STRUCTURE GEOTECHNICAL REPORT

FAP 332 (US-45) over N. Fork Saline River Overflow

Ex. S.N. 083-0002
Pr. S.N. 083-0074

F.A.P. ROUTE 332 (US-45)
SECTION 29B-4
SALINE COUNTY, ILLINOIS
JOB NO. P-99-001-08
CONTRACT NO. 78716
PTB 193/032 WO 2
KEG NO. 19-1143.02

08/16/2022
Exp. 11/30/2023

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TABLE OF CONTENTS

EXHIBITS

1.0 PROJECT DESCRIPTION AND PROPOSED STRUCTURE INFORMATION

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed 3-span structure for US-45 over North Fork Saline River Overflow in Saline County, Illinois. The purpose of this report is to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of construction of a 3-span structure (Proposed SN 083-0074) carrying US-45 over the North Fork Saline River Overflow. The general location of the structure is shown on a Location Map, Exhibit A. The site lies within the limits of the Third Principal Meridian (T. 7S R. 7E Section 24) within the Mt. Vernon Hill Country of the Till Plains section of the Central Lowland Province.

1.3 Proposed Bridge Information

The proposed structure (SN 083-0074) located at US-45 over North Fork Saline River Overflow will consist of a 3-span structure built on a 0°skew from the centerline of US-45 at the local tangent to Station 704+61.84. The structure will have a width of 42'-10". The structure will be located at approximate station 704+61.84 (US-45). Integral abutments and piers are proposed for the substructures.

The structure will measure 254'-0", from back-to-back of abutments. The structure will support two 12' lanes, with shoulders width of 8'-0". The structure is to be removed and replaced using staged construction to maintain one lane of traffic at all times. Further substructure details will be based on the findings of this Structure Geotechnical Report (SGR).

2.0 SITE INVESTIGATION, SUBSURFACE EXPLORATION, AND GENERALIZED SUBSURFACE CONDITIONS

The site investigation was performed by the Illinois Department of Transportation (IDOT).

Five standard penetration test (SPT) borings, designated 1-S through 5-S, were drilled between May 24 and October 5, 2010. The stations and offsets as listed on the borings have been revised as summarized in Table 2.0. The previous stationing, listed on the Boring Logs, is referenced under the new stationing. The boring locations are shown on the Type, Size, and Location Plan (TS&L), Exhibit B, as provided by Kaskaskia Engineering Group, LLC. (KEG). Detailed information regarding the nature and thickness of the soils and bedrock encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit C. A soil profile for borings 1-S through 5-S can be found under Subsurface Profile, Exhibit D.

Table 2.0 - Boring Stations and Offsets

Designation	Stationing	Offset from Proposed Centerline	Surface Elevation (ft.)
1-S	706+09 - Revised *(723+58)*	8' Rt – Revised *(29' Lt CL)*	370.0
2-S	703+09 - Revised *(720+58)*	8' Lt – Revised *(45' Lt CL)*	370.0
3-S	704+63 - Revised *(722+12)*	66' Rt – Revised *(29' Rt CL)*	351.1
4-S	705+94 - Revised *(722+43)*	74' Rt – Revised *(34' Rt CL)*	352.3
5-S	702+99 - Revised *(720+48)*	72' Rt – Revised *(35' Rt CL)*	352.9

2.1 Subsurface Conditions

The stratigraphy of the borings exhibited layers of silty clay, clay, silt, sand, and clay shale. In general, the lithologic succession beneath the ground surface is as follows:

1. Silty Clay to Clay- From the surface of each boring, approximately 27 to 49.5 ft. of silty clay to clay was encountered. The driving resistances (N-values) ranged from 0 to 20 blows per foot (bpf), and unconfined compressive strength (Qu) values ranged between 0.2 to 5.8 tons per square foot (tsf). The moisture contents ranged from 20 to 50 percent.

2. Sand - Below the silty clay to clay layers, sand was encountered to depths of 34.5 to 54.5 feet. The N-values ranged from 1 to 16 bpf. The moisture contents varied from 18 to 26 percent.

3. Silt to Silty Loam - Borings 3-S, 4-S, and 5-S encountered a layer stiff silt to silty loam below the sand layers near depths of 49.5 to 59.5 feet. The silt to silty loam ranged from 10 to 15 ft. thick. The N-values ranged from 6 to 39 bpf, and the moisture contents varied from 19 to 23 percent. The Qu values varied from 0.8 to 4.1 tsf.

4. Silty Clay to Clay - Below the sand in Borings 1-S and 2-S, and below the Silt to Silty Loam in Borings 3-S, 4-S, and 5-S, silty clay to clay was encountered to depths between 74.5 to 96 ft. The N-values ranged between 1 and 52 bpf. The moisture contents ranged from 18 to 30 percent. The Qu values ranged from 0.4 to 4.7 tsf.

5. Sandy Clay – Below the Silty Clay to Clay in Borings 1-S and 2-S, a sandy clay layer was encountered to depths of 99 to 99.5 feet. This layer ranged from 3 to 10 feet thick. The N-value in Boring 1-S was 16 bpf, with a Qu of 1.3 tsf, and a 21% moisture content.

6. Sand – Borings 3-S, 4-S, and 5-S encountered a sand layer below the silty clay and clays to a depth near 79.5 feet. The sand layers were each about 5 feet thick. The N-values for the sands ranged from 0 to 6 bpf.

7. Clay Shale - Below the sands and sandy clay, clay shale was encountered in all five borings at depths. Clay shale was found at depths of 79.5 to 99.5 ft., with blow counts of 28 to 120 blows for 3 to 14-inches of penetration.

2.2 Bedrock

Table 2.2 shows the elevations of top of clay shale for Borings 1-S through 5-S.

Table 2.2 - Elevation of Top of Clay Shale

Designation	Station	Offset	Top of Rock Elevation (ft.)
1-S	706+09 - Revised *(723+58)*	8' Rt – Revised *(29' Lt CL)*	271.0
2-S	703+09 - Revised *(720+58)*	8' Lt – Revised *(45' Lt CL)*	270.5
3-S	704+63 - Revised *(722+12)*	66' Rt – Revised *(29' Rt CL)*	270.6
4-S	705+94 - Revised *(722+43)*	74' Rt – Revised *(34' Rt CL)*	270.8
5-S	702+99 - Revised *(720+48)*	72' Rt – Revised *(35' Rt CL)*	271.4

2.3 Groundwater

Groundwater was encountered in Borings 1-S through 5-S during drilling at the levels shown in Table 2.3. The surface elevation of North Fork Saline River at the times of drilling ranged between El. 349 and El. 350.7.

Table 2.3 – Groundwater Levels

Designation	Station	Offset	Groundwater Elevation (ft.)
1-S	706+09 - Revised *(723+58)*	8' Rt – Revised *(29' Lt CL)*	338.0
2-S	703+09 - Revised *(720+58)*	8' Lt – Revised *(45' Lt CL)*	330.5
3-S	704+63 - Revised *(722+12)*	66' Rt – Revised *(29' Rt CL)*	321.6
4-S	705+94 - Revised *(722+43)*	74' Rt – Revised *(34' Rt CL)*	337.8
5-S	702+99 - Revised *(720+48)*	72' Rt – Revised *(35' Rt CL)*	325.9

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

Since no significant grading or changes to the existing roadway elevations are anticipated for the proposed structure and the soil characteristics as detailed in the borings provided, it is estimated that with proper preparation and construction the structure will experience settlements of less than 0.25 inches. Therefore, no settlement calculations were performed for the proposed structure.

3.2 Slope Stability

The proposed construction of the new US-45 over North Fork Saline River Overflow will result in new end-slopes at the abutment locations for the approach embankments.

The proposed abutments are integral abutments with end-slopes at 1 Vertical to 2 Horizontal (1V:2H). Slope stability of the end-slopes was analyzed using SLOPE/W; the soil properties at the site, including those in Borings 1-S and 2-S; and end-slope geometrics. KEG modeled the slopes at both abutment locations. Three conditions were modeled for each: end-of-construction (E-O-C), long-term (L-T), and the seismic condition. 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 seismic condition.

In order to model the E-O-C condition, undrained soil strength parameters were used with a friction angle of 0° assumed for cohesive soils. Drained soil strength parameters with assumed friction angles ranging from 12° to 34° were used to model the L-T cases where excess pore water pressure from construction has dissipated. For clay and silty clay materials, a nominal cohesion of 50 to 150 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 proposed conditions. The FOS obtained in the analysis are shown in Table 3.2. SLOPE/W program output from this analysis can be found in SLOPE/W Slope Stability Analysis, Exhibit E.

Table 3.2 - Slope Stability Critical FOS

Location	Slope	Calculated Critical FOS		
		End-of-Construction	Long-Term	Seismic
North Abutment	1V:2H	1.8	1.5	1.0
South Abutment	1V:2H	2.9	1.5	1.1

In order for the seismic condition to achieve the minimum required factor of safety of 1.0, the proposed piles for the piers at the toe of the end slopes were included in the stability model. The stability analysis showed that a maximum pile spacing of 8 feet is required for the pier support. The results of the analysis, as provided in Table 3.2, indicate an acceptable FOS will exist at the north and south abutments of both structures under short-term and long-term conditions.

3.3 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 E.

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. Published information and mapping (http://seismicmaps.org/), including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge

Design, was used to develop the parameters for the project site location. The values, based on Soil Site Class E, are summarized below.

Table 3.3 - Summary of Seismic Parameters

Parameter	Value
Soil Site Class	E
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.885g (Site Class E)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.485g (Site Class E)
Seismic Performance Zone	2

*S_{DS} and S_{D1} values shown as provided by IDOT

As indicated in the table above, the Seismic Performance Zone is 2, based on S_{D1} and Table 3.15.2 in the IDOT Bridge Manual, the Soil Site Class E, and Figure 2.3.10-2 in the IDOT Bridge Manual. Because these structures are considered critical, the appropriate Response Modification Factors as indicated in the AASHTO Bridge Design Specifications, Table 3.10.7.1-1 shall be applied.

3.4 Scour

The design scour elevations for the proposed structure are shown in Table 3.4. Class A4 stone riprap will be placed on the surface of the proposed abutment end slopes and around each of the pier substructures on the surface, 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 3.4 - Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	North Abutment	Pier 1	Pier 2	South Abutment	
Q_{100}	363.36	318.75	317.12	363.38	5
Q_{200}	363.36	315.17	312.74	363.38	
Design	363.36	318.75	317.12	363.38	
Check	363.36	315.17	312.74	363.38	

3.5 Liquefaction

Per the Geotechnical Manual, due to the location of this structure and the seismic conditions resulting in an SPZ 2, a liquefaction analysis was performed using the liquefaction analysis worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis. The PGA and Mw pairs to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website: http://earthquake.usgs.gov/hazards/interactive/ for both New Madrid Seismic Zone (NMSZ) and Central Eastern United States (CEUS) models. The deaggregation data indicated a NMSZ maximum Magnitude of 7.5, contributing 7.1% to the hazard for this site. The Peak Horizontal Ground Surface Acceleration coefficient was set to the NMSZ PGA (0.118g) calculated in the IDOT Liquefaction Analysis Spreadsheet.

The soil profiles for Borings 1-S, 2-S, and 3-S were analyzed for the north abutment, south

abutments, and piers, respectively. Based off of the soil descriptions in the boring logs and typical soil characteristics, it was assumed that the Plasticity Index of the silty clay, silty clay loam, and clay materials is greater than 12 and therefore not considered to be susceptible to liquefaction. The results from the analysis for the soil profile encountered in the three borings showed no potential for liquefaction for the north abutment. A layer of sand with approximately 20 percent fines was encountered 54.5' below ground surface at the south abutment and 74.5' below ground surface at the Piers was marginally identified as liquefiable; however, layers that deep in the soil strata are not generally of concern. Therefore, no reduction for liquefaction was considered for the pile design capacities or other foundation considerations for the piers or abutments.

A summary of the liquefaction analysis including each specific run is included in Exhibit F, Liquefaction Analyses Results.

4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

4.1 General Feasibility

Due to the depths to bedrock and anticipated foundation loads, driven piles appear applicable for support of the bridge substructures. The Modified IDOT Static Method of Estimating Pile Length and the IDOT Drilled Shaft Axial Capacity in Shale spreadsheet, as provided by Illinois Department of Transportation – Bureau of Bridges and Structures (IDOT BBS) Foundations and Geotechnical Unit, were used to estimate the capacities of the driven piles end bearing in competent clay shale.

The preliminary design loads, as provided by KEG, are provided in Table 4.1.

Table 4.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
Abutments	1300
Piers	2300

4.2 Pile Supported Foundations

The foundations supporting the proposed bridges must provide sufficient support to resist dead, live, and wind loads, including seismic loadings. Based on the encountered subsurface conditions, the Modified IDOT Static Method of Estimating Pile Length provided by IDOT BBS Foundations and Geotechnical Unit, and the information available to date, KEG recommends using H-piles or Metal Shell Piles. The Modified IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit G).

The estimated pile lengths for the pile types considered are shown in Table 4.2.1 through 4.2.9 below and under Exhibit G, Pile Length/Pile Type. The Nominal Required Bearing (RN) represents the resistance the pile will experience during driving and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available (RF) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

As discussed in sections above and shown in the tables, including under Pile Length/Pile Type, Exhibit G; down-drag and liquefaction do not impact the subsurface soils at this site and have not been included in the pile strength estimates. Due to the anticipated scour elevations, a reduction in factored resistance available was taken into consideration.

