	173.7	86.8	187.4	93.7	197.1	98.6	204.3	102.1	216.6	108.3
420.00 - 419.00	5.2	2.6	209.6	104.8	218.1	109.1	224.0	112.0	228.2	114.1	234.7	117.4
419.00 - 418.00	5.2	2.6	245.7	122.8	249.0	124.5	251.1	125.5	252.2	126.1	244.0	122.0
418.00 - 417.00	5.2	2.6	281.8	140.9	280.0	140.0	278.2	139.1	276.4	138.2		
417.00 - 416.00	21.6	10.8	282.4	141.2	280.6	140.3	278.9	139.4	277.2	138.6		
416.00 - 415.00	21.6	10.8	282.9	141.4	281.2	140.6	279.5	139.8	265.7	132.9		
415.00 - 414.00	21.6	10.8	283.3	141.7	281.7	140.9	266.3	133.2				
414.00 - 413.00	21.6	10.8	283.8	141.9	266.3	133.2						
413.00 - 412.00	21.6	10.8	265.5	132.7								
412.00 - 411.00	21.6	10.8										
411.00 - 410.00	21.6	10.8										
410.00 - 409.00	21.6	10.8										
409.00 - 408.00	21.6	10.8										
408.00 - 407.00	21.6	10.8										
407.00 - 406.00	13.1	6.5										

Drilled Shaft Design Table for Pier 3 - SB-6

Estimated Top of Shale Elevation: 435.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	434	51	360	411	206	100	0.10	170	0.19
2	433	102	403	505	252	120	0.09	210	0.18
3	432	153	445	598	299	140	0.09	240	0.16
4	431	204	436	640	320	150	0.08	275	0.16
5	430	254	449	704	352	170	0.08	300	0.16
6	429	305	459	764	382	190	0.09	325	0.15
7	428	356	466	823	411	200	0.08	350	0.15
8	427	407	481	888	444	220	0.08	375	0.15
9	426	458	495	953	476	230	0.08	400	0.15
10	425	509	508	1017	508	250	0.08	425	0.15
11	424	560	520	1080	540	250	0.08	450	0.14
12	423	611	532	1143	571	275	0.08	475	0.14
13	422	662	543	1205	603	300	0.08	500	0.14
14	421	718	546	1264	632	300	0.08	550	0.15
15	420	775	548	1322	661	325	0.08	550	0.14
16	419	831	549	1381	690	325	0.08	600	0.15
17	418	888	551	1439	719	350	0.08	600	0.15
18	417	944	547	1491	745	350	0.08	600	0.14
19	416	1001	542	1543	772	375	0.08	650	0.15
20	415	1057	538	1595	798	375	0.08	650	0.14
21	414	1114	533	1647	824	400	0.08	700	0.15
22	413	1171	529	1699	850	400	0.08	700	0.15
23	412	1227	524	1751	875	425	0.09	750	0.15
24	411	1280	524	1805	902	450	0.09	750	0.15
42 in. Diameter Drilled Shaft									
1	434	59	482	542	271	130	0.12	220	0.22
2	433	119	532	651	325	160	0.11	275	0.21
3	432	178	581	760	380	180	0.10	325	0.21
4	431	238	580	818	409	200	0.10	350	0.20
5	430	297	599	896	448	220	0.10	375	0.18
6	429	356	614	970	485	240	0.10	400	0.18
7	428	416	635	1050	525	250	0.10	425	0.17
8	427	475	654	1129	564	275	0.10	475	0.18
9	426	534	671	1206	603	300	0.10	500	0.17
10	425	594	688	1281	641	300	0.09	550	0.18
11	424	653	703	1356	678	325	0.09	550	0.17
12	423	713	718	1431	715	350	0.10	600	0.17
13	422	772	733	1505	752	375	0.10	650	0.18
14	421	838	736	1574	787	375	0.09	650	0.17
15	420	904	739	1643	822	400	0.10	700	0.17
16	419	970	742	1712	856	425	0.10	700	0.16
17	418	1036	738	1774	887	425	0.09	750	0.17
18	417	1102	734	1835	918	450	0.10	750	0.16
19	416	1168	729	1897	948	450	0.09	800	0.17
20	415	1234	724	1958	979	475	0.10	800	0.16
21	414	1300	719	2019	1010	500	0.10	850	0.17
22	413	1366	714	2080	1040	500	0.10	850	0.17
23	412	1432	709	2141	1070	500	0.09	900	0.17
48 in. Diameter Drilled Shaft									
1	434	68	622	690	345	170	0.14	300	0.28
2	433	136	679	814	407	200	0.13	350	0.25
3	432	204	735	939	469	230	0.12	400	0.24
4	431	271	792	1063	532	250	0.12	450	0.23
5	430	339	768	1107	554	275	0.12	450	0.21
6	429	407	799	1206	603	300	0.12	500	0.21
7	428	475	826	1301	650	325	0.12	550	0.21

