STRUCTURE GEOTECHNICAL REPORT

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

Ex. S.N. 083-0001
Pr. S.N. 083-0073

F.A.P. ROUTE 332 (US-45)
SECTION 29B-3
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

Authored By:
Matthew D. Masterson, P.E.
Christoph Opperman, E.I.
Kaskaskia Engineering Group, LLC
208 East Main Street, Suite 100
Belleville, Illinois 62220
mmasterson@kaskaskiaeng.com
618-233-5877

Prepared for:
Crawford, Murphy & Tilly
2750 West Washington Street
Springfield, Illinois 62702

November 6, 2020

Revised August 16, 2022

Kaskaskia
Engineering Group, LLC

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 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 083-0073) carrying US-45 over North Fork Saline River. 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 083-0073) located at US-45 over North Fork Saline River will consist of a 3-span structures built on a 0°skew from the centerline of US-45 at the local tangent to Station 721+23.00. The structure will have a width of 42'-10". The structure will be located at approximate station 721+23.00 (US-45). Integral abutments and piers are proposed for the substructures.

The structure will measure 231'-0", from back-to-back of abutments. The structure will support two 12' lanes, with shoulder widths of 8'-0". The structure is to be removed and replaced using staged construction to always maintain one lane of traffic. 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).

Two standard penetration test (SPT) borings, designated 1-S and 2-S, were drilled between May 11 and 17, 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 and 2-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	722+48 - Revised *(739+97)*	27' Rt - Revised *(10' Lt CL)*	369.1
2-S	719+79 - Revised *(737+28)*	48' Rt - Revised *(11' Lt CL)*	368.4

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. Clay - From the surface of each boring, approximately 15 to 15.5 ft. of clay was encountered. The driving resistances (N-values) ranged from 3 to 24 blows per foot (bpf), and unconfined compressive strength (Qu) values ranged between 0.6 to 6.1 tons per square foot (tsf). The moisture contents ranged from 18 to 31 percent.

2. Silty Clay/Silty Clay Loam - Below the clay, silty clay/silty clay loam was encountered to depths of 70 to 103 feet. The N-values ranged from 2 to 27 bpf, and Qu values ranged from 0.2 to 3.5 tsf. The moisture contents varied from 18 to 28 percent.

3. Clay - Boring 1-S encountered a layer of stiff to medium stiff clay below the silty clay layers to a depth of 99.5 feet. The N-values ranged from 2 to 24 bpf, and the moisture contents varied from 24 to 28 percent. Qu values ranged from

4. Sand Loam/Sandy Clay Loam - Below the clays in Boring 1-S, sand loam and sandy clay loam were encountered to a depth of 109.5 feet. The N-value of this layer was 0 bpf. The moisture content was 25 percent. The Qu value was 0.2 tsf.

5. Clay Shale - Below the sand loam/sandy clay loam in Boring 1-S and below the Silty Clay Loam in 2-S, clay shale was encountered in boring 1-S and 2-S, at depths of 103.5 to 109.5 ft. with blow counts of 100 blows for 2 to 8-inches of penetration.

2.2 Bedrock

Table 2.2 shows the elevations of top of clay shale for Borings 1-S and 2-S.

Table 2.2 - Elevation of Top of Clay Shale

Designation	Station	Offset	Top of Clay Shale Elevation (ft.)
1-S	722+48 - Revised *(739+97)*	27’ Rt - Revised *(10’ Lt CL)*	257.1
2-S	719+79 - Revised *(737+28)*	48’ Rt - Revised *(11’ Lt CL)*	265.4

2.3 Groundwater

Groundwater was encountered in Borings 1-S and 2-S at El. 334.1 and El. 330.9. The surface elevation the North Fork Saline River at the time of drilling was El. 339.1.

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 will result in new end-slopes at the abutment locations and new side-slopes 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 and Seismic cases where excess pore water pressure from construction has dissipated. For clay and silty clay materials, a nominal cohesion between 50 and 200 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	1.7	1.5	1.0
South Abutment	1V:2H	2.6	1.5	1.0

In order for the seismic condition to achieve the minimum required factor of safety of 1.0, the proposed piles for the abutments and piers, and the existing timber piles (to remain in place) were included in the stability model. The stability analysis showed that a maximum pile spacing of 8 feet is required at both the abutments and piers. The results of the analysis, as provided in Table 3.2, indicate an acceptable FOS will exist at the north and south abutments under short-term, long-term, and seismic 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}	0.884g (Site Class E)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.484g (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
	South Abutment	Pier 1	Pier 2	North Abutment	
Q_{100}	363.33	318.75	317.12	363.31	5
Q_{200}	363.33	315.17	312.74	363.31	
Design	363.33	318.75	317.12	363.31	
Check	363.33	315.17	312.74	363.31	

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 and 2-S were analyzed for the south and north abutments, 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. 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 depth 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, as provided by Illinois Department of Transportation – Bureau of Bridges and Structures (IDOT BBS) Foundations and Geotechnical Unit, was used to estimate the capacities of the driven piles in 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	1100
Piers	2600

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 4.2.5 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 at the piers, a reduction in factored resistance available was taken into consideration at the Pier locations.