Table 4.2.1 - Estimated Pile Lengths for HP 10x42 H-Pile

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	335	181	89	363.36
Pier 1	335	168	77	346.80
Pier 2	*335	167	79	346.80
North Abutment	335	184	94	365.38

*Pile does not achieve maximum nominal capacity at the piers prior to reaching the underlying shale where driving may damage pile

Table 4.2.2 - Estimated Pile Lengths for HP 12x53 H-Pile

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	418	219	89	363.36
Pier 1	*418	210	77	346.80
Pier 2	*418	209	79	346.80
North Abutment	418	230	94	365.38

Table 4.2.3 - Estimated Pile Lengths for HP 12x63 H-Pile

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	497	273	95	363.36
Pier 1	*497	253	78	346.80
Pier 2	*497	252	80	346.80
North Abutment	*497	273	95	365.38

Table 4.2.4 - Estimated Pile Lengths for HP 14x73 H-Pile

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	578	318	95	363.36
Pier 1	*578	294	78	346.80
Pier 2	*578	293	80	346.80
North Abutment	*578	318	95	365.38

Table 4.2.5 - Estimated Pile Lengths for HP 14x89 H-Pile

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	705	388	97	363.36
Pier 1	*705	364	80	346.80
Pier 2	*705	363	82	346.80
North Abutment	*705	388	97	365.38

Table 4.2.6 - Estimated Pile Lengths for MS 12" ϕ .25" Walls

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	283	156	45	363.36
	273	150	50	
	392	159	55	
Pier 1	280	125	60	346.80
	314	144	65	
	392	150	70	
Pier 2	286	131	62	346.80
	320	150	67	
	392	156	72	
North Abutment	275	151	70	365.38
	316	174	75	
	392	208	85	

Table 4.2.7 - Estimated Pile Lengths for MS 14" ϕ .25" Walls

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	335	184	45	363.36
	319	175	50	
	459	187	55	
Pier 1	328	147	60	346.80
	371	171	65	
	459	176	70	
Pier 2	335	154	62	346.80
	377	178	67	
	459	183	72	
North Abutment	327	180	70	365.38

	374	206	75	
	459	244	85	

Table 4.2.8 - Estimated Pile Lengths for MS 14" ϕ .312" Walls

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	335	184	45	363.36
	319	175	50	
	341	187	55	
Pier 1	328	147	60	346.80
	371	171	65	
	570	176	70	
Pier 2	335	154	62	346.80
	377	178	67	
	570	183	72	
North Abutment	327	180	70	365.38
	374	206	75	
	570	244	85	

Table 4.2.9 - Estimated Pile Lengths for MS 16" ϕ .312" Walls

	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment	387	213	45	363.36
	365	201	50	
	392	216	55	
Pier 1	378	170	60	346.80
	429	198	65	
	654	201	70	
Pier 2	385	178	62	346.80
	437	206	67	
	654	209	72	
North Abutment	380	209	70	365.38
	433	238	75	
	654	281	85	

KEG recommends one (1) test pile be performed near the North Abutment. A test pile is performed prior to production driving so that actual, on-site field data can be gathered to further evaluate pile driving requirements for the project. This also is the way the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

4.3 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 4.3 is included for the structural engineer's use in evaluating lateral pile response. The values were estimated based on the descriptions as listed on the boring logs. No specific hydrometer analyses were performed on the site soils.

Table 4.3 - 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)				
1-S	363.0	120	0	650	26	150	7	65	100	0.010
	345.5	125	0	650	26	75	1	80	100	0.010
	320.5	125	0	1050	26	75	6	80	500	0.007
	315.5	110	34	0	34	0	5	3	20	--
	310.5	125	0	400	26	50	1	80	30	0.020
	295.5	110	0	2600	28	150	35	65	1000	0.005
	280.5	120	0	3300	26	100	24	65	1000	0.005
	271.0	115	0	1300	28	50	16	65	500	0.007
	269.5	125	12	5000	12	5000	100	--	2000	0.004
2-S	363.0	120	0	1000	26	75	7	65	100	0.007
	353.0	125	0	760	26	75	4	80	100	0.010
	325.5	125	0	3700	26	125	17	80	1000	0.005
	320.5	110	0	400	28	50	6	65	30	0.020
	315.5	110	34	0	34	0	4	3	60	--
	305.5	120	0	950	26	50	9	65	100	0.007
	280.5	110	0	3850	28	100	33	65	1000	0.005
	276.0	125	0	2300	26	100	8	80	1000	0.005
	270.5	115	34	0	34	0	8	3	20	--
	260.0	125	12	5000	12	5000	100	--	2000	0.004
3-S	324.1	125	0	740	26	50	2	65	100	0.010
	306.6	110	34	0	34	0	12	3	60	--
	296.6	110	0	3500	28	150	35	65	1000	0.005
	276.6	120	0	2700	26	100	13	65	1000	0.005
	271.6	110	34	0	34	0	0	3	20	--
	261.1	125	12	5000	12	5000	100	--	2000	0.004
4-S	322.8	125	0	1200	26	50	6	65	500	0.007
	317.8	110	34	0	34	0	6	3	20	--
	314.3	125	0	850	26	50	10	65	100	0.010
	307.8	110	34	0	34	0	23	3	60	--
	277.8	125	0	3600	26	100	21	65	1000	0.005
	272.8	110	34	0	34	0	1	3	20	--

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)				
	267.3	125	12	5000	12	5000	100	--	2000	0.004
5-S	320.9	120	0	2500	26	100	10	80	1000	0.005
	318.4	110	34	0	34	0	9	3	20	--
	308.4	125	0	1300	26	100	10	65	500	0.007
	293.4	110	0	2800	28	100	23	65	1000	0.005
	278.4	120	0	3000	26	100	18	80	1000	0.005
	273.4	110	34	0	34	0	6	3	20	--
	267.9	125	12	5000	12	5000	100	--	2000	0.004

5.0 CONSTRUCTION CONSIDERATIONS

5.1 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.

5.2 Site and Soil Conditions

Should any bridge or embankment design considerations assumed by either IDOT or KEG change, KEG should be contacted to determine if the recommendations stated in this report still apply. See Section 205 - Embankment, of the Standard Specifications of Road and Bridge Construction for specific information on embankment construction.

5.3 Foundation Construction

Conventional pile driving equipment and methodologies should be assumed.

A Joint Utility Locating Information for Excavators (J.U.L.I.E.) locate shall be conducted to determine if any underground utilities are present in the area of the proposed structure prior to construction. If utilities become a problem during construction, the appropriate owner shall be contacted immediately.

5.4 Cofferdam Construction

Cofferdams will be required at the proposed pier locations. The estimated water surface elevation is greater than 6 ft. above the bottom elevation of the substructure. Therefore, Type 2 cofferdams will be required. All cofferdams are required to be dewatered. Due to the cohesive nature of the soils indicated at and below the pier encasements, seal coats should not be required.

6.0 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.

7.0 GEOTECHNICAL DATA

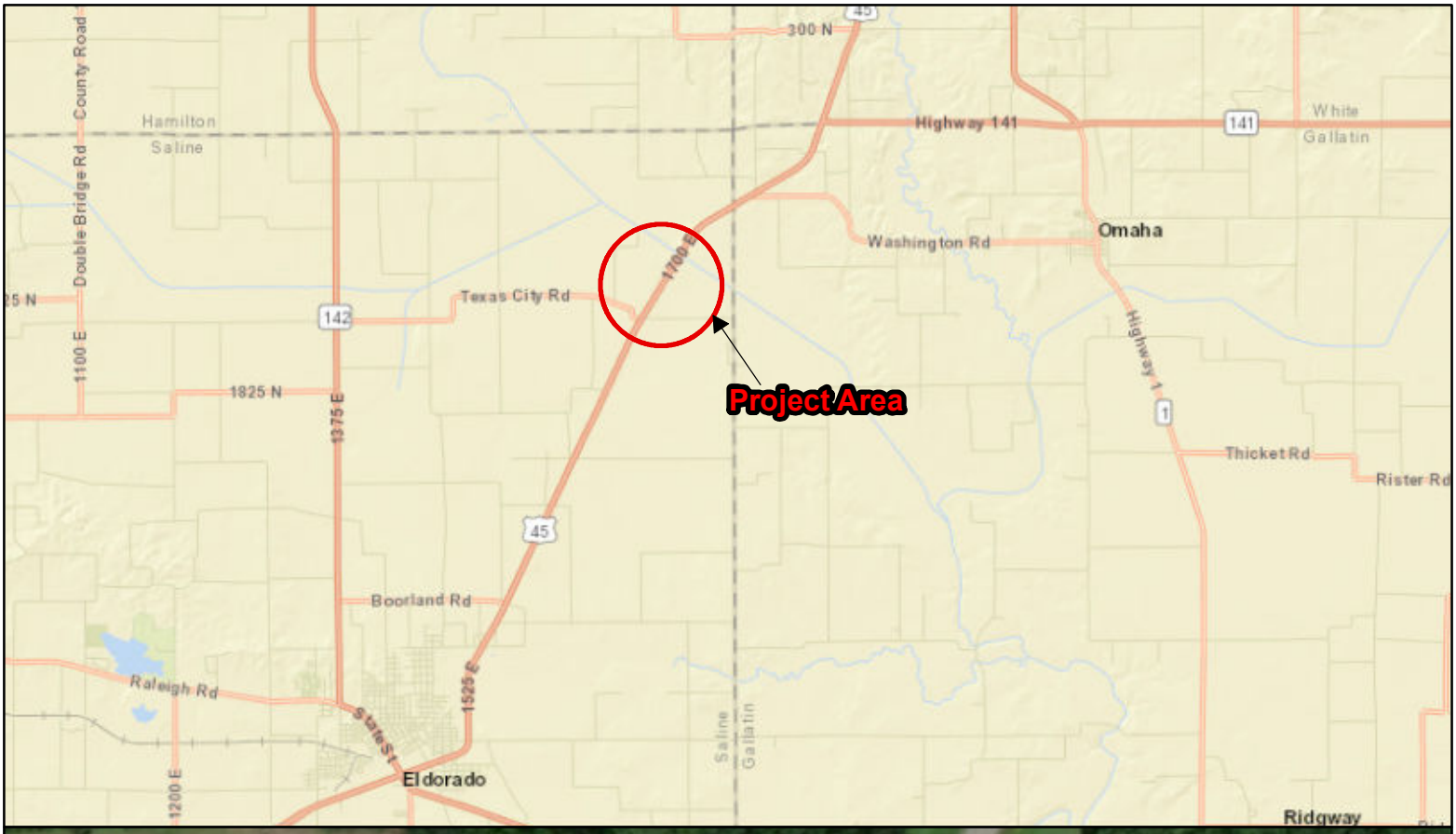
Soil borings can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

8.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of CM&T and IDOT. They are specific only to the project described and are based on the subsurface information obtained by IDOT at five boring locations within the bridge area in 2010; 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

LOCATION MAP



Kaskaskia Engineering Group, LLC

LOCATION MAP

Bridge Improvement Project
US 45 (FAP 332)
SN 083-0002
Saline County, Illinois

Exhibit No.

A

KEG JOB #19-1143.02

EXHIBIT B

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

BENCHMARK:

Chiseled "□" on top of wingwall of NW corner of Structure 083-0002 along US 45, Sta. 705+88, Offset 17.00' Rt., Elevation 370.45.

SALVAGE:

None

EXISTING STRUCTURE:

SN 083-0002 was originally built in 1953 under SBI-1, Section 29-B-Y. The structure is a 4-span continuous bridge with stub abutments and an overall length of 246'-6" from back to back of abutments. The superstructure consists of a 7" thick slab supported on haunched reinforced concrete T-beams. The width of the structure is 33'-8" out to out of deck. The piers are reinforced concrete solid wall piers on untreated timber piles. The structure is to be removed and replaced using staged construction to maintain one lane of traffic open at all times.

DESIGN SPECIFICATIONS:

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition.

LOADING HL-93:

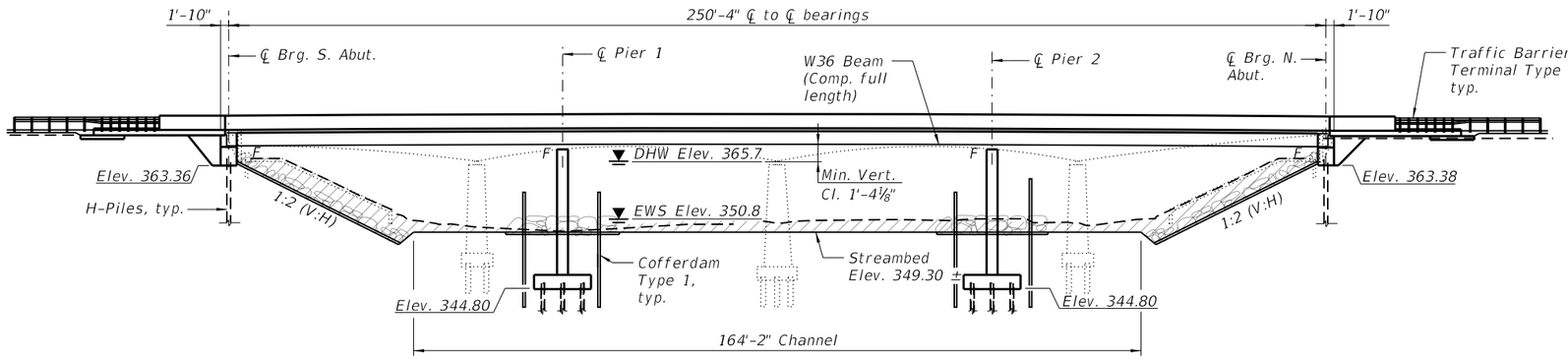
Allow 50 #/sq.ft. for future wearing surface.