Drilled Shaft Design Table for Pier 3 - SB-6

Estimated Top of Shale Elevation: 435.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
8	427	543	850	1393	696	325	0.11	600	0.21
9	426	611	872	1483	741	350	0.11	600	0.19
10	425	679	893	1571	786	375	0.11	650	0.20
11	424	746	912	1659	829	400	0.11	700	0.20
12	423	814	930	1745	872	425	0.11	700	0.19
13	422	882	948	1830	915	450	0.11	750	0.19
14	421	958	953	1911	955	475	0.11	800	0.20
15	420	1033	958	1991	995	475	0.11	800	0.19
16	419	1108	954	2063	1031	500	0.11	850	0.19
17	418	1184	951	2134	1067	500	0.10	900	0.19
18	417	1259	946	2206	1103	550	0.11	900	0.19
19	416	1335	942	2276	1138	550	0.11	950	0.19
20	415	1410	937	2347	1173	550	0.10	950	0.18
21	414	1485	932	2417	1209	600	0.11	1000	0.19
22	413	1561	927	2487	1244	600	0.11	1000	0.18
54 in. Diameter Drilled Shaft									
1	434	76	779	856	428	210	0.15	350	0.29
2	433	153	843	996	498	240	0.14	400	0.26
3	432	229	907	1136	568	275	0.14	475	0.26
4	431	305	970	1276	638	300	0.13	550	0.27
5	430	382	967	1349	675	325	0.13	550	0.24
6	429	458	1005	1463	732	350	0.13	600	0.23
7	428	534	1039	1573	787	375	0.13	650	0.23
8	427	611	1069	1680	840	400	0.13	700	0.23
9	426	687	1096	1783	892	425	0.12	750	0.23
10	425	763	1122	1885	943	450	0.12	800	0.23
11	424	840	1145	1985	993	475	0.12	800	0.22
12	423	916	1168	2084	1042	500	0.12	850	0.22
13	422	992	1189	2181	1091	500	0.12	900	0.22
14	421	1077	1196	2273	1137	550	0.12	950	0.22
15	420	1162	1194	2356	1178	550	0.12	950	0.21
16	419	1247	1192	2438	1219	600	0.12	1000	0.21
17	418	1332	1188	2520	1260	600	0.12	1100	0.23
18	417	1417	1184	2601	1301	650	0.13	1100	0.22
19	416	1501	1180	2682	1341	650	0.12	1100	0.21
20	415	1586	1175	2762	1381	650	0.12	1200	0.22
21	414	1671	1170	2841	1421	700	0.12	1200	0.22
72 in. Diameter Drilled Shaft									
1	434	102	1357	1459	729	350	0.20	600	0.40
2	433	204	1455	1659	829	400	0.20	700	0.39
3	432	305	1555	1860	930	450	0.19	750	0.35
4	431	407	1656	2064	1032	500	0.19	850	0.35
5	430	509	1759	2268	1134	550	0.18	950	0.35
6	429	611	1864	2474	1237	600	0.18	1000	0.33
7	428	713	1806	2519	1259	600	0.17	1100	0.35
8	427	814	1857	2672	1336	650	0.18	1100	0.32
9	426	916	1904	2820	1410	700	0.18	1200	0.32
10	425	1018	1946	2964	1482	700	0.17	1200	0.30
11	424	1120	1986	3106	1553	750	0.17	1300	0.31
12	423	1221	2013	3234	1617	800	0.17	1300	0.29
13	422	1323	2037	3360	1680	800	0.17	1400	0.30
14	421	1436	2042	3478	1739	850	0.17	1400	0.29
15	420	1549	2045	3595	1797	850	0.16	1500	0.30
16	419	1663	2047	3709	1855	900	0.16	1500	0.29
17	418	1776	2047	3822	1911	950	0.17	1600	0.29
18	417	1889	2046	3935	1967	950	0.16	1600	0.28