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	179	77	365.30
Pier 1	335	174	72	335.50
Pier 2	335	178	80	335.50
North Abutment	335	180	86	365.31

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	229	87	365.30
Pier 1	418	217	72	335.50
Pier 2	418	223	80	335.50
North Abutment	418	224	96	365.31

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	101	365.30
Pier 1	497	260	73	335.50
Pier 2	497	266	81	335.50
North Abutment	497	273	108	365.31

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	101	365.30
Pier 1	578	303	73	335.50
Pier 2	578	309	81	335.50
North Abutment	578	318	108	365.31

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	102	365.30
Pier 1	705	372	75	335.50
Pier 2	705	379	83	335.50
North Abutment	705	388	109	365.31

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	303	167	47	365.30
	342	188	52	
	*377	207	57	
Pier 1	243	118	47	335.50
	280	138	57	
	*288	143	67	
Pier 2	258	133	56	335.50
	278	144	66	
	*305	159	76	
North Abutment	309	170	56	365.31
	335	184	61	
	*362	199	66	

- ❖ Metal Shell does not achieve maximum nominal capacity at the piers prior to reaching the underlying shale where driving may damage pile

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	359	198	47	365.30
	404	222	52	
	*444	244	57	
Pier 1	286	139	47	335.50
	327	162	57	
	*337	167	67	
Pier 2	302	156	56	335.50
	324	168	66	
	*360	188	76	
North Abutment	367	202	56	365.31
	394	216	61	
	426	234	66	

- Metal Shell does not achieve maximum nominal capacity at the piers prior to reaching the underlying shale where driving may damage pile

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	497	273	67	365.30
	529	291	72	
	*558	307	77	
Pier 1	286	139	47	335.50
	327	162	57	
	*337	167	67	
Pier 2	302	156	56	335.50
	324	168	66	
	*360	188	76	
North Abutment	477	262	71	365.31
	512	282	76	
	565	311	86	

- Metal Shell does not achieve maximum nominal capacity at the piers prior to reaching the underlying shale where driving may damage pile

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	571	314	67	365.30
	608	335	72	
	641	352	77	
Pier 1	330	161	47	335.50
	374	185	57	
	*385	191	67	
Pier 2	347	179	56	335.50
	371	192	66	
	*417	218	76	
North Abutment	552	304	71	365.31
	590	324	76	
	647	356	86	

- Metal Shell does not achieve maximum nominal capacity at the piers prior to reaching the underlying shale where driving may damage pile

1

KEG recommends one (1) test pile be performed near Pier 2. 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 manner in which 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	% fines < #200	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)				
1-S	354.6	125	0	1600	26	150	7	80	500	0.007
	334.6	125	0	3900	26	150	18	80	1000	0.005
	314.6	110	0	500	28	100	4	65	100	0.010
	279.6	120	0	2400	26	100	15	65	1000	0.005
	259.6	115	0	400	28	50	1	65	30	0.020
	257.1	110	34	2500	34	200	54	3	125	--

Boring	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term		N	% fines < #200	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)				
	240.0	125	12	5000	12	5000	100	--	2000	0.004
2-S	353.4	125	0	1300	26	200	4	80	500	0.007
	334.4	125	0	4400	26	150	17	80	2000	0.004
	318.4	120	0	700	26	100	7	65	100	0.010
	298.4	120	0	2700	26	100	19	65	1000	0.005
	278.4	125	0	1600	26	100	11	80	500	0.007
	265.4	110	0	200	28	50	5	65	30	0.020
	257.9	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. The foundation soils below the pier encasements are anticipated to be cohesive and sealcoats 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

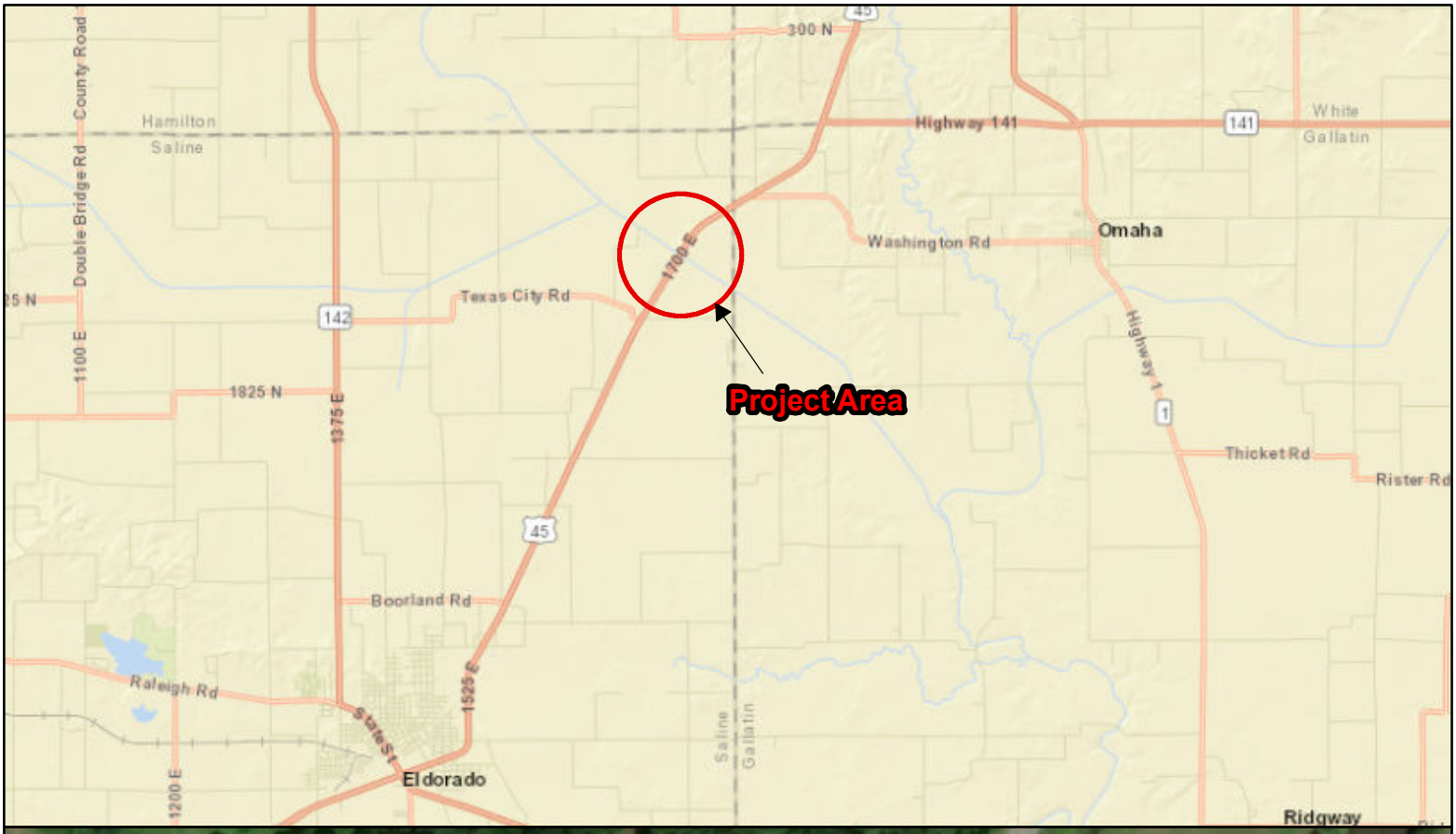
Soil borings can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