SEISMIC DATA:

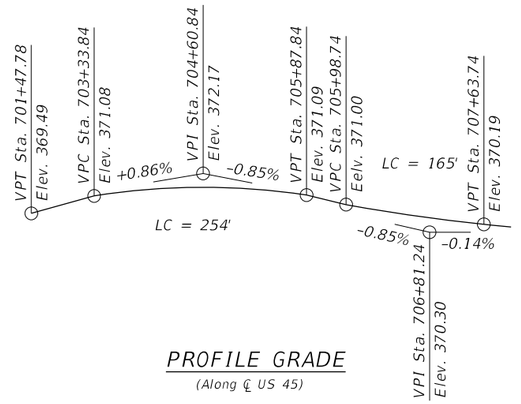
Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.319g
Design Spectral Acceleration at 2.0 sec. (S_{DS}) = 0.755g
Soil Site Class = D

DESIGN STRESSES:

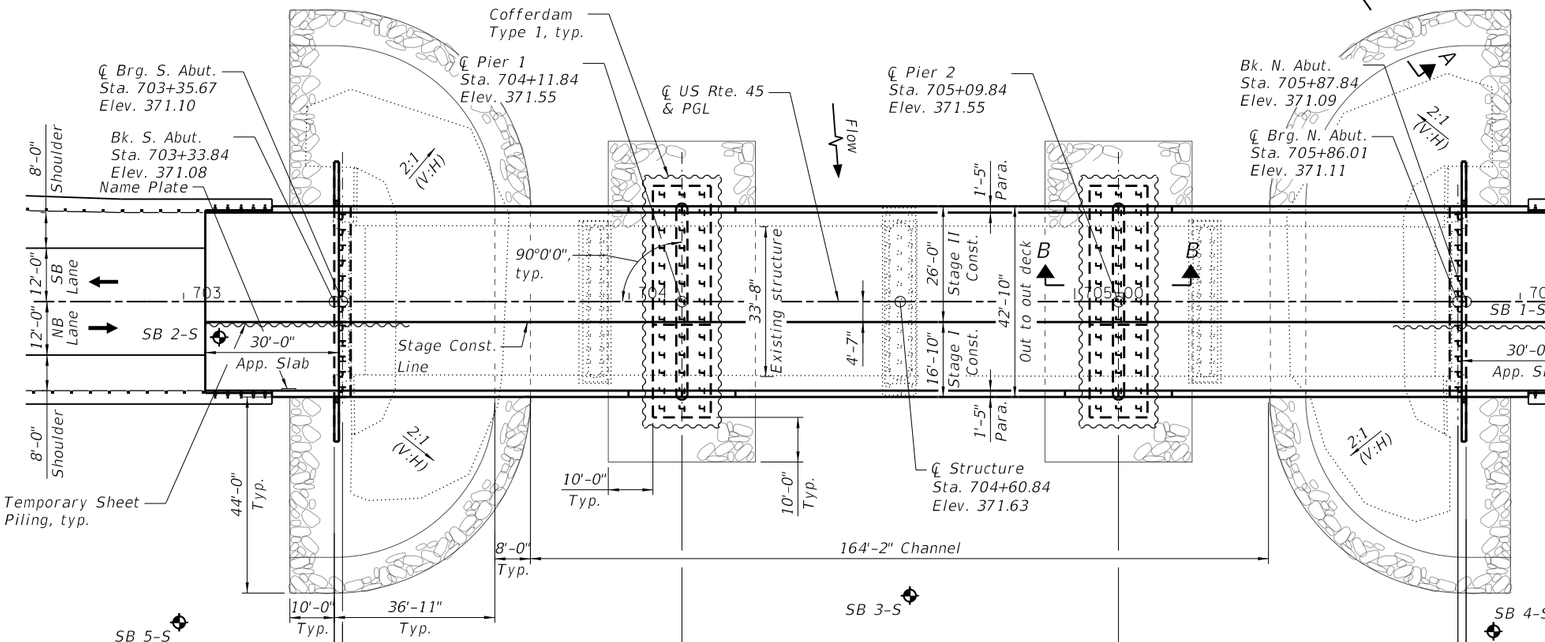
FIELD UNITS
f'c = 4,000 psi (superstructure)
f'c = 3,500 psi
fy = 60,000 psi (reinforcement)
fy = 50,000 psi (M270 Grade 50W)



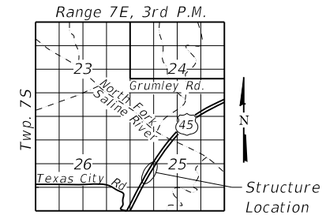
ELEVATION



PROFILE GRADE
(Along ℄ US 45)



PLAN



LOCATION SKETCH

LICENSED STRUCTURAL ENGINEER
AHMAD TALAL S. IDRISS
081-005753
SPRINGFIELD ILLINOIS
STATE OF ILLINOIS

Ahmad T. Idriss
EXP. 11-30-2022

LEGEND

- Soil Boring
- Proposed guardrail
- Stone Riprap Class A4
- Channel Excavation (See Roadway Plans)

Notes:
1. See Sheet 2 of 28 for Section A-A and B-B.
2. See Roadway Plans for Channel Excavation limits and quantity.

GENERAL PLAN
US ROUTE 45
OVER NORTH FORK SALINE RIVER OVERFLOW
FAP ROUTE 332 - SECTION (29B-4)
SALINE COUNTY
STA. 704+60.84
STRUCTURE NO. 083-0074

FILE NAME: L:\DOT\1190610\WO_10\Drawn\Structures\CADD_Sheets\SN 083-0074\1190781\bellsSN 083-0074_01_GPE.dgn

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USER NAME = Denise Herrera	DESIGNED - DH	REVISED -	
	DRAWN - DH	REVISED -	
PLOT SCALE = N/A	CHECKED - ATI	REVISED -	
PLOT DATE = 5/19/2022 (8:54:58 AM)	DATE - 05/19/2022	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
SN 083-0074

SCALE: | SHEET 1 OF 28 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	29B-4	SALINE	150	86
		CONTRACT NO. 78716		
	ILLINOIS FED. AID PROJECT			

EXHIBIT C

BORING LOGS

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 332 (US 45) Over Overflow of NF Saline River — Sheet 1 of 3

Route: FAP 332 (US 45) Structure Number: 083-0002 Date: 5/24/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 0.5 mile North of Texas City Checked By: R Graeff

Boring No 1-S
Station ~~723+58~~ 706+09
Offset ~~29' Lt CL~~ 8' Rt CL
Ground Surface 370.0 Ft

Surf Wat Elev: 350.7
Ground Water Elevation
when Drilling 338
At Completion
At: Hrs:

	DEPTH	BLOWS	Qu tsf	W%
Asphalt and concrete over crushed aggregate				
368.5				
Medium, very moist, grey and brown, Silty Clay A7-6		1		
		WH	0.7B	24
		1		
365.5				
Medium, very moist, grey, Silty Clay A7-6 with gravel and cinders.	5.0	2		
		7	0.6B	22
		7		
363.0				
Medium, very moist, grey, Clay A7-6		WH		
		1	0.6B	24
		WH		
360.5				
Soft, very moist, grey, Clay A7-6	10.0	WH		
		WH	0.3B	26
		WH		
358.0				
Medium, very moist, grey, Clay A7-6		WH		
		WH	0.6B	33
		WH		
355.5				
Soft, very moist, grey, Clay A7-6	15.0	WH		
		WH	0.4B	26
		1		
353.0				
Medium, very moist, grey, Clay A7-6		WH		
		WH	0.8B	24
		1		
350.5				
Medium to stiff, moist to very moist, grey, Silty Clay to Clay A7-6	20.0	WH		
		1	1.0B	33
		1		
348.0				
Medium, very moist, grey, Clay A7-6		WH		
		1	0.8B	29
		1		
345.5				
	25.0	1		

	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, brown mottled grey, Clay A7-6		4	1.7B	29
		6		
		1		
		3	1.9B	24
		5		
340.5				
Medium, very moist, brown mottled grey, Clay A7-6	30.0	1		
		2	0.7B	28
		3		
		WH		
		1	0.7B	24
		2		
	35.0	1		
		2	0.7B	24
		3		
		1		
		2	0.6B	25
		2		
330.5				
Stiff, moist, grey, Clay A7-6 with Sand layers	40.0	1		
		3	1.5B	24
		4		
325.5				
Medium, very moist, grey, Silty Clay Loam A-6 w/ sand seams	45.0	WH		
		3	0.7S	24
		3		
320.5				
	50.0	WH		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline
Date: 5/24/2010

Boring No: 1-S
Station: ~~723+58~~ 706+09
Offset: ~~29' Lt CL~~ 8' Rt CL
Ground Surface: 370.0 Ft

	DEPTH	BLOWS	Qu tsf	W%
Loose, very moist, grey, Sand with Clay layers 85% Sand 11% Silt 4% Clay		1 4		18
	315.5		Washed	
Soft, very moist, grey, Clay A7-6	55.0	1		
		WH 1	0.4B	22
	310.5			
Very stiff, moist to very moist, grey, Silt Loam A-4	60.0	11		
		14 19	2.1S	21
	65.0	11		
		21 21	2.7S	25
	300.5			
Very stiff, moist, grey, Silty Clay Loam A-6	70.0	9		
		15 16	2.9S	20
	295.5			
	75.0	6		
Very stiff, moist, grey, Silty Clay to Clay A7-6		12 14	3.3B	26
	80.0	3		
		9 12	3.3B	23
	85.0			
	280.5			
Stiff, moist, olive grey, Sandy Clay A-6	90.0	4		
		8 8	1.3S	21
	95.0			
	271.0			
Hard, damp, grey, Clay Shale	100.0	100/10"		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline

Date: 5/24/2010

Boring No: 1-S
Station: ~~723+58~~ 706+09
Offset: ~~29' Lt CL~~ 8' Rt CL
Ground Surface: 370.0 Ft

DEPTH	BLOWS	Qu tsf	W%	DEPTH	BLOWS	Qu tsf	W%
269.5							
105.0				130.0			
110.0				135.0			
115.0				140.0			
120.0				145.0			
125.0				150.0			

Bottom of hole = 100.5 feet

Free water observed at 32.0 feet

Elevation refernced to BM @
NW wingwall: Elev.= 370.4 feet

To convert "N" values to "N60"
multiply by 1.25

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 332 (US 45) Over Overflow of NF Saline River

Sheet 1 of 3

Route: FAP 332 (US 45) Structure Number: 083-0002 Date: 6/22/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 0.5 mile North of Texas City Checked By: R Graeff

Boring No 2-S
Station ~~720+50~~ 703+09
Offset ~~45' Lt CL~~ 8' Lt CL
Ground Surface 370.0 Ft

Surf Wat Elev: 350.7
Ground Water Elevation
when Drilling 330.5
At Completion
At: Hrs:

	DEPTH	BLOWS	Qu tsf	W%
Asphalt and concrete over crushed aggregate				
368.5				
Medium to stiff, moist, brown, Silty Clay A7-6		1		
		2	1.0B	21
366.5		2		
old concrete pavement				
365.5				
Medium, very moist, brown, Silty Clay A-6	5.0	3		
		6	0.8E	24
		4		
363.0				
Medium, very moist, grey and brown, Clay A7-6		WH		
		1	0.7B	28
		1		
360.5				
Soft, very moist, grey and brown, Clay A7-6	10.0	WH		
		WH	0.4B	32
		1		
358.0				
Medium, very moist, grey and brown, Clay A7-6		WH		
		1	0.8B	27
		3		
355.5				
Stiff, moist, grey, Clay A7-6	15.0	1		
		3	1.1B	30
		4		
353.0				
Hard to very stiff, moist, brown streaked grey, Clay A7-6		3		
		7	4.1B	21
		9		
	20.0	4		
		8	3.9S	24
		11		
		4		
		8	4.3B	20
		12		
	25.0	2		

	DEPTH	BLOWS	Qu tsf	W%
Hard to very stiff, moist, brown streaked grey, Clay A7-6		6	3.1B	22
		9		
		4		
		8	4.3B	26
		11		
	30.0	3		
		8	4.1B	27
		10		
		4		
		8	5.8B	26
		12		
	35.0	5		
		8	3.9B	23
		11		
333.0				
Stiff to very stiff, moist, brown mottled grey, Clay A7-6		3		
		4	2.1B	26
		6		
	40.0	1		
		4	1.7B	25
		6		
325.5				
Soft, very moist, grey, Silt Loam to Silty Clay Loam A-4 with Sand seams	45.0	1		
		3	0.4B	23
		3		
320.5				12.0
Loose to very loose, wet, grey,	50.0	WH		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Date: 6/22/2010
Section: 29-B-Y
County: Saline