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table: Unit Resistances for Pier 3 - SB-6

Estimated Top of Shale Elevation: 435.00

LAYER ELEVATIONS (FT)	UNIT SIDE RESISTANCE		UNIT TIP RESISTANCE AT BASE OF LAYER									
			DRILLED SHAFT ϕ									
			36"		42"		48"		54"		72"	
	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)
435.00 - 434.00	5.4	2.7	51.0	25.5	50.1	25.1	49.5	24.8	49.0	24.5	48.0	24.0
434.00 - 433.00	5.4	2.7	57.0	28.5	55.3	27.6	54.0	27.0	53.0	26.5	51.5	25.7
433.00 - 432.00	5.4	2.7	63.0	31.5	60.4	30.2	58.5	29.3	57.0	28.5	55.0	27.5
432.00 - 431.00	5.4	2.7	61.7	30.8	60.3	30.2	63.0	31.5	61.0	30.5	58.6	29.3
431.00 - 430.00	5.4	2.7	63.5	31.8	62.3	31.1	61.1	30.6	60.8	30.4	62.2	31.1
430.00 - 429.00	5.4	2.7	64.9	32.5	63.8	31.9	63.6	31.8	63.2	31.6	65.9	33.0
429.00 - 428.00	5.4	2.7	66.0	33.0	66.0	33.0	65.7	32.9	65.3	32.7	63.9	31.9
428.00 - 427.00	5.4	2.7	68.1	34.0	67.9	34.0	67.6	33.8	67.2	33.6	65.7	32.8
427.00 - 426.00	5.4	2.7	70.0	35.0	69.8	34.9	69.4	34.7	68.9	34.5	67.3	33.7
426.00 - 425.00	5.4	2.7	71.8	35.9	71.5	35.7	71.0	35.5	70.5	35.3	68.8	34.4
425.00 - 424.00	5.4	2.7	73.6	36.8	73.1	36.6	72.6	36.3	72.0	36.0	70.2	35.1
424.00 - 423.00	5.4	2.7	75.2	37.6	74.7	37.3	74.0	37.0	73.4	36.7	71.2	35.6
423.00 - 422.00	5.4	2.7	76.9	38.4	76.2	38.1	75.4	37.7	74.8	37.4	72.0	36.0
422.00 - 421.00	6.0	3.0	77.2	38.6	76.5	38.3	75.8	37.9	75.2	37.6	72.2	36.1
421.00 - 420.00	6.0	3.0	77.5	38.7	76.8	38.4	76.2	38.1	75.1	37.5	72.3	36.2
420.00 - 419.00	6.0	3.0	77.7	38.9	77.1	38.6	75.9	38.0	74.9	37.5	72.4	36.2
419.00 - 418.00	6.0	3.0	77.9	39.0	76.7	38.3	75.6	37.8	74.7	37.4	72.4	36.2
418.00 - 417.00	6.0	3.0	77.3	38.7	76.2	38.1	75.3	37.7	74.5	37.2	72.4	36.2
417.00 - 416.00	6.0	3.0	76.7	38.4	75.8	37.9	74.9	37.5	74.2	37.1		
416.00 - 415.00	6.0	3.0	76.1	38.0	75.3	37.6	74.6	37.3	73.9	37.0		
415.00 - 414.00	6.0	3.0	75.4	37.7	74.8	37.4	74.2	37.1	73.6	36.8		
414.00 - 413.00	6.0	3.0	74.8	37.4	74.2	37.1	73.7	36.9				
413.00 - 412.00	6.0	3.0	74.1	37.0	73.7	36.8						
412.00 - 411.00	5.6	2.8	74.2	37.1								
411.00 - 410.00	5.6	2.8										
410.00 - 409.00	5.6	2.8										
409.00 - 408.00	5.6	2.8										
408.00 - 407.00	5.6	2.8										
407.00 - 406.00	5.6	2.8										
406.00 - 405.00	5.6	2.8										