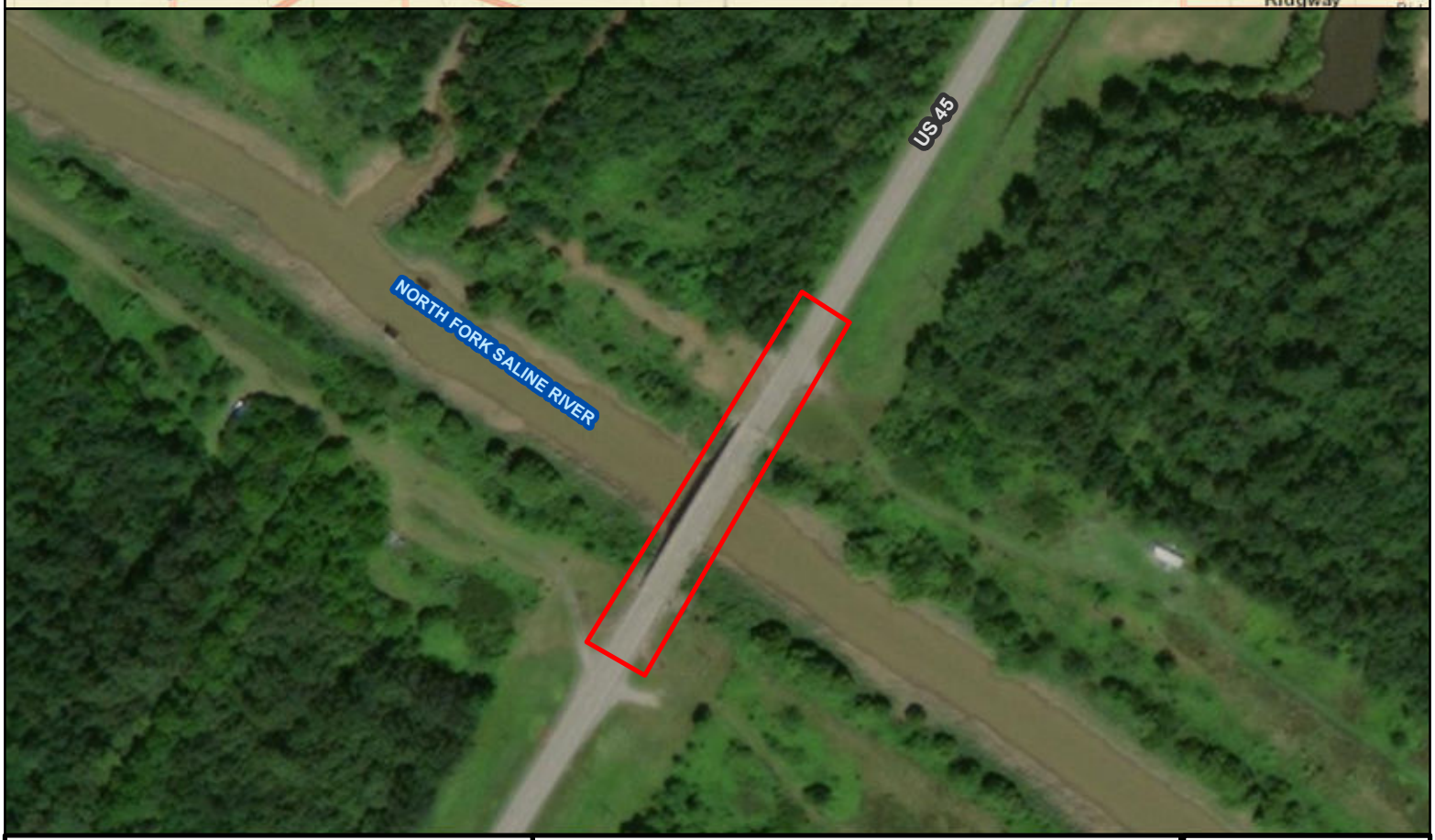
8.0 LIMITATIONS

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 two 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 083-0001
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 NE corner of Structure 083-0001 along US 45, Sta. 722+20, Offset 17' Rt., Elevation 370.51.

SALVAGE:

None

EXISTING STRUCTURE:

SN 083-0001 was originally built in 1953 under SB1-1, Section 29-B-Y. The structure is a 3-span continuous bridge with stub abutments and an overall length of 221'-11" 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 treated timber piles. The structure is to be removed and replaced using stage 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.