Boring No: 2-S
Station: ~~720+58~~ 703+09
Offset: ~~45' Lt CL~~ 8' Lt CL
Ground Surface: 370.0 Ft

	DEPTH	BLOWS	Qu tsf	W%
Fine Sand with Silt layers 80% Sand 14% Silt 6% Clay		1 3		18
315.5		Washed		
Soft, very moist, grey, Silty Clay A-6 with sand seams	55.0	1 3 3	0.4B	21
310.5				
Stiff, moist, grey, Silty Clay to Silty Clay Loam A-6 with Sand layers	60.0	3 5 6	1.5B	18
305.5				
Hard, damp to moist, grey, Silt to Silt Loam A-4	65.0	13 24 28	4.3S	24
300.5				
Very stiff to hard, moist, grey, Silty Clay to Silty Clay Loam A-6	70.0	6 14 18	3.9S	20
	75.0	5		

	DEPTH	BLOWS	Qu tsf	W%
Very stiff to hard, moist, grey, Silty Clay to Silty Clay Loam A-6		12 16	4.1B	21
	80.0	4		
		8 12	3.1B	22
	85.0			
280.5				
Very stiff, moist, grey mottled brown, Clay A7-6	90.0	2 3 5	2.3B	25
276.0				
Loose?, very moist, grey, Fine Silty Sand	95.0			
270.5				
Hard, damp, grey Clay A7-6 270.0	100.0	20		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline
Date: 6/22/2010

Boring No: 2-S
Station: ~~720+50~~ 703+09
Offset: ~~45' Lt CL~~ 8' Lt CL
Ground Surface: 370.0 Ft

DEPTH	BLOWS	Qu tsf	W%	DEPTH	BLOWS	Qu tsf	W%
Hard, dry, grey, Clay Shale	100/8"						
105.0	100/4"			130.0			
Hard, dry, grey, Clay Shale 260.0	110.0	100/3"		135.0			
Bottom of hole= 109.8 feet							
Free water observed at 39.5 feet							
Elevation refernced to BM @ NW wingwall: Elev.= 370.4 feet							
To convert "N" values to "N60" multiply by 1.25	115.0			140.0			
	120.0			145.0			
	125.0			150.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 332 (US 45) Over Overflow of NF Saline River — Sheet 1 of 2

Route: FAP 332 (US 45) Structure Number: 083-0002 Date: 9/29/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 0.5 mile North of Texas City Checked By: R Graeff

Boring No 3-S
Station ~~722+12~~ 704+63
Offset ~~29' Rt CL~~ 66' Rt CL
Ground Surface 351.1 Ft

Surf Wat Elev: 349.0
Ground Water Elevation
when Drilling 321.6
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	Description	DEPTH	BLOWS	Qu tsf	W%
	1			Stiff, moist, grey mottled brown,		3	0.7S	26
	1	1.6B	38	Clay to Silty Clay A7-6		2		
	1							
					324.1			
	WH			Very loose, wet, grey, Sand to		WH		
	1	1.4B	31	Sand Loam		WH		27
	1			73% Sand; 19% Silt; 8% Clay		WH		
346.6					321.6	Washed 3'		
5.0	WH			Medium, very moist, grey, Clay	30.0	3		
	WH	0.8B	28	A7-6		7		18
	1					8		
344.1						Washed 2'		
	WH			Soft, very moist, grey, Silty Clay		5		
	WH	0.3B	33	to Clay A7-6		6		
	1					7		
					316.6	Washed 3'		
10.0	WH				35.0	2		
	WH	0.3B	32	Medium dense, very moist, grey		7		24
	1			Sand with Silty Clay layers		7		
339.1				62% Sand; 29% Silt; 9% Clay	314.1	Washed 2'		
	WH			Very soft, very moist, grey, Clay		4		
	WH	0.2B	50	A7-6		6		19
	WH					8		
336.6								
15.0	1			Stiff, moist, grey mottled brown,	40.0	2		
	2	1.4B	28	Clay A7-6		7		
	2					9		
334.1								
	WH			Very soft, very moist, grey, Clay				
	WH	0.2B	40	A7-6				
	1							
331.6					306.6	Washed 2'		
20.0	1			Medium, very moist, grey, Silty	45.0	13		
	3	0.8B	25	Clay Loam to Silt Loam A-4		21	2.9S	19
	5					18		
329.1								
	WH			Soft, very moist, grey, Clay A7-6				
	WH	0.4B	24					
	1							
326.6					301.6			
25.0	WH				50.0	6		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline
Date: 9/29/2010

Boring No: 3-S
Station: ~~722+12~~ 704+63
Offset: ~~29' Rt CL~~ 66' Rt CL
Ground Surface: 351.1 Ft

	DEPTH	BLOWS	Qu tsf	W%
Hard, damp, grey, Silt Loam to Silty Clay Loam A-4		13 17	4.1S	21
296.6				
Hard, moist, grey, Clay A7-6	55.0	4 9 11	4.7B	23
291.6				
Very stiff, moist, grey, Silty Clay to Clay A7-6	60.0	2 5 8	2.1B	28
286.6				
Stiff, moist to very moist, grey, Silty Clay to Silty Clay Loam A-6	65.0	WH 1 2	1.2B	20
281.6				
Very stiff, moist, bluish grey, Silty Clay Loam to Clay Loam A-6	70.0	3 8 9	2.8S	18
276.6				
	75.0	WR		

	DEPTH	BLOWS	Qu tsf	W%
Very loose, very moist, grey, Sand		WR WR		
271.6				
Hard, damp, grey, weathered Clay Shale 270.6	80.0	9 30		
Hard, dry, grey, Clay Shale		60		
	85.0	100/4"		
Hard, dry, grey, Clay Shale				
261.1	90.0	100/3"		
Bottom of hole= 89.8 feet				
Free water observed at 29.5 feet				
Elevation referenced to BM @ NW wingwall: Elev.= 370.4 feet				
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)	95.0			
To convert "N" values to "N60" multiply by 1.25				
	100.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 332 (US 45) Over Overflow of NF Saline River — Sheet 1 of 2

Route: FAP 332 (US 45) Structure Number: 083-0002 Date: 10/4/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 0.5 mile North of Texas City Checked By: R Graeff

Boring No 4-S
Station ~~723+43~~ 705+94
Offset ~~34' Rt CL~~ 74' Rt CL
Ground Surface 352.3 Ft

Surf Wat Elev: 349.0
Ground Water Elevation
when Drilling 337.8
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	Description
				Very stiff, damp to moist, brown mottled grey, Clay to Silty Clay A7-6
	2			
	3	2.5B	21	
	3			
347.8				
5.0	WH			Medium, v moist, brown mottled grey, Clay to Silty Clay A7-6
	1	0.9B	24	
	1			
345.3				
	1			Stiff, moist to very moist, brown mottled grey, Clay A7-6
	3	1.2B	22	
	4			
10.0	1			
	3	1.2B	23	
	3			
340.3				
	1			Medium, very moist, brown mottled grey, Clay A7-6
	2	0.8B	22	
	3			
337.8				
15.0	1			Stiff, moist to very moist, grey and brown, Clay to Clay Loam A7-6
	2	1.1B	21	
	3			
335.3				
	1			Medium, very moist, grey and brown, Clay A7-6
	3	0.8B	23	
	3			
332.8				
20.0	2			Stiff, moist, grey and brown, Clay A7-6
	3	1.1B	22	
	4			
330.3				
	1			Stiff, moist, grey, Clay A7-6
	4	1.8B	20	
	6			
327.8				
25.0	1			

DEPTH	BLOWS	Qu tsf	W%	Description
	4	1.2B	23	Stiff, moist, grey, Clay to Silty Clay A7-6
	4			
325.3				
	1			Soft, very moist, grey, Silty Clay Loam A-6 with sand seams
	3	0.4B	28	
	4			
322.8				
30.0	WR			Very loose, wet, grey, Fine Sand
	WH		26	90% Sand
	1			6% Silt
				4% Sand
320.3	Washed 3'			
	5			Medium, very moist, grey, Fine Sand
	4			
	7			
317.8	Washed 2'			
35.0	1			Medium, very moist, grey, Silty Clay Loam A-4 with sand seams
	3	0.9S	19	
	3			
	Washed 2'			
	3			
314.3	6	0.8S	23	
	8			
				Medium dense, very moist, grey, Sand and Silt
40.0	6			86% Sand
	11		20	10% Silt
	12			4% Clay
				2% Sand
				84% Silt
307.8				14% Clay
45.0	11			Very stiff, damp, grey, Silt to Silt Loam A-4
	18	3.7S	19	
	19			
302.8				
50.0	5			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline
Date: 10/4/2010

Boring No: 4-S
Station: ~~723+43~~ 705+94
Offset: ~~34' Rt CL~~ 74' Rt CL
Ground Surface: 352.3 Ft

	DEPTH	BLOWS	Qu tsf	W%
Hard, damp, grey, Clay to Silty Clay A7-6		13 13	4.1B	20
	297.8			
Very stiff, damp to moist, grey, Clay A7-6	55.0	5		
		11 11	3.5B	23
	60.0	3		
		9 10	3.3B	20
	65.0	3		
		7 8	3.5B	19
	282.8			
??? No recovery (see 3-S)	70.0	1 2 3		
	277.8			
Very loose, wet, grey, Sand	75.0	WR		
Very loose, wet, grey, Sand		WH 1		
	272.8			
Hard, damp, grey, Clay to weathered Clay Shale	80.0	1		
		14 25	4.3B	17
	270.8			
Hard, dry, grey, Clay Shale				
	267.3	85.0	100/3"	
Bottom of hole= 84.8 feet				
Free water observed at 14.5 feet				
Elevation referenced to BM @ NW wingwall: Elev.= 370.4 feet				
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)	90.0			
To convert "N" values to "N60" multiply by 1.25	95.0			
	100.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 332 (US 45) Over Overflow of NF Saline River

Sheet 1 of 2

Route: FAP 332 (US 45) Structure Number: 083-0002 Date: 10/5/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 0.5 mile North of Texas City Checked By: R Graeff

Boring No 5-S
Station ~~720+48~~ 702+99
Offset ~~35' Rt CL~~ 72' Rt CL
Ground Surface 352.9 Ft

Surf Wat Elev: 349.0
Ground Water Elevation
when Drilling 325.9
At Completion
At: Hrs:

	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, brown mottled grey, Clay A7-6		5 7 7	2.6S	23
	5.0	2 4 4	2.7B	28
	10.0	2 4 6	2.7B	27
	15.0	3 5 7	3.7B	24
	20.0	3 5 7	3.7B	26
		2 6 7	3.9B	28
		3 7 8	3.5B	25
		3 6 8	3.7B	22
330.9				
Stiff, moist, brown mottled grey, Clay A7-6		2 4 4	1.7B	28
327.9	25.0	2		

	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist to very moist, brown mottled grey, Silty Clay to Silty Clay Loam A-6		3 3	1.2B	22
325.9				
Medium, very moist, grey, Silty Clay Loam A-6		WH 1 2	0.6B	26
323.4				
Soft, very moist, grey, Silty Clay Loam A-6 with Sand layers	30.0	WH 1 1	0.4B	24
320.9		Washed 3'		
Loose, very moist, grey, Sand with clay layers		3 3 6		20
318.4		Washed 2'		
Stiff, very moist, grey, Silty Clay Loam A-4 with sand layers	35.0	3 5 6	1.1B	20
315.9				
Stiff, moist, grey, Silty Clay Loam A-6		1 8 6	1.7B	17
313.4				
Stiff, moist, grey, Silty Clay Loam A-6 with sand layers	40.0	1 3 3	1.1B	19
308.4				
Very stiff, moist, grey, Silt to Silt Loam A-4	45.0	7 8 8	2.4S	18
	50.0	7		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline
Date: 10/5/2010

Boring No: 5-S
Station: ~~720+48~~ 702+99
Offset: ~~35' Rt CL~~ 72' Rt CL
Ground Surface: 352.9 Ft