Drilled Shaft Design Table for West Abutment - B-1 & SB-4

Estimated Top of Shale Elevation: 448.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	447	23	164	187	94	40	0.08	80	0.20
2	446	46	184	230	115	50	0.08	100	0.18
3	445	70	203	272	136	60	0.08	110	0.16
4	444	93	199	291	146	70	0.09	120	0.16
5	443	116	205	321	160	80	0.09	130	0.15
6	442	139	209	348	174	80	0.08	140	0.14
7	441	162	212	375	187	90	0.08	150	0.14
8	440	185	215	401	200	100	0.08	170	0.15
9	439	209	217	426	213	100	0.08	180	0.14
10	438	232	219	451	225	110	0.08	190	0.14
11	437	255	221	476	238	110	0.07	200	0.14
12	436	278	222	500	250	120	0.08	200	0.13
13	435	301	223	524	262	130	0.08	210	0.13
14	434	325	224	548	274	130	0.07	220	0.13
15	433	348	266	614	307	150	0.08	250	0.13
16	432	371	309	680	340	170	0.08	275	0.14
17	431	394	353	747	373	180	0.08	300	0.14
18	430	417	396	813	407	200	0.08	350	0.15
19	429	441	439	880	440	210	0.08	375	0.15
20	428	464	482	946	473	230	0.09	400	0.15
21	427	513	483	996	498	240	0.08	400	0.15
22	426	562	484	1046	523	250	0.08	425	0.15
23	425	611	485	1096	548	250	0.08	450	0.15
24	424	660	485	1146	573	275	0.08	475	0.15
42 in. Diameter Drilled Shaft									
1	447	27	220	247	123	60	0.12	100	0.22
2	446	54	242	296	148	70	0.11	120	0.20
3	445	81	265	346	173	80	0.10	140	0.19
4	444	108	264	373	186	90	0.10	150	0.18
5	443	135	273	408	204	100	0.10	170	0.18
6	442	162	279	442	221	110	0.10	180	0.17
7	441	189	285	474	237	110	0.09	190	0.17
8	440	216	289	505	253	120	0.09	210	0.17
9	439	243	292	535	268	130	0.09	220	0.17
10	438	270	295	565	283	140	0.09	230	0.16
11	437	298	297	594	297	140	0.09	240	0.16
12	436	325	299	623	312	150	0.09	250	0.16
13	435	352	300	652	326	160	0.09	275	0.16
14	434	379	350	729	364	180	0.09	300	0.16
15	433	406	400	806	403	200	0.10	325	0.16
16	432	433	450	883	442	220	0.10	375	0.17
17	431	460	501	961	480	240	0.10	400	0.17
18	430	487	551	1038	519	250	0.10	425	0.17
19	429	514	602	1116	558	275	0.10	450	0.17
20	428	541	652	1193	597	275	0.09	500	0.18
21	427	598	654	1252	626	300	0.10	550	0.19
22	426	656	655	1311	655	325	0.10	550	0.18
23	425	713	656	1369	685	325	0.10	550	0.17
48 in. Diameter Drilled Shaft									
1	447	31	283	314	157	70	0.12	130	0.26
2	446	62	309	371	185	90	0.13	150	0.23
3	445	93	335	428	214	100	0.12	180	0.23
4	444	124	361	484	242	120	0.12	200	0.22
5	443	155	350	505	252	120	0.11	210	0.21
6	442	185	359	544	272	130	0.11	220	0.20
7	441	216	366	582	291	140	0.11	240	0.20