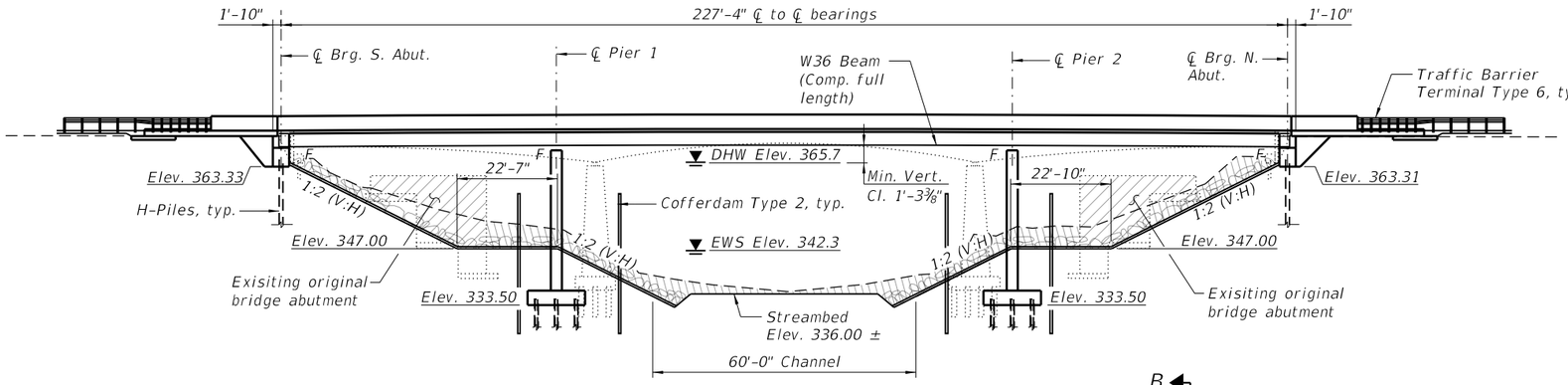
SEISMIC DATA:

Seismic Peformance 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

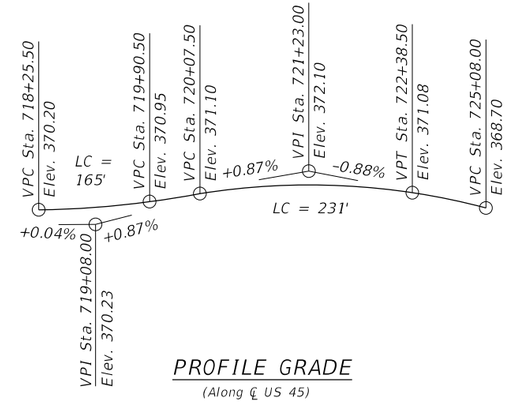
DESIGN STRESSES:

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)

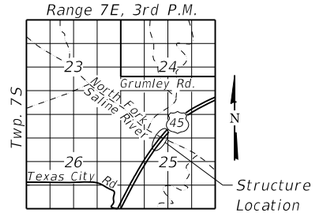


ELEVATION

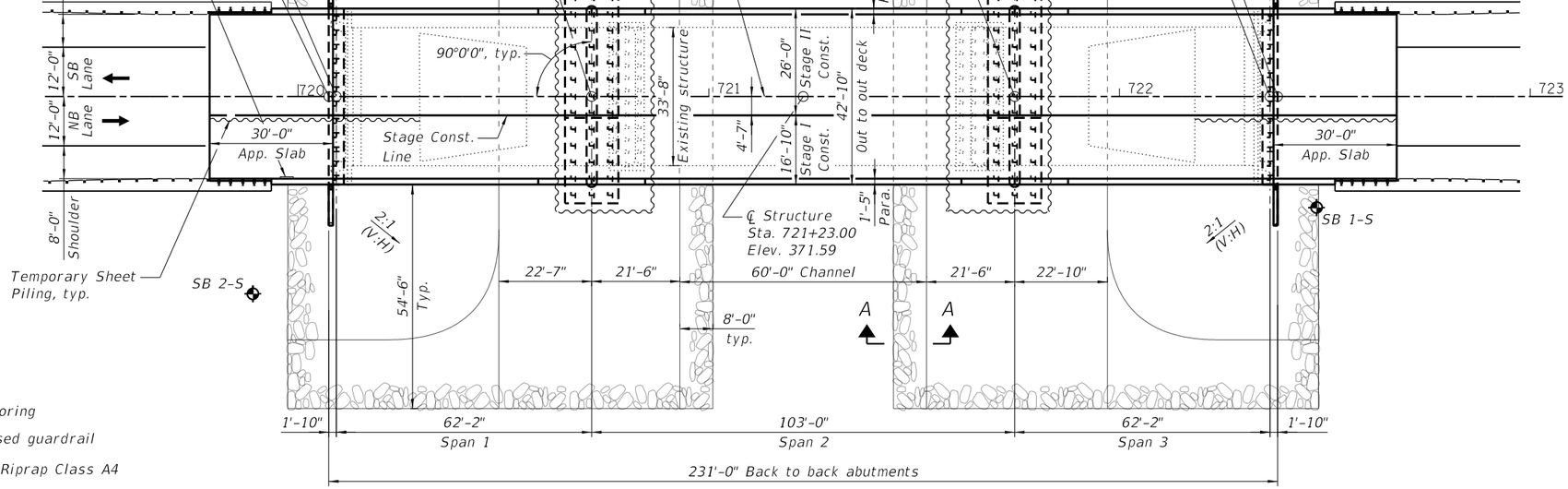


PROFILE GRADE

(Along ℄ US 45)



LOCATION SKETCH



PLAN

LEGEND

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

Notes:
1. See Sheet 2 of 25 for Section A-A and B-B.
2. See Roadway Plans for Channel Excavation limits and quantity.

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

Ahmad T. Idriss
EXP. 11-30-2022

"I certify that to the best of my knowledge, information and belief, this design is structurally adequate for the design loading shown on the plans. The design is an economical one for the style of the structure and complies with the requirements of the current Design Specifications listed."