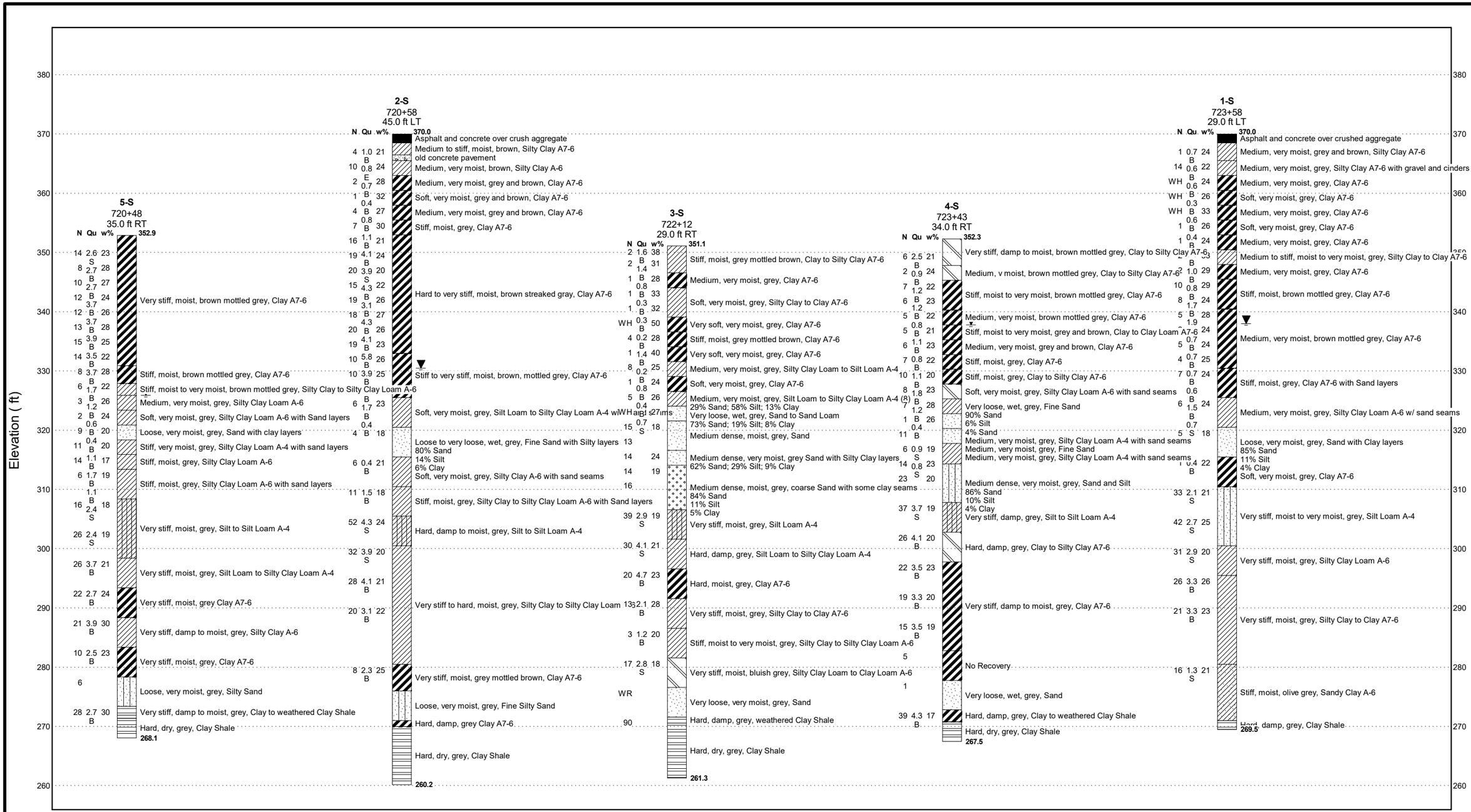
	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, grey, Silt to Silt Loam A-4		13 13	2.4S	19
	298.4			
Very stiff, moist, grey, Silt Loam to Silty Clay Loam A-4	55.0	7 12 14	3.7B	21
	293.4			
Very stiff, moist, grey, Clay A7-6	60.0	4 9 13	2.7B	24
	288.4			
Very stiff, damp to moist, grey, Silty Clay A-6	65.0	3 10 11	3.9B	30
	283.4			
Very stiff, moist, grey, Clay A7-6	70.0	2 5 5	2.5B	23
	278.4			
	75.0	2		

	DEPTH	BLOWS	Qu tsf	W%
Loose, very moist, grey, Silty Sand		3 3		
	273.4			
Very stiff, damp to moist, grey, Clay to weathered Clay Shale	80.0	1 8 20	2.7B	30
	271.4			
Hard, dry, grey, Clay Shale				
	267.9	85.0	100/3"	
Bottom of hole= 84.8 feet				
Free water observed at 27.0 feet				
Elevation referenced to BM @ NW wingwall: Elev.= 370.4 feet				
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)	90.0			
To convert "N" values to "N60" multiply by 1.25				
	95.0			
	100.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

EXHIBIT D

SUBSURFACE PROFILE



PRINTERMOD2 11X17 19-1143.02 STRUCTURE 2 US 45 OVER N FORK SALINE RIVER.GPJ IL_DOT.GDT 8/31/20

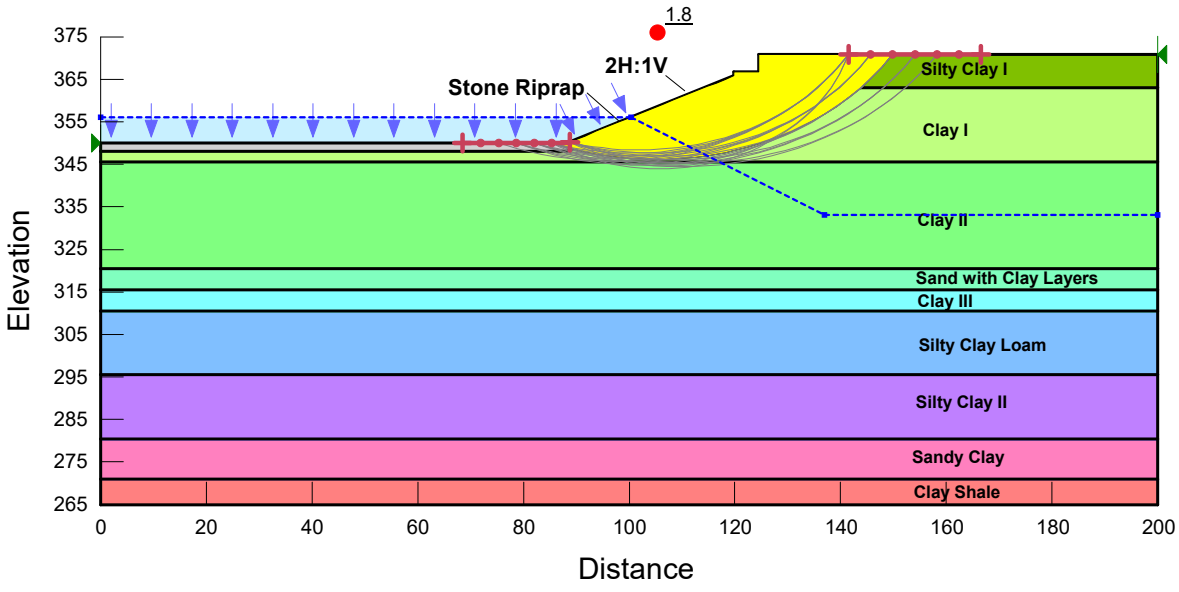
Illinois Department of Transportation
Division of Highways

NOT TO HORIZONTAL SCALE

SUBSURFACE DATA PROFILE

Route: FAP 332 (US 45)
Section: 29-B-Y
County: Saline

US 45 over N Fork Saline River
SN 083-0002 North Abutment - Boring 1-S
End-of-construction (Undrained Condition)



Name: Silty Clay I
Unit Weight: 120 pcf
Cohesion': 650 psf
Phi': 0 °

Name: Clay I
Unit Weight: 125 pcf
Cohesion': 650 psf
Phi': 0 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 1,050 psf
Phi': 0 °

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

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 400 psf
Phi': 0 °

Name: Silty Clay Loam
Unit Weight: 110 pcf
Cohesion': 2,600 psf
Phi': 0 °

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 3,300 psf
Phi': 0 °

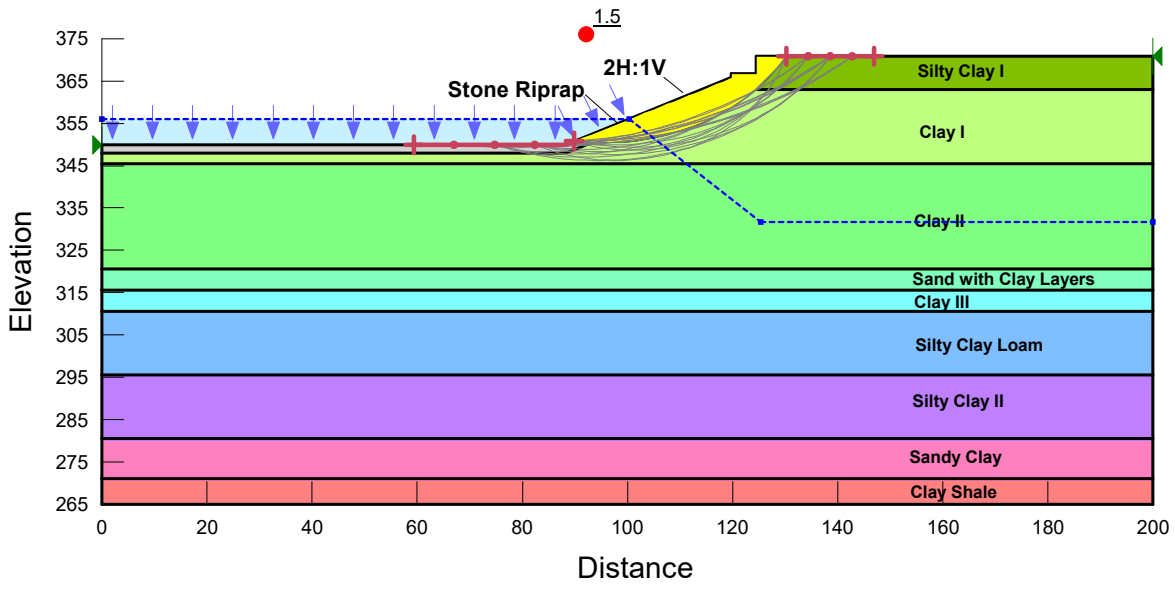
Name: Sandy Clay
Unit Weight: 115 pcf
Cohesion': 1,300 psf
Phi': 0 °

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

Name: Stone Riprap
Unit Weight: 145 pcf
Phi': 42 °

Name: Concrete
Unit Weight: 150 pcf

US 45 over N Fork Saline River
SN 083-0002 North Abutment - Boring 1-S
Long Term Analysis (Drained Condition)



Name: Silty Clay 1
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 28 °

Name: Clay I
Unit Weight: 125 pcf
Cohesion': 75 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 75 psf
Phi': 26 °

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

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Silty Clay Loam
Unit Weight: 110 pcf
Cohesion': 150 psf
Phi': 28 °

Name: Silty Clay II Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 28 °

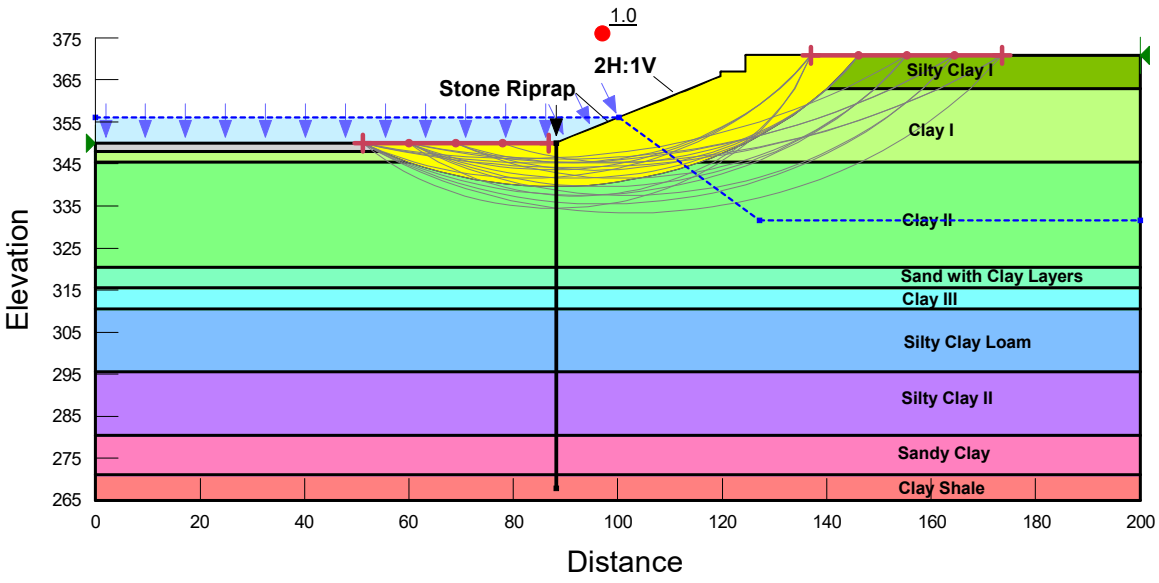
Name: Sandy Clay Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

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

Name: Stone Riprap
Unit Weight: 145 pcf
Phi': 42 °

Name: Concrete
Unit Weight: 150 pcf

US 45 over N Fork Saline River
SN 083-0002 North Abutment - Boring 1-S
Long Term Analysis (Drained Condition)
Seismic PGA 0.293g
8' Pile Spacing



Name: Silty Clay I
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 28 °

Name: Clay I
Unit Weight: 125 pcf
Cohesion': 75 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °

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

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Silty Clay Loam
Unit Weight: 110 pcf
Cohesion': 150 psf
Phi': 28 °