Drilled Shaft Design Table for West Abutment - B-1 & SB-4

Estimated Top of Shale Elevation: 448.00

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
8	440	247	372	619	310	150	0.11	250	0.19
9	439	278	376	655	327	160	0.11	275	0.20
10	438	309	380	689	345	170	0.11	300	0.20
11	437	340	384	724	362	180	0.11	300	0.19
12	436	371	386	757	379	180	0.10	325	0.19
13	435	402	443	845	423	210	0.11	350	0.19
14	434	433	500	933	467	230	0.11	375	0.19
15	433	464	558	1022	511	250	0.11	425	0.19
16	432	495	615	1110	555	275	0.11	450	0.19
17	431	526	673	1199	599	275	0.11	500	0.20
18	430	556	731	1287	644	300	0.11	550	0.21
19	429	587	789	1376	688	325	0.11	600	0.21
20	428	618	847	1465	733	350	0.11	600	0.20
21	427	684	849	1533	766	375	0.11	650	0.21
22	426	749	851	1600	800	400	0.12	650	0.20
54 in. Diameter Drilled Shaft									
1	447	35	355	390	195	90	0.14	160	0.29
2	446	70	384	454	227	110	0.14	190	0.28
3	445	104	413	517	259	120	0.13	210	0.25
4	444	139	442	581	291	140	0.13	240	0.25
5	443	174	435	609	305	150	0.13	250	0.24
6	442	209	447	656	328	160	0.13	275	0.24
7	441	243	456	700	350	170	0.13	300	0.24
8	440	278	464	742	371	180	0.13	300	0.22
9	439	313	470	783	392	190	0.12	325	0.22
10	438	348	476	824	412	200	0.12	350	0.22
11	437	383	480	863	431	210	0.12	350	0.21
12	436	417	544	962	481	240	0.13	400	0.22
13	435	452	609	1061	531	250	0.12	425	0.21
14	434	487	674	1161	580	275	0.12	475	0.22
15	433	522	739	1260	630	300	0.12	550	0.24
16	432	556	804	1360	680	325	0.12	550	0.22
17	431	591	869	1460	730	350	0.13	600	0.23
18	430	626	934	1560	780	375	0.13	650	0.23
19	429	661	1000	1661	830	400	0.13	700	0.24
20	428	696	1065	1761	880	425	0.13	750	0.24
21	427	769	1068	1837	919	450	0.13	750	0.23
72 in. Diameter Drilled Shaft									
1	447	46	618	665	332	160	0.20	275	0.40
2	446	93	657	750	375	180	0.20	300	0.36
3	445	139	696	835	417	200	0.19	350	0.37
4	444	185	734	920	460	220	0.18	375	0.34
5	443	232	773	1005	502	250	0.19	425	0.35
6	442	278	811	1090	545	250	0.17	450	0.33
7	441	325	780	1104	552	275	0.18	450	0.31
8	440	371	795	1166	583	275	0.17	475	0.31
9	439	417	883	1300	650	325	0.18	550	0.32
10	438	464	972	1435	718	350	0.17	600	0.32
11	437	510	1060	1570	785	375	0.17	650	0.31
12	436	556	1149	1706	853	425	0.18	700	0.31
13	435	603	1238	1841	920	450	0.17	750	0.31
14	434	649	1327	1976	988	475	0.17	800	0.31
15	433	696	1416	2111	1056	500	0.17	850	0.31
16	432	742	1504	2246	1123	550	0.18	900	0.30
17	431	788	1593	2381	1191	550	0.17	1000	0.32
18	430	835	1682	2517	1258	600	0.17	1100	0.34

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table: Unit Resistances for West Abutment - B-1 & SB-4