GENERAL PLAN
US ROUTE 45
OVER NORTH FORK SALINE RIVER
FAP ROUTE 332 - SECTION (29B-3)
SALINE COUNTY
STA. 721+23.00
STRUCTURE NO. 083-0073

FILE NAME: I:\IDOT\190661\0\WO_10\Drawn\Structures\CADD_Sheets\SN 083-0073\09787 18-sht+SN 083-0073_01_GPE.dgn

CMT
License No. 184-000613 ©Copyright CMT, Inc.

USER NAME = Denise Herrera	DESIGNED - DH	REVISED -	
	DRAWN - DH	REVISED -	
PLOT SCALE = N/A	CHECKED - ATI	REVISED -	
PLOT DATE = 5/3/2022 (8:20:41 AM)	DATE - 05/03/2022	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
SN 083-0073

SCALE: | SHEET 1 OF 25 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	29B-3	SALINE	143	54
		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 North Fork Saline River — Sheet 1 of 3

Route: FAP 332 (US 45) Structure Number: 083-0001 Date: 5/11/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 1 mile North of Texas City Checked By: R Graeff

Boring No 1-S
Station 739+97
Offset 10' Lt CL
Ground Surface 369.1 Ft

Surf Wat Elev: 339.1
Ground Water Elevation
when Drilling 334.1
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, brown, Clay A7-6				Hard, damp, brown streaked grey, Clay A7-6	9	5.0B	23
					12		
	2				4		
	6	2.6S	24		11	5.4B	23
	8				13		
5.0	1			30.0	3		
	3	2.1B	27		7	4.0S	28
	4				9		
362.1				337.1			
Stiff, moist, brown, Clay A7-6	1			Very stiff, moist, brown, Clay A7-6	4		
	2	1.2B	27		8	3.7B	19
	3				12		
359.6				334.6			
Medium, very moist, brown, Clay A7-6	10.0 1			Stiff, very moist, brown mottled grey, Silty Clay to Silty Clay Loam A-6	35.0 1		
	2	0.6B	31		4	1.2B	22
	2				5		
357.1				332.1			
Stiff, moist, grey, Clay A7-6	1			Very soft, very moist, brown, Silty Clay Loam A-6	WH		
	2	1.4B	27		1	0.2B	28
	3				1		
354.6							
Very stiff, moist, brown and grey, Clay A7-6	15.0 3				40.0 WH		
	6	2.4S	22		1	0.2B	19
	8				1		
352.1							
Hard, damp, brown streaked grey, Clay A7-6	3						
	6	6.1B	18				
	9						
				324.6			
	20.0 3			Very soft, very moist, grey, Silty Clay Loam A-4 with Sand seams	45.0 WH		
	8	4.1B	20		1	0.2B	20
	10				1		
	3						
	8	4.1B	21				
	10						
				319.6			
	25.0 3				50.0 1		

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: 5/11/2010

Boring No: 1-S
Station: 739+97
Offset: 10' Lt CL
Ground Surface: 369.1 Ft

	DEPTH	BLOWS	Qu tsf	W%
Medium, very moist, grey, Silty Clay A-6 with Sand layers		2 3	0.8B	23
	314.6			
Stiff, moist, grey, Silty Clay Loam A-6	55.0	1 5 9	1.5B	18
	309.6			
Very stiff, moist, grey, Silty Clay A-6	60.0	3 9 15	3.5B	21
	304.6			
Stiff, moist, grey, Silty Clay A7-6	65.0	3 5 7	1.6B	25
	70.0	2 4 6	1.9B	26
	294.6			
	75.0	3		
Very stiff, moist, grey, Clay A7-6		9 15	3.5B	24
	80.0	1		
		3 5	2.3B	28
	85.0			
	279.6			
Medium, very moist, grey, Clay A7-6 with Sand and Silt seams	90.0	WH 1 1	0.6B	24
	95.0			
	269.6			
	100.0	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: 5/11/2010

Boring No: 1-S
Station: 739+97
Offset: 10' Lt CL
Ground Surface: 369.1 Ft

	DEPTH	BLOWS	Qu tsf	W%
Very loose, wet, grey, Sand Loam to Sandy Clay Loam A-4 with Sand seams		WH	0.2B	25
		WH		
	105.0			
	259.6			
Dense, moist, blue grey, Sand Loam A-4 with pea gravel	110.0	19		
		24	2.5S	22
		30		
	257.1			
Hard, dry, grey, Clay Shale				
	115.0	100/3"		
	120.0	100/2"		
Hard, dry, grey, Clay Shale				
	244.1	125.0	100/2"	

Bottom of hole = 124.7 feet

Free water observed at 35.0 feet

Elevation referenced to BM at NE wingwall; Elev.= 370.5 feet

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

DEPTH	BLOWS	Qu tsf	W%
130.0			
135.0			
140.0			
145.0			
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 North Fork Saline River — Sheet 1 of 3

Route: FAP 332 (US 45) Structure Number: 083-0001 Date: 5/17/2010

Section 29-B-Y Bored By: R Moberly

County: Saline Location: 1 mile North of Texas City Checked By: R Graeff

Boring No 2-S
Station 737+28
Offset 11' Lt CL
Ground Surface 368.4 Ft

Surf Wat Elev: 339.1
Ground Water Elevation
when Drilling 330.9
At Completion
At: Hrs:

	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, brown, Clay A7-6				
		1		
		2	1.2B	27
		3		
	5.0			
		1		
		1	1.1B	29
		2		
		1		
		1	1.1B	28
		2		
	358.4 10.0			
Stiff, moist, grey, Clay A7-6		1		
		2	1.1B	29
		2		
		1		
		3	1.8B	27
		3		
	353.4 15.0			
Very stiff, moist, brown mottled grey, Clay A7-6		3		
		6	2.8S	19
		8		
	350.9			
Hard, damp to moist, brown, Clay A7-6 with Silt lenses		3		
		7	5.8B	25
		9		
	20.0			
		3		
		7	4.1B	19
		9		
		3		
		8	4.0B	22
		10		
	343.4 25.0			