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 28 °

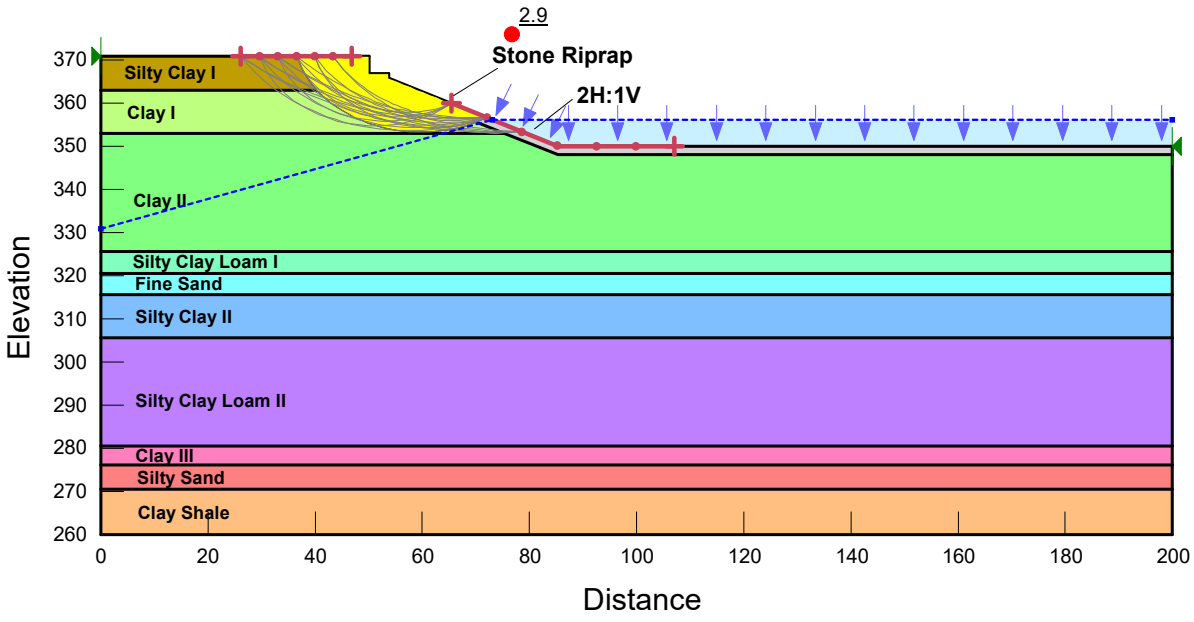
Name: Sandy Clay
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

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

Name: Stone Riprap
Unit Weight: 145 pcf
Phi': 42 °

Name: Concrete
Unit Weight: 150 pcf

US 45 over N Fork Saline River
SN 083-0002 South Abutment - Boring 2-S
End-of-construction (Undrained Condition)



Name: Silty Clay 1
Unit Weight: 120 pcf
Cohesion': 1,000 psf
Phi': 0 °

Name: Clay I
Unit Weight: 125 pcf
Cohesion': 760 psf
Phi': 0 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 3,700 psf
Phi': 0 °

Name: Silty Clay Loam I
Unit Weight: 110 pcf
Cohesion': 400 psf
Phi': 0 °

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

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 950 psf
Phi': 0 °

Name: Silty Clay Loam II
Unit Weight: 110 pcf
Cohesion': 3,850 psf
Phi': 0 °

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 2,300 psf
Phi': 0 °

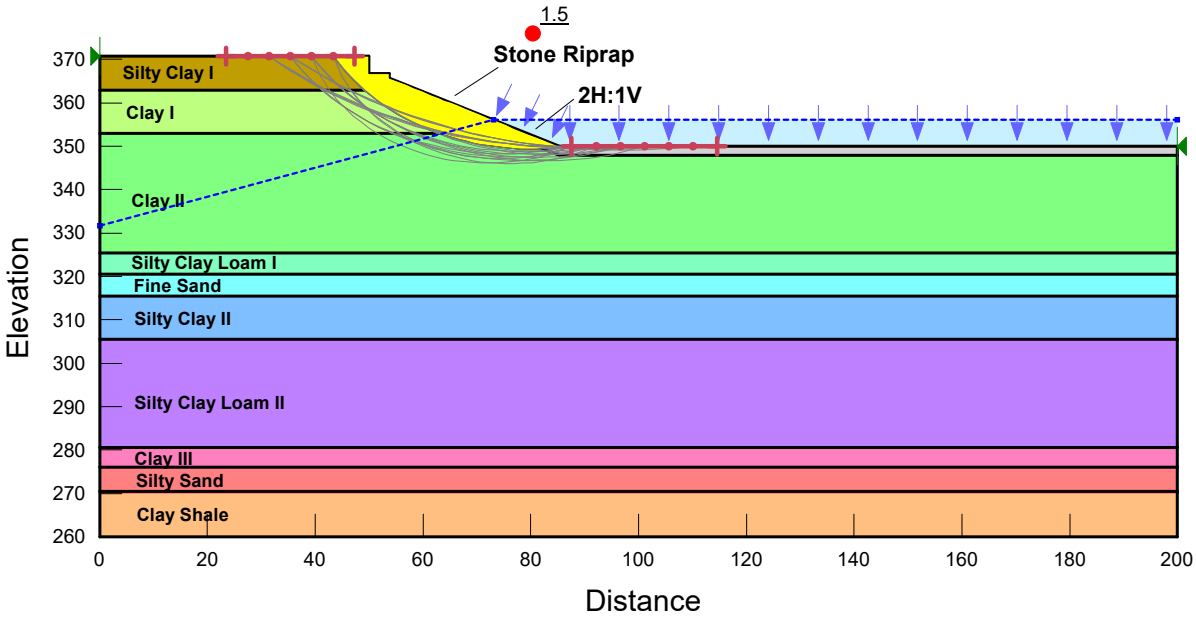
Name: Silty Sand
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °

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

Name: Stone Riprap Unit Weight: 145 pcf
Phi': 42 °

Name: Concrete
Unit Weight: 150 pcf

US 45 over N Fork Saline River
SN 083-0002 South Abutment - Boring 2-S
Long Term Analysis (Drained Condition)



Name: Silty Clay 1
Unit Weight: 120 pcf
Cohesion': 75 psf
Phi': 28 °

Name: Clay I
Unit Weight: 125 pcf
Cohesion': 75 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 125 psf
Phi': 26 °

Name: Silty Clay Loam I
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 28 °

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

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silty Clay Loam II
Unit Weight: 110 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

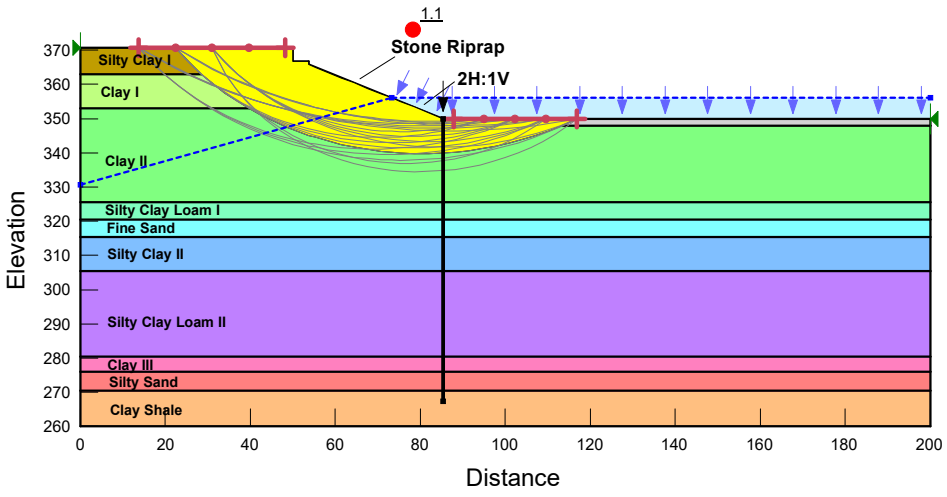
Name: Silty Sand
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °

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

Name: Stone Riprap Unit Weight: 145 pcf
Phi': 42 °

Name: Concrete
Unit Weight: 150 pcf

US 45 over N Fork Saline River
SN 083-0002 South Abutment - Boring 2-S
Long Term Analysis (Drained Condition)
Seismic PGA 0.293g
8' Pile Spacing



Name: Silty Clay I Unit Weight: 120 pcf
Cohesion': 75 psf
Phi': 28 °

Name: Clay I
Unit Weight: 125 pcf
Cohesion': 75 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 125 psf
Phi': 26 °

Name: Silty Clay Loam I
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 28 °

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

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silty Clay Loam II
Unit Weight: 110 pcf
Cohesion': 100 psf
Phi': 28 °

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silty Sand
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °

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

Name: Stone Riprap
Unit Weight: 145 pcf
Phi': 42 °

Name: Concrete Model:
Weight: 150 pcf

EXHIBIT F

LIQUEFACTION ANALYSES RESULTS

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: 1-S N Abut
ELEVATION OF BORING GROUND SURFACE ==========: 370.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 32.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 36.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.201
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.00 FT.
HAMMER EFFICIENCY==========: 73 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.996**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **#DIV/0!** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 128
Ground Motion Prediction Equations = NMSZ
PGA = **0.118**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
365.5	4.5	1	0.7		13		24	0.117	0.527	1.753	1.753	0.052	0.117	0.527	0.527	1.321	**0.068**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
363	7	14	0.6		13		22	0.116	0.817	24.352	24.352	0.280	0.116	0.817	0.817	1.359	**0.379**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
360.5	9.5	1	0.6		13		24	0.116	1.107	1.582	1.582	0.051	0.116	1.107	1.107	1.139	**0.058**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
358	12	0	0.3		13		26	0.108	1.377	0.000	0.000	0.049	0.108	1.377	1.377	1.090	**0.053**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
355.5	14.5	0	0.6		13		33	0.116	1.667	0.000	0.000	0.049	0.116	1.667	1.667	1.049	**0.051**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
353	17	1	0.4		13		26	0.111	1.944	1.460	1.460	0.051	0.111	1.944	1.944	1.017	**0.051**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
350.5	19.5	1	0.8		13		24	0.119	2.242	1.397	1.397	0.050	0.119	2.242	2.242	0.989	**0.050**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
348	22	2	1		13		33	0.122	2.547	2.665	2.665	0.056	0.122	2.547	2.547	0.964	**0.054**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
345.5	24.5	2	0.8		13		29	0.119	2.844	2.543	2.543	0.056	0.119	2.844	2.844	0.943	**0.052**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
343	27	10	1.7		13		29	0.128	3.164	12.090	12.090	0.132	0.128	3.164	3.164	0.907	**0.119**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
340.5	29.5	8	1.9		13		24	0.129	3.487	9.205	9.205	0.106	0.129	3.487	3.487	0.893	**0.095**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
338	32	5	0.7		13		28	0.117	3.779	5.511	5.511	0.076	0.117	3.779	3.779	0.889	**0.067**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
335.5	34.5	3	0.7		13	10	24	0.055	3.917	3.248	3.248	0.060	0.117	4.072	4.072	0.878	**0.052**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
333	37	5	0.7		13	10	24	0.055	4.054	5.318	5.318	0.074	0.055	4.209	4.271	0.870	**0.065**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
330.5	39.5	4	0.6		13	17	25	0.053	4.187	4.183	4.183	0.066	0.053	4.342	4.560	0.866	**0.057**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
325.5	44.5	7	1.5		13	10	24	0.064	4.507	7.028	7.028	0.088	0.064	4.662	5.192	0.846	**0.074**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
320.5	49.5	6	0.7		13	10	24	0.055	4.782	5.826	5.826	0.078	0.055	4.937	5.779	0.841	**0.066**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
315.5	54.5	5		15			18	0.055	5.057	4.696	7.420	0.091	0.055	5.212	6.366	0.824	**0.075**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
310.5	59.5	1	0.4		13	10	22	0.049	5.302	0.912	0.912	0.049	0.049	5.457	6.923	0.828	**0.040**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
305.5	64.5	33	2.1				21	0.068	5.642	31.173	31.173	0.580	0.068	5.797	7.575	0.694	**0.401**	#DIV/0!	**#DIV/0!**	**N.L. (3)**
300.5	69.5	42	2.7				25	0.071	5.997	39.353	39.353	0.100	0.071	6.152	8.242	0.653	**0.065**	#DIV/0!	**#DIV/0!**	**N.L. (3)**
295.5	74.5	31	2.9		13	10	20	0.072	6.357	26.367	26.367	0.322	0.072	6.512	8.914	0.688	**0.220**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
290.5	79.5	26	3.3		13	17	26	0.074	6.727	20.688	20.688	0.224	0.074	6.882	9.596	0.704	**0.157**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
280.5	89.5	21	3.3		13	10	23	0.074	7.467	15.059	15.059	0.161	0.074	7.622	10.960	0.714	**0.114**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
271	99	16	1.3		13	10	21	0.062	8.056	10.685	10.685	0.119	0.062	8.211	12.142	0.727	**0.086**	#DIV/0!	**#DIV/0!**	**N.L. (2)**
269.5	100.5	100			13			0.083	8.180	77.271	77.271	0.544	0.083	8.335	12.360	0.578	**0.314**	#DIV/0!	**#DIV/0!**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR $w_c/LL \leq 0.85$
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 2-S S Abut
ELEVATION OF BORING GROUND SURFACE ========== 370.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 40.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 40.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.201
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.996**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **464** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 128
Ground Motion Prediction Equations = NMSZ
PGA = **0.118**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
366.5	3.5	4	1		13		21	0.122	0.427	7.248	7.248	0.090	0.122	0.427	0.427	1.410	**0.126**	0.975	**0.127**	**N.L. (1)**
363	7	10	0.8		13		24	0.119	0.844	16.437	16.437	0.175	0.119	0.844	0.844	1.285	**0.224**	0.943	**0.123**	**N.L. (1)**
360.5	9.5	2	0.7		13		28	0.117	1.136	3.138	3.138	0.059	0.117	1.136	1.136	1.133	**0.067**	0.915	**0.119**	**N.L. (1)**
358	12	1	0.4		13		32	0.111	1.414	1.545	1.545	0.051	0.111	1.414	1.414	1.084	**0.055**	0.885	**0.115**	**N.L. (1)**
355.5	14.5	4	0.8		13		27	0.119	1.711	5.987	5.987	0.080	0.119	1.711	1.711	1.045	**0.083**	0.851	**0.111**	**N.L. (1)**
353	17	7	1.1		13		30	0.123	2.019	10.055	10.055	0.114	0.123	2.019	2.019	1.011	**0.114**	0.815	**0.106**	**N.L. (1)**
350.5	19.5	16	4.1		13		21	0.139	2.366	22.821	22.821	0.254	0.139	2.366	2.366	0.966	**0.245**	0.778	**0.101**	**N.L. (1)**
348	22	19	3.9		13		24	0.138	2.711	26.053	26.053	0.314	0.138	2.711	2.711	0.922	**0.289**	0.741	**0.097**	**N.L. (1)**
345.5	24.5	20	4.3		13		20	0.140	3.061	25.922	25.922	0.311	0.140	3.061	3.061	0.886	**0.275**	0.706	**0.092**	**N.L. (1)**
343	27	15	3.1		13		22	0.135	3.399	17.700	17.700	0.188	0.135	3.399	3.399	0.876	**0.165**	0.673	**0.088**	**N.L. (1)**
340.5	29.5	19	4.3		13		26	0.140	3.749	21.729	21.729	0.238	0.140	3.749	3.749	0.841	**0.199**	0.644	**0.084**	**N.L. (1)**
338	32	18	4.1		13		27	0.139	4.096	19.345	19.345	0.207	0.139	4.096	4.096	0.826	**0.171**	0.617	**0.081**	**N.L. (1)**
335.5	34.5	20	5.8		13		26	0.144	4.456	20.588	20.588	0.223	0.144	4.456	4.456	0.802	**0.178**	0.595	**0.078**	**N.L. (1)**
333	37	19	3.9		13	10	23	0.138	4.801	18.493	18.493	0.197	0.138	4.801	4.801	0.792	**0.156**	0.576	**0.075**	**N.L. (1)**
330.5	39.5	10	2.1		13	17	26	0.130	5.126	9.177	9.177	0.106	0.130	5.126	5.126	0.819	**0.086**	0.561	**0.073**	**N.L. (1)**
325.5	44.5	10	1.7		13	17	25	0.065	5.451	8.854	8.854	0.103	0.065	5.451	5.732	0.809	**0.083**	0.538	**0.074**	**N.L. (2)**
320.5	49.5	6	0.4		13	10	23	0.049	5.696	5.180	5.180	0.073	0.049	5.696	6.289	0.820	**0.060**	0.523	**0.075**	**N.L. (2)**
315.5	54.5	4		20			18	0.053	5.961	3.358	7.239	0.090	0.053	5.961	6.866	0.801	**0.072**	0.514	**0.077**	**0.935 (C)**
310.5	59.5	6	0.4		13	10	21	0.049	6.206	4.905	4.905	0.071	0.049	6.206	7.423	0.807	**0.057**	0.508	**0.079**	**N.L. (2)**
305.5	64.5	11	1.5		13	8	18	0.064	6.526	8.683	8.683	0.102	0.064	6.526	8.055	0.778	**0.079**	0.505	**0.081**	**N.L. (2)**
300.5	69.5	52	4.3		13		24	0.077	6.911	44.982	44.982	0.237	0.077	6.911	8.752	0.623	**0.147**	0.493	**0.081**	**N.L. (2)**
295.5	74.5	32	3.9		13	10	20	0.076	7.291	24.405	24.405	0.281	0.076	7.291	9.444	0.672	**0.188**	0.486	**0.082**	**N.L. (2)**
290.5	79.5	28	4.1		13	10	21	0.077	7.676	20.155	20.155	0.217	0.077	7.676	10.141	0.684	**0.148**	0.479	**0.083**	**N.L. (2)**
280.5	89.5	20	3.1		13	10	22	0.073	8.406	13.111	13.111	0.142	0.073	8.406	11.495	0.708	**0.100**	0.465	**0.083**	**N.L. (2)**
270.5	99.5	8	2.3		13	17	25	0.069	9.096	4.851	4.851	0.071	0.069	9.096	12.809	0.747	**0.053**	0.451	**0.083**	**N.L. (2)**
270	100	20			13			0.067	9.130	12.055	12.055	0.132	0.067	9.130	12.874	0.700	**0.092**	0.451	**0.083**	**N.L. (2)**
269.4	100.6	100			13			0.083	9.179	70.633	70.633	0.491	0.083	9.179	12.961	0.556	**0.272**	0.450	**0.083**	**N.L. (2)**
265.2	104.8	100			13			0.083	9.528	65.490	65.490	0.448	0.083	9.528	13.571	0.548	**0.245**	0.444	**0.082**	**N.L. (2)**
260.2	109.8	100			13			0.083	9.943	56.296	56.296	0.367	0.083	9.943	14.298	0.539	**0.197**	0.437	**0.082**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

EXHIBIT G

PILE LENGTH/PILE TYPE

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== North Abut.
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 365.38 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 363.38 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 363.38 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 42.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 242.82 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 91.06 KIPS

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**335** KIPS	**184** KIPS	**94** FT.

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

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
360.50	2.88	0.60			4.4		7.2	6.4		***6.8***	7	0	0	4	5
358.00	2.50	0.30			2.0	2.9	12.1	2.9	0.4	***10.1***	10	0	0	6	7
355.50	2.50	0.60			3.8	5.7	***14.0***	5.6	0.7	15.4	14	0	0	8	10
353.00	2.50	0.40			2.6	3.8	20.4	3.9	0.5	***19.8***	20	0	0	11	12
350.50	2.50	0.80			4.9	7.6	***27.2***	7.2	1.0	27.2	27	0	0	15	15
348.00	2.50	1.00			5.9	9.5	***31.1***	8.6	1.2	35.6	31	0	0	17	17
345.50	2.50	0.80			4.9	7.6	44.6	7.2	1.0	***43.8***	44	0	0	24	20
343.00	2.50	1.70			8.6	16.2	***55.1***	12.7	2.1	56.8	55	0	0	30	22
340.50	2.50	1.90			9.3	18.1	***53.0***	13.7	2.3	69.0	53	0	0	29	25
338.00	2.50	0.70			4.3	6.7	***57.3***	6.4	0.8	75.4	57	0	0	32	27
335.50	2.50	0.70			4.3	6.7	***61.7***	6.4	0.8	81.8	62	0	0	34	30
333.00	2.50	0.70			4.3	6.7	***65.1***	6.4	0.8	88.1	65	0	0	36	32
330.50	2.50	0.60			3.8	5.7	***77.4***	5.6	0.7	94.8	77	0	0	43	35
325.50	5.00	1.50			15.9	14.3	***85.7***	23.4	1.8	117.2	86	0	0	47	40
320.50	5.00	0.70			8.7	6.7	***96.2***	12.8	0.8	130.2	96	0	0	53	45
315.50	5.00		5	Medium Sand	1.5	8.5	***93.0***	2.2	1.1	131.8	93	0	0	51	50
310.50	5.00	0.40			5.2	3.8	***114.5***	7.7	0.5	141.6	114	0	0	63	55
305.50	5.00	2.10			19.8	20.0	***140.0***	29.2	2.5	171.4	140	0	0	77	60
300.50	5.00	2.70			23.4	25.7	***165.3***	34.5	3.3	206.2	165	0	0	91	65
295.50	5.00	2.90			24.6	27.7	***193.8***	36.3	3.5	242.9	194	0	0	107	70
290.50	5.00	3.30	26		27.1	31.5	***220.8***	39.8	4.0	282.8	221	0	0	121	75
280.50	10.00	3.30	21		54.1	31.5	***255.9***	79.7	4.0	360.0	256	0	0	141	85
271.00	9.50	1.30			27.3	12.4	***355.5***	40.1	1.6	409.3	~~355~~	~~0~~	~~0~~	~~196~~	~~94~~
270.00	1.00			Shale	41.1	84.8	***396.6***	60.5	10.7	469.8	~~397~~	~~0~~	~~0~~	~~218~~	~~95.4~~
269.00	1.00			Shale	41.1	84.8	***437.7***	60.5	10.7	530.4	~~438~~	~~0~~	~~0~~	~~241~~	~~96.4~~
268.00	1.00			Shale	41.1	84.8	***478.8***	60.5	10.7	590.9	~~479~~	~~0~~	~~0~~	~~263~~	~~97.4~~
267.00	1.00			Shale	41.1	84.8	***519.9***	60.5	10.7	651.4	~~520~~	~~0~~	~~0~~	~~286~~	~~98.4~~
266.00	1.00			Shale	41.1	84.8	***561.0***	60.5	10.7	711.9	~~561~~	~~0~~	~~0~~	~~309~~	~~99.4~~
265.00	1.00			Shale	41.1	84.8	***602.1***	60.5	10.7	772.4	~~602~~	~~0~~	~~0~~	~~331~~	~~100.4~~
264.00	1.00			Shale	41.1	84.8	***643.3***	60.5	10.7	833.0	~~643~~	~~0~~	~~0~~	~~354~~	~~101.4~~
263.00	1.00			Shale	41.1	84.8	***684.4***	60.5	10.7	893.5	~~684~~	~~0~~	~~0~~	~~376~~	~~102.4~~
262.00	1.00			Shale	41.1	84.8	***725.5***	60.5	10.7	954.0	~~725~~	~~0~~	~~0~~	~~399~~	~~103.4~~
261.00	1.00			Shale	41.1	84.8	***766.6***	60.5	10.7	1014.5	~~767~~	~~0~~	~~0~~	~~422~~	~~104.4~~
260.00	1.00			Shale	41.1	84.8	***807.7***	60.5	10.7	1075.0	~~808~~	~~0~~	~~0~~	~~444~~	~~105.4~~
259.00	1.00			Shale	41.1	84.8	***848.8***	60.5	10.7	1135.6	~~849~~	~~0~~	~~0~~	~~467~~	~~106.4~~
258.00	1.00			Shale	41.1	84.8	***889.9***	60.5	10.7	1196.1	~~890~~	~~0~~	~~0~~	~~489~~	~~107.4~~
257.00	1.00			Shale	41.1	84.8	***931.0***	60.5	10.7	1256.6	~~931~~	~~0~~	~~0~~	~~512~~	~~108.4~~
256.00	1.00			Shale		84.8			10.7						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== 3-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 346.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 344.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 318.75 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 42.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 3
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 143.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 53.70 KIPS

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**335** KIPS	**168** KIPS	**77** FT.