Estimated Top of Shale Elevation: 448.00

LAYER ELEVATIONS (FT)	UNIT SIDE RESISTANCE		UNIT TIP RESISTANCE AT BASE OF LAYER									
			DRILLED SHAFT ϕ									
			36"		42"		48"		54"		72"	
	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)	NOM. (KSF)	FACT. (KSF)
448.00 - 447.00	2.5	1.2	23.2	11.6	22.8	11.4	22.6	11.3	22.3	11.2	21.9	10.9
447.00 - 446.00	2.5	1.2	26.0	13.0	25.2	12.6	24.6	12.3	24.1	12.1	23.2	11.6
446.00 - 445.00	2.5	1.2	28.7	14.4	27.5	13.8	26.7	13.3	26.0	13.0	24.6	12.3
445.00 - 444.00	2.5	1.2	28.1	14.1	27.5	13.7	28.7	14.4	27.8	13.9	26.0	13.0
444.00 - 443.00	2.5	1.2	28.9	14.5	28.4	14.2	27.8	13.9	27.4	13.7	27.3	13.7
443.00 - 442.00	2.5	1.2	29.6	14.8	29.1	14.5	28.6	14.3	28.1	14.1	28.7	14.4
442.00 - 441.00	2.5	1.2	30.1	15.0	29.6	14.8	29.1	14.6	28.7	14.3	27.6	13.8
441.00 - 440.00	2.5	1.2	30.4	15.2	30.0	15.0	29.6	14.8	29.2	14.6	28.1	14.1
440.00 - 439.00	2.5	1.2	30.7	15.4	30.3	15.2	30.0	15.0	29.6	14.8	31.2	15.6
439.00 - 438.00	2.5	1.2	31.0	15.5	30.6	15.3	30.3	15.1	29.9	15.0	34.4	17.2
438.00 - 437.00	2.5	1.2	31.2	15.6	30.9	15.4	30.5	15.3	30.2	15.1	37.5	18.8
437.00 - 436.00	2.5	1.2	31.4	15.7	31.1	15.5	30.7	15.4	34.2	17.1	40.6	20.3
436.00 - 435.00	2.5	1.2	31.5	15.8	31.2	15.6	35.3	17.6	38.3	19.1	43.8	21.9
435.00 - 434.00	2.5	1.2	31.6	15.8	36.4	18.2	39.8	19.9	42.4	21.2	46.9	23.5
434.00 - 433.00	2.5	1.2	37.7	18.9	41.6	20.8	44.4	22.2	46.4	23.2	50.1	25.0
433.00 - 432.00	2.5	1.2	43.8	21.9	46.8	23.4	49.0	24.5	50.5	25.3	53.2	26.6
432.00 - 431.00	2.5	1.2	49.9	24.9	52.0	26.0	53.6	26.8	54.6	27.3	56.3	28.2
431.00 - 430.00	2.5	1.2	56.0	28.0	57.3	28.6	58.2	29.1	58.7	29.4	59.5	29.7
430.00 - 429.00	2.5	1.2	62.1	31.1	62.6	31.3	62.8	31.4	62.9	31.4		
429.00 - 428.00	2.5	1.2	68.2	34.1	67.8	33.9	67.4	33.7	67.0	33.5		
428.00 - 427.00	5.2	2.6	68.4	34.2	68.0	34.0	67.6	33.8	67.2	33.6		
427.00 - 426.00	5.2	2.6	68.5	34.2	68.1	34.0	67.7	33.9				
426.00 - 425.00	5.2	2.6	68.6	34.3	68.2	34.1						
425.00 - 424.00	5.2	2.6	68.7	34.3								
424.00 - 423.00	5.2	2.6										
423.00 - 422.00	5.2	2.6										
422.00 - 421.00	5.2	2.6										
421.00 - 420.00	5.2	2.6										
420.00 - 419.00	5.2	2.6										
419.00 - 418.00	5.2	2.6										

EXHIBIT H

ILLINOIS STATE GEOLOGICAL SURVEY MINE MAP

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS

For further information contact:
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615 East Peabody Drive
Champaign, Illinois 61820-6964
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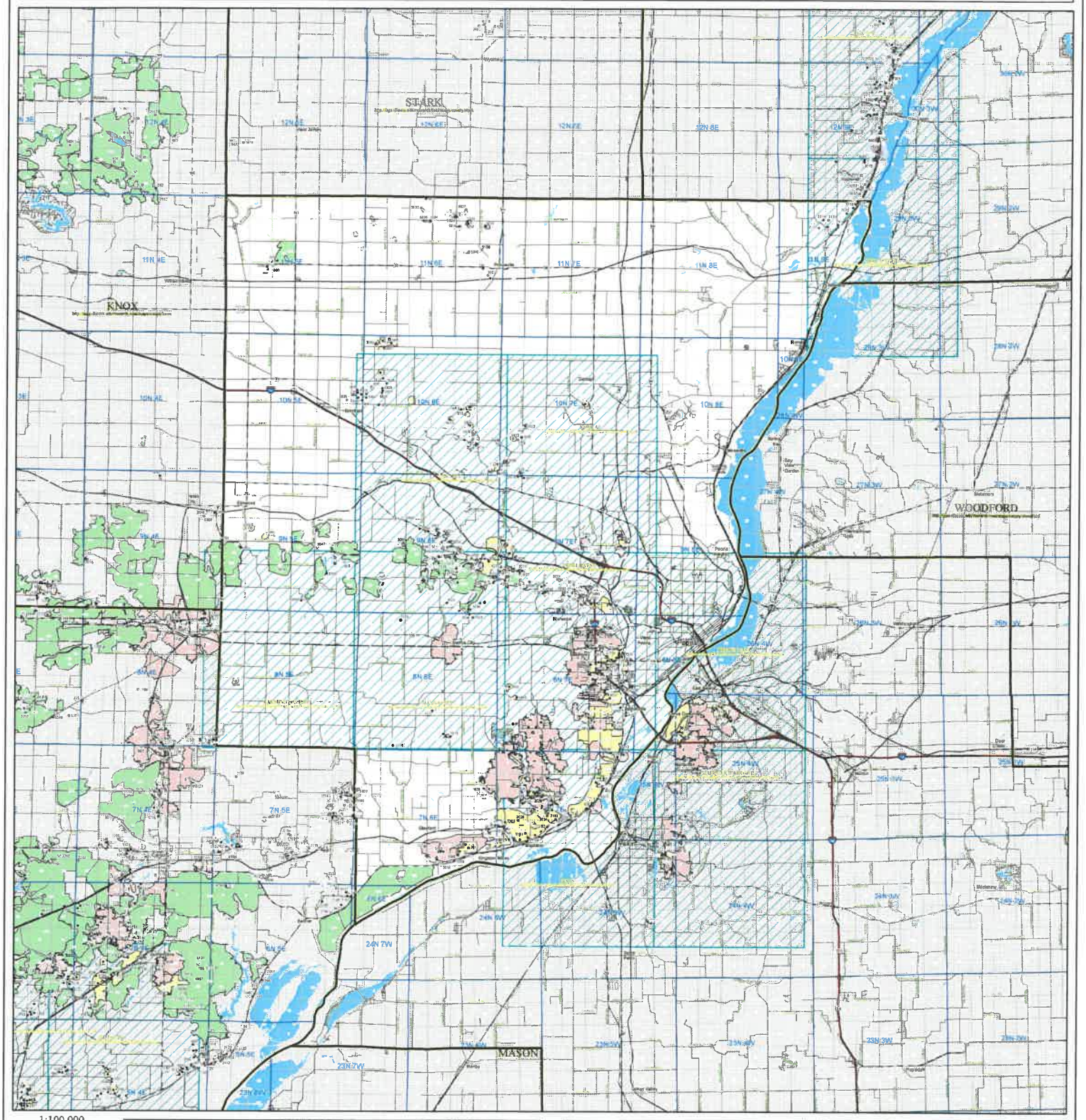
http://www.isgs.illinois.edu