	DEPTH	BLOWS	Qu tsf	W%
Hard, damp to moist, brown, Clay A7-6		3		
		9	5.0B	24
		11		
		3		
		9	4.3B	25
		10		
	30.0			
		2		
		7	5.0B	24
		7		
		3		
		8	4.5B	23
	334.4	10		
	35.0			
Soft, very moist, brown, Silty Clay A-6		1		
		2	0.3B	23
		3		
	330.9			
Soft, very moist, brown, Silty Clay A-6 with Sand layers		1		
		3	0.3B	21
		5		
	328.4 40.0			
Stiff, moist to very moist, brown, Silty Clay to Silty Clay Loam A-6 with Sand layers		2		
		4	1.4S	22
		4		
	323.4 45.0			
Medium, very moist, grey, Silty Clay to Clay A7-6 with Sand seams and layers		1		
		3	0.7B	21
		3		
	318.4 50.0			

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: 5/17/2010

Boring No: 2-S
Station: 737+28
Offset: 11' Lt CL
Ground Surface: 368.4 Ft

	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, grey, Silty Clay to Silty Clay Loam A-6		2		
		7	3.3B	19
		10		
	55.0			
		8		
		13	3.1B	20
		14		
	60.0			
		3		
		7	2.7B	25
		11		
303.4	65.0			
Stiff, moist to very moist, grey, Silty Clay A7-6		2		
		5	1.6B	26
		7		
298.4	70.0			
Stiff, moist, grey, Clay A7-6		2		
		4	1.3B	26
		6		
293.4	75.0			

	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey, Clay to Silty Clay A7-6		3		
		6	1.9B	27
		8		
	80.0			
		2		
		3	1.6B	27
		5		
	85.0			
278.4	90.0			
Very soft, very moist, grey, Silt Loam to Silty Clay Loam A-4		2		
		4	0.2B	21
		3		
	95.0			
268.4	100.0			

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: 5/17/2010

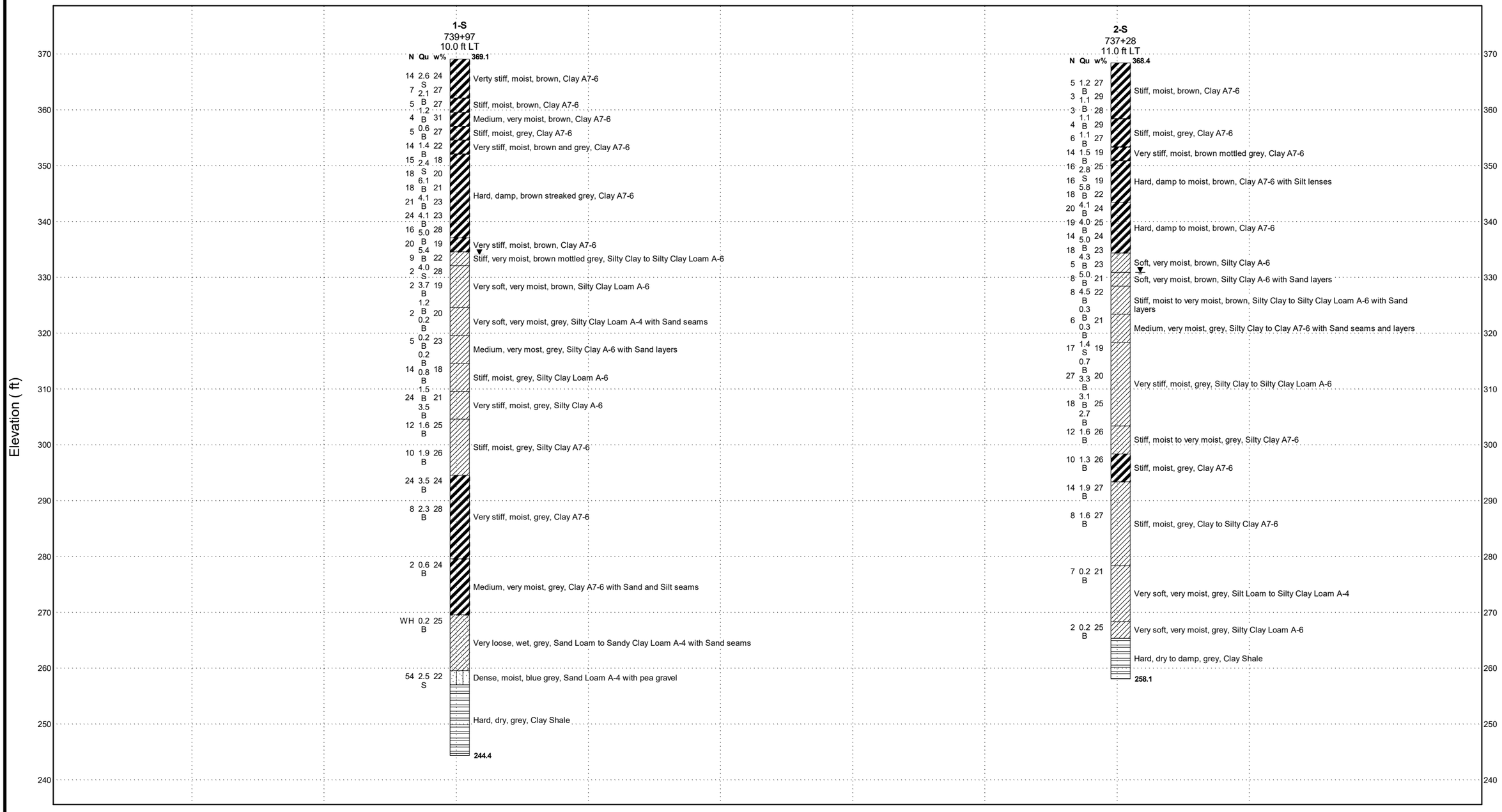
Boring No: 2-S
Station: 737+28
Offset: 11' Lt CL
Ground Surface: 368.4 Ft