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

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
344.10	0.70	0.80			1.4		4.2	2.0		***2.4***	2	1	0	1	3
341.60	2.50	0.30			2.0	2.9	6.2	2.9	0.4	***5.3***	5	2	0	1	5
339.10	2.50	0.30			2.0	2.9	***7.3***	2.9	0.4	8.1	7	3	0	1	8
336.60	2.50	0.20			1.4	1.9	20.1	2.0	0.2	***11.6***	12	4	0	3	10
334.10	2.50	1.40			7.6	13.3	***16.2***	11.1	1.7	21.3	16	8	0	1	13
331.60	2.50	0.20			1.4	1.9	***23.3***	2.0	0.2	24.0	23	9	0	4	15
329.10	2.50	0.80			4.9	7.6	***24.3***	7.2	1.0	30.7	24	11	0	2	18
326.60	2.50	0.40			2.6	3.8	***29.8***	3.9	0.5	34.9	30	13	0	4	20
324.10	2.50	0.70			4.3	6.7	***27.5***	6.4	0.8	40.4	27	15	0	0	23
321.60	2.50		0	Medium Sand	0.0	0.0	52.9	0.0	0.0	***43.7***	44	15	0	9	25
319.10	2.50		15	Medium Sand	2.3	25.4	51.8	3.3	3.2	***46.5***	47	16	0	9	28
316.60	2.50		13	Medium Sand	2.0	22.0	55.4	2.9	2.8	***49.6***	50	16	0	11	30
314.10	2.50		14	Medium Sand	2.1	23.7	57.5	3.1	3.0	***52.7***	53	16	0	13	33
311.60	2.50		14	Medium Sand	2.1	23.7	63.0	3.1	3.0	***56.3***	56	16	0	15	35
306.60	5.00		16	Medium Sand	4.8	27.1	68.3	7.1	3.4	***63.4***	63	16	0	19	40
301.60	5.00	2.90			24.6	27.7	104.4	36.3	3.5	***101.1***	101	16	0	39	45
296.60	5.00	4.10	30		31.9	39.1	***142.0***	46.9	4.9	148.8	142	16	0	62	50
291.60	5.00	4.70	20		34.3	44.8	***151.5***	50.5	5.7	196.2	152	16	0	67	55
286.60	5.00	2.10			19.8	20.0	***162.8***	29.2	2.5	224.2	163	16	0	73	60
281.60	5.00	1.20			13.5	11.4	***191.5***	19.9	1.4	246.1	192	16	0	89	65
276.60	5.00	2.80			24.0	26.7	***188.9***	35.4	3.4	278.1	189	16	0	88	70
271.60	5.00		0	Fine Sand	0.0	0.0	***273.6***	0.0	0.0	288.8	274	16	0	134	75
270.60	1.00			Shale	41.1	84.8	***314.7***	60.5	10.7	349.3	315	16	0	157	76.2
269.60	1.00			Shale	41.1	84.8	***355.9***	60.5	10.7	409.8	~~356~~	~~16~~	~~0~~	~~179~~	~~77.2~~
268.60	1.00			Shale	41.1	84.8	***397.0***	60.5	10.7	470.4	~~397~~	~~16~~	~~0~~	~~202~~	~~78.2~~
267.60	1.00			Shale	41.1	84.8	***438.1***	60.5	10.7	530.9	~~438~~	~~16~~	~~0~~	~~225~~	~~79.2~~
266.60	1.00			Shale	41.1	84.8	***479.2***	60.5	10.7	591.4	~~479~~	~~16~~	~~0~~	~~247~~	~~80.2~~
265.60	1.00			Shale	41.1	84.8	***520.3***	60.5	10.7	651.9	~~520~~	~~16~~	~~0~~	~~270~~	~~81.2~~
264.60	1.00			Shale	41.1	84.8	***561.4***	60.5	10.7	712.5	~~561~~	~~16~~	~~0~~	~~292~~	~~82.2~~
263.60	1.00			Shale	41.1	84.8	***602.5***	60.5	10.7	773.0	~~603~~	~~16~~	~~0~~	~~315~~	~~83.2~~
262.60	1.00			Shale	41.1	84.8	***643.6***	60.5	10.7	833.5	~~644~~	~~16~~	~~0~~	~~338~~	~~84.2~~
261.60	1.00			Shale	41.1	84.8	***684.7***	60.5	10.7	894.0	~~685~~	~~16~~	~~0~~	~~360~~	~~85.2~~
260.60	1.00			Shale	41.1	84.8	***725.8***	60.5	10.7	954.5	~~726~~	~~16~~	~~0~~	~~383~~	~~86.2~~
259.60	1.00			Shale	41.1	84.8	***766.9***	60.5	10.7	1015.1	~~767~~	~~16~~	~~0~~	~~405~~	~~87.2~~
258.60	1.00			Shale	41.1	84.8	***808.0***	60.5	10.7	1075.6	~~808~~	~~16~~	~~0~~	~~428~~	~~88.2~~
257.60	1.00			Shale	41.1	84.8	***849.2***	60.5	10.7	1136.1	~~849~~	~~16~~	~~0~~	~~451~~	~~89.2~~
256.60	1.00			Shale	41.1	84.8	***890.3***	60.5	10.7	1196.6	~~890~~	~~16~~	~~0~~	~~473~~	~~90.2~~
255.60	1.00			Shale		84.8			10.7						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== 3-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 346.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 344.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 317.12 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 42.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 3
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 143.20 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 53.70 KIPS

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**335** KIPS	**167** KIPS	**79** FT.

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

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
342.10	2.70	0.80			5.3		8.1	7.7		***8.1***	8	3	0	2	5
339.60	2.50	0.30			2.0	2.9	***10.1***	2.9	0.4	11.1	10	4	0	2	7
337.10	2.50	0.30			2.0	2.9	***11.2***	2.9	0.4	13.9	11	5	0	1	10
334.60	2.50	0.20			1.4	1.9	24.0	2.0	0.2	***17.3***	17	6	0	4	12
332.10	2.50	1.40			7.6	13.3	***20.1***	11.1	1.7	27.0	20	10	0	1	15
329.60	2.50	0.20			1.4	1.9	***27.2***	2.0	0.2	29.7	27	11	0	4	17
327.10	2.50	0.80			4.9	7.6	***28.2***	7.2	1.0	36.4	28	13	0	2	20
324.60	2.50	0.40			2.6	3.8	***33.7***	3.9	0.5	40.6	34	15	0	4	22
322.10	2.50	0.70			4.3	6.7	***31.4***	6.4	0.8	46.2	31	17	0	0	25
319.60	2.50		0	Medium Sand	0.0	0.0	56.8	0.0	0.0	***49.4***	49	17	0	10	27
317.10	2.50		15	Medium Sand	2.3	25.4	55.7	3.3	3.2	***52.3***	52	17	0	12	30
314.60	2.50		13	Medium Sand	2.0	22.0	59.3	2.9	2.8	***55.4***	55	17	0	13	32
312.10	2.50		14	Medium Sand	2.1	23.7	61.4	3.1	3.0	***58.5***	58	17	0	15	35
309.60	2.50		14	Medium Sand	2.1	23.7	66.9	3.1	3.0	***62.0***	62	17	0	17	37
304.60	5.00		16	Medium Sand	4.8	27.1	72.2	7.1	3.4	***69.2***	69	17	0	21	42
299.60	5.00	2.90			24.6	27.7	108.3	36.3	3.5	***106.9***	107	17	0	42	47
294.60	5.00	4.10	30		31.9	39.1	***145.9***	46.9	4.9	154.5	146	17	0	63	52
289.60	5.00	4.70	20		34.3	44.8	***155.4***	50.5	5.7	201.9	155	17	0	68	57
284.60	5.00	2.10			19.8	20.0	***166.7***	29.2	2.5	230.0	167	17	0	74	62
279.60	5.00	1.20			13.5	11.4	***195.4***	19.9	1.4	251.8	195	17	0	90	67
274.60	5.00	2.80			24.0	26.7	***192.8***	35.4	3.4	283.8	193	17	0	89	72
269.60	5.00		0	Fine Sand	0.0	0.0	***277.5***	0.0	0.0	294.5	278	17	0	135	77
268.60	1.00			Shale	41.1	84.8	***318.6***	60.5	10.7	355.1	319	17	0	158	78.2
267.60	1.00			Shale	41.1	84.8	***359.8***	60.5	10.7	415.6	~~360~~	~~17~~	~~0~~	~~181~~	~~79.2~~
266.60	1.00			Shale	41.1	84.8	***400.9***	60.5	10.7	476.1	~~401~~	~~17~~	~~0~~	~~203~~	~~80.2~~
265.60	1.00			Shale	41.1	84.8	***442.0***	60.5	10.7	536.6	~~442~~	~~17~~	~~0~~	~~226~~	~~81.2~~
264.60	1.00			Shale	41.1	84.8	***483.1***	60.5	10.7	597.1	~~483~~	~~17~~	~~0~~	~~248~~	~~82.2~~
263.60	1.00			Shale	41.1	84.8	***524.2***	60.5	10.7	657.7	~~524~~	~~17~~	~~0~~	~~271~~	~~83.2~~
262.60	1.00			Shale	41.1	84.8	***565.3***	60.5	10.7	718.2	~~565~~	~~17~~	~~0~~	~~294~~	~~84.2~~
261.60	1.00			Shale	41.1	84.8	***606.4***	60.5	10.7	778.7	~~606~~	~~17~~	~~0~~	~~316~~	~~85.2~~
260.60	1.00			Shale	41.1	84.8	***647.5***	60.5	10.7	839.2	~~648~~	~~17~~	~~0~~	~~339~~	~~86.2~~
259.60	1.00			Shale	41.1	84.8	***688.6***	60.5	10.7	899.8	~~689~~	~~17~~	~~0~~	~~361~~	~~87.2~~
258.60	1.00			Shale	41.1	84.8	***729.7***	60.5	10.7	960.3	~~730~~	~~17~~	~~0~~	~~384~~	~~88.2~~
257.60	1.00			Shale	41.1	84.8	***770.8***	60.5	10.7	1020.8	~~771~~	~~17~~	~~0~~	~~407~~	~~89.2~~
256.60	1.00			Shale	41.1	84.8	***811.9***	60.5	10.7	1081.3	~~812~~	~~17~~	~~0~~	~~429~~	~~90.2~~
255.60	1.00			Shale	41.1	84.8	***853.1***	60.5	10.7	1141.8	~~853~~	~~17~~	~~0~~	~~452~~	~~91.2~~
254.60	1.00			Shale	41.1	84.8	***894.2***	60.5	10.7	1202.4	~~894~~	~~17~~	~~0~~	~~475~~	~~92.2~~
253.60	1.00			Shale		84.8			10.7						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== South Abut.
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 365.36 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 363.36 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 363.36 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 42.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 242.82 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 91.06 KIPS

PILE TYPE AND SIZE ========== Metal Shell 16"Φ w/.312" walls
Pile Perimeter========== 4.189 FT.
Pile End Bearing Area========== 1.396 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
654 KIPS	**392** KIPS	**216** KIPS	**55** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)				NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
360.50	2.86	0.70			9.9		***16.0***				16	0	0	9	5
358.00	2.50	0.40			5.2	6.1	***27.3***				27	0	0	15	7
355.50	2.50	0.80			9.7	12.3	***41.6***				42	0	0	23	10
353.00	2.50	1.10			12.6	16.8	***100.1***				100	0	0	55	12
350.50	2.50	4.10	16		31.7	62.8	***128.7***				129	0	0	71	15
348.00	2.50	3.90	19		30.5	59.7	***165.3***				165	0	0	91	17
345.50	2.50	4.30	20		32.9	65.9	***179.8***				180	0	0	99	20
343.00	2.50	3.10	15		25.7	47.5	***223.9***				224	0	0	123	22
340.50	2.50	4.30	19		32.9	65.9	***253.7***				254	0	0	140	25
338.00	2.50	4.10	18		31.7	62.8	***311.4***				311	0	0	171	27
335.50	2.50	5.80	20		34.1	88.8	***316.4***				316	0	0	174	30
333.00	2.50	3.90	19		30.5	59.7	***319.3***				319	0	0	176	32
330.50	2.50	2.10			19.7	32.2	***332.8***				333	0	0	183	35
325.50	5.00	1.70			34.3	26.0	***347.3***				347	0	0	191	40
320.50	5.00	0.40			10.4	6.1	***386.7***				387	0	0	213	45
315.50	5.00		4	Fine Sand	7.3	35.2	***364.9***				365	0	0	201	50
310.50	5.00	0.40			10.4	6.1	***392.2***				392	0	0	216	55
305.50	5.00	1.50			31.5	23.0	***743.5***				~~744~~	~~0~~	~~0~~	~~409~~	~~60~~
300.50	5.00		52	Hard Till	71.6	342.8	***683.3***				~~683~~	~~0~~	~~0~~	~~376~~	~~65~~
295.50	5.00		32	Hard Till	36.9	210.9	***572.0***				572	0	0	315	70
290.50	5.00	4.10	28		63.4	62.8	***620.1***				620	0	0	341	75
280.50	10.00	3.10	20		102.7	47.5	***710.5***				~~711~~	~~0~~	~~0~~	~~391~~	~~85~~
276.00	4.50	2.30	8		37.6	35.2	***765.6***				~~766~~	~~0~~	~~0~~	~~421~~	~~89~~
270.50	5.50		8	Very Fine Silty Sand	14.5	52.7	***859.2***				~~859~~	~~0~~	~~0~~	~~473~~	~~95~~
270.00	0.50		20	Hard Till	2.3	131.8	***1169.2***				~~1169~~	~~0~~	~~0~~	~~643~~	~~95~~
269.00	1.00			Shale	263.7	439.5	***1432.9***				~~1433~~	~~0~~	~~0~~	~~788~~	~~96.4~~
268.00	1.00			Shale	263.7	439.5	***1696.5***				~~1697~~	~~0~~	~~0~~	~~933~~	~~97.4~~
267.00	1.00			Shale	263.7	439.5	***1960.2***				~~1960~~	~~0~~	~~0~~	~~1078~~	~~98.4~~
266.00	1.00			Shale	263.7	439.5	***2223.9***				~~2224~~	~~0~~	~~0~~	~~1223~~	~~99.4~~
265.00	1.00			Shale	263.7	439.5	***2487.6***				~~2488~~	~~0~~	~~0~~	~~1368~~	~~100.4~~
264.00	1.00			Shale	263.7	439.5	***2751.3***				~~2751~~	~~0~~	~~0~~	~~1513~~	~~101.4~~
263.00	1.00			Shale	263.7	439.5	***3015.0***				~~3015~~	~~0~~	~~0~~	~~1658~~	~~102.4~~
262.00	1.00			Shale	263.7	439.5	***3278.7***				~~3279~~	~~0~~	~~0~~	~~1803~~	~~103.4~~
261.00	1.00			Shale	263.7	439.5	***3542.3***				~~3542~~	~~0~~	~~0~~	~~1948~~	~~104.4~~
260.00	1.00			Shale	263.7	439.5	***3806.0***				~~3806~~	~~0~~	~~0~~	~~2093~~	~~105.4~~
259.00	1.00			Shale	263.7	439.5	***4069.7***				~~4070~~	~~0~~	~~0~~	~~2238~~	~~106.4~~
258.00	1.00			Shale	263.7	439.5	***4333.4***				~~4333~~	~~0~~	~~0~~	~~2383~~	~~107.4~~
257.00	1.00			Shale		439.5									