Coal Mines and Industrial Mineral Mines
PEORIA
County

County Coal Map Series
ISGS Coal Section
Map construction: August 03, 2016

This product is under review and may not meet the standards of the Illinois State Geological Survey.

County coal maps and select quadrangle maps available as downloadable PDF files at: http://www.isgs.illinois.edu



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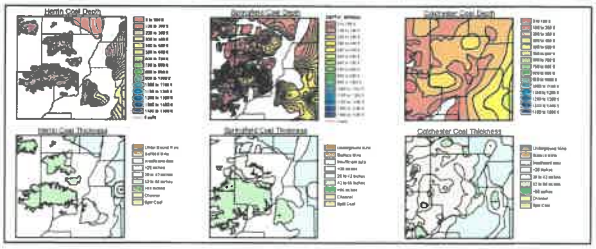

- County
- Township
- Section
- Quadrangle study (Available on Website)
- Lake or river
- Coal mine - active
- Underground coal mine - abandoned
- Surface coal mine - abandoned
- Indefinite underground coal mine boundary - abandoned
- Underground industrial mine and surrounding buffer region
- 951, 951 Coal mine index number (polygon label, point label)
- Opening type unknown
- Uncertain location
- Abandoned surface tipple
- Active surface tipple
- Abandoned shaft
- Active shaft
- Abandoned slope
- Active slope
- Abandoned drift
- Active drift
- Underground industrial mine entrance or general location

Map Explanation

This map accompanies the coal mines directory for this county. Please consult the directory for an explanation of the coal mine information shown on this map. Buffer regions for industrial mineral mines were incorporated into this map due to limited information regarding these mines. The size of the buffer region is dependent on the uncertainty or inaccuracy of the mine location. For more information regarding industrial mineral mines please contact the ISGS Industrial Minerals Section.

The maps and digital files used for this study were compiled from data obtained from a variety of public and private sources and have varying degrees of completeness and accuracy. They present reasonable interpretations of the geology of the area and are based on available data. These data were compiled and digitized at a scale of 1:62,500. Locations of some features may be offset by 500 feet or more due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors.

These data are not intended for use in site-specific screening or decision-making. Data included in this map are suitable for use at a scale of 1:100,000.

Disclaimer

The Illinois State Geological Survey and the University of Illinois make no guarantees, expressed or implied, regarding the correctness of the interpretations presented in this data set and accept no liability for the consequences of decisions made by others on the basis of the information presented here.