DEPTH	BLOWS	Qu tsf	W%
Very soft, very moist, grey, Silty Clay Loam A-6	WH		
	1	0.2B	25
	1		
265.4			
Hard, dry to damp, grey, Clay Shale			
105.0			
	100/8"		
Hard, dry, grey, Clay Shale 110.0			
257.9	100/4"		
Bottom of hole = 110.3 feet			
Free water observed at 37.5 feet			
Elevation referenced to BM at NE wingwall; Elev.= 370.5 feet			
To convert "N" values to "N60" multiply by 1.25			
115.0			
120.0			
125.0			
130.0			
135.0			
140.0			
145.0			
150.0			

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 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

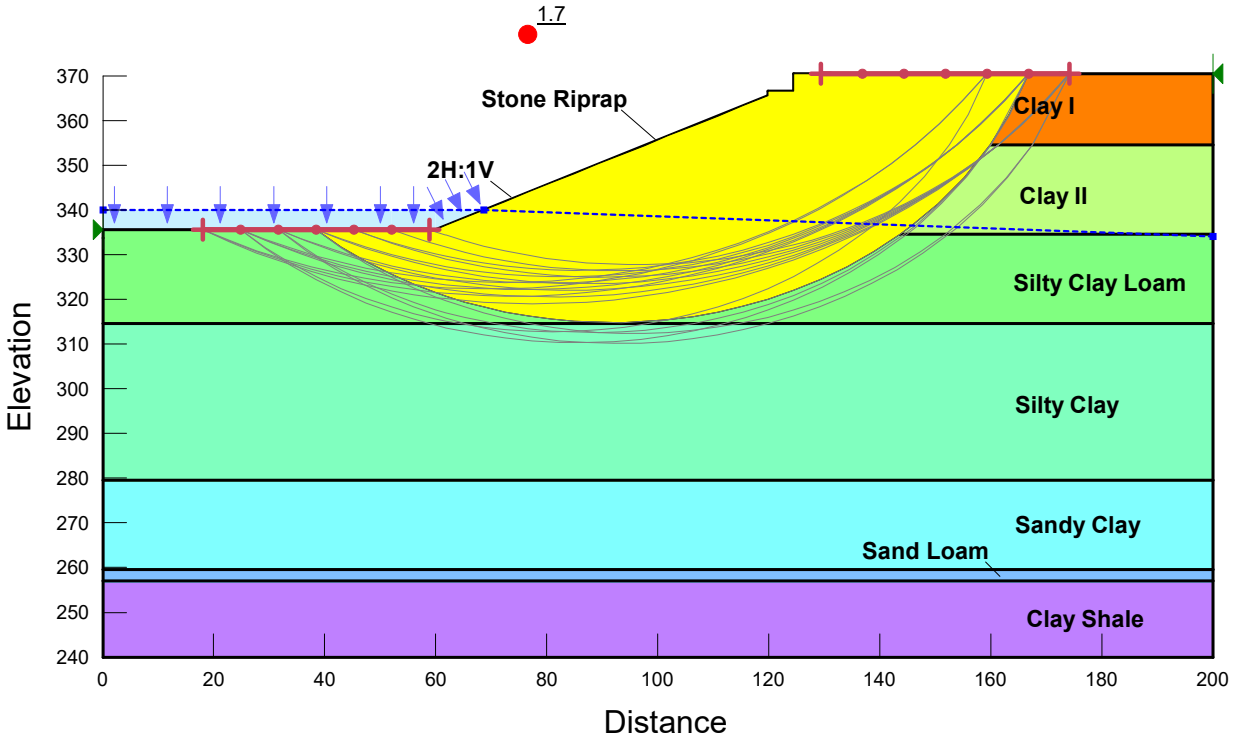
SUBSURFACE DATA PROFILE

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

EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS

US 45 over N Fork Saline River
SN 083-0001 North Abutment - Boring 1-S
End-of-construction (Undrained Condition)



Name: Clay I
Unit Weight: 125 pcf
Cohesion': 1,600 psf
Phi': 0 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 3,900 psf
Phi': 0 °

Name: Silty Clay Loam
Unit Weight: 110 pcf
Cohesion': 500 psf
Phi': 0 °

Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 2,400 psf
Phi': 0 °

Name: Sandy Clay
Unit Weight: 115 pcf
Cohesion': 400 psf
Phi': 0 °

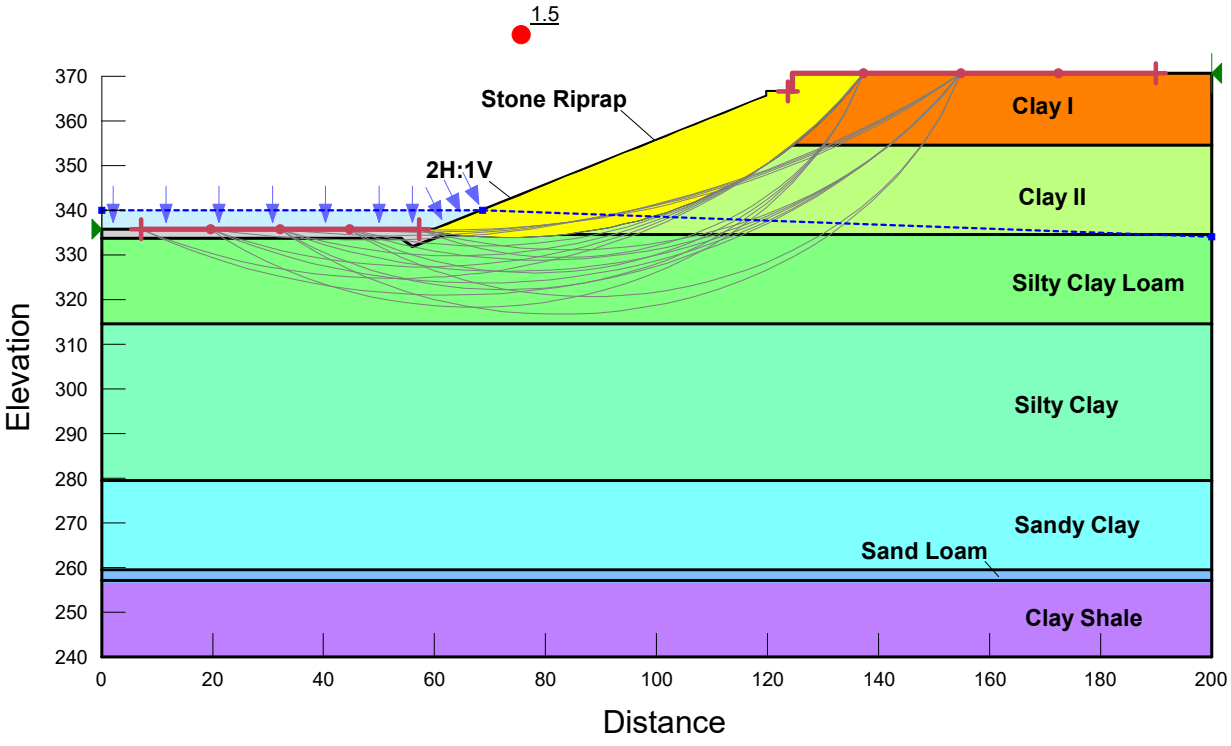
Name: Sand Loam
Unit Weight: 110 pcf
Cohesion': 2,500 psf
Phi': 34 °

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

Name: Concrete
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °

Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

US 45 over N Fork Saline River
SN 083-0001 North Abutment - Boring 1-S
Long Term Analysis (Drained Condition)



Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 26 °

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

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

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

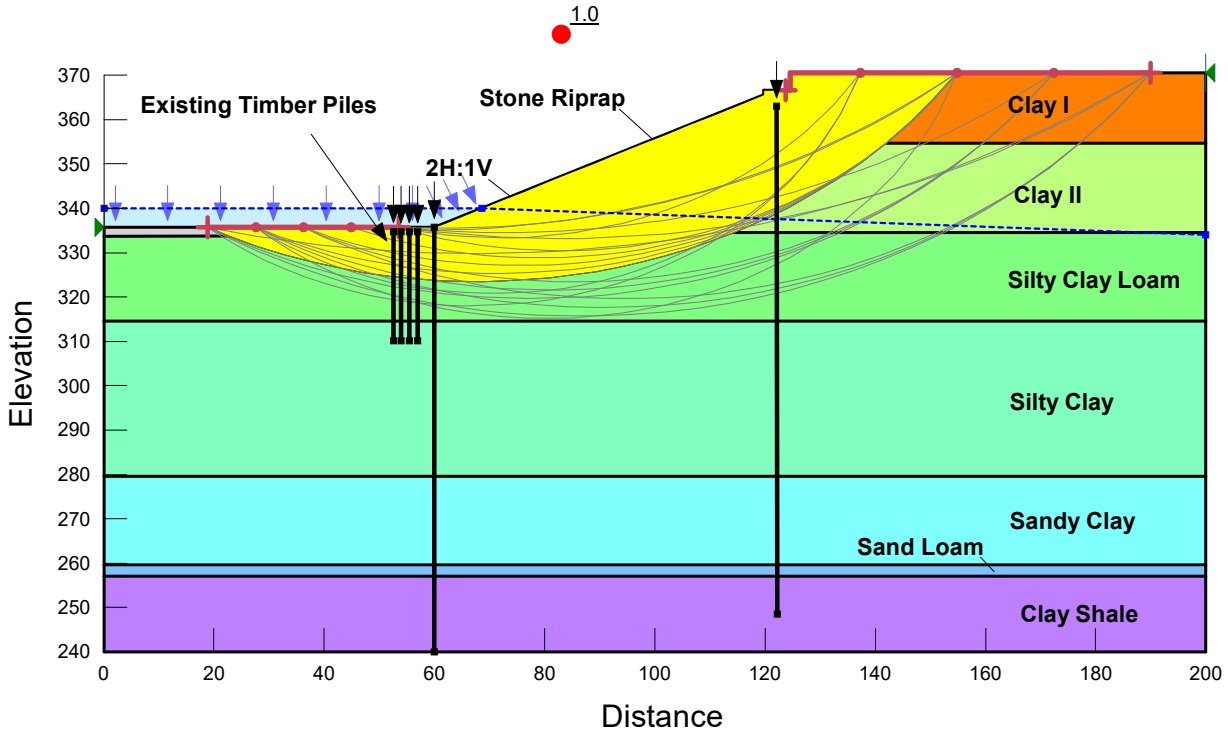
Name: Sand Loam
Unit Weight: 110 pcf
Cohesion': 200 psf
Phi': 34 °

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

Name: Concrete
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °

Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

US 45 over N Fork Saline River
SN 083-0001 North Abutment - Boring 1-S
Long Term Analysis (Drained Condition)
Seismic PGA 0.292g
8' Pile Spacing (Abutment and Pier)



Name: Clay I
Unit Weight: 125 pcf
Cohesion': 200 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 26 °

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

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

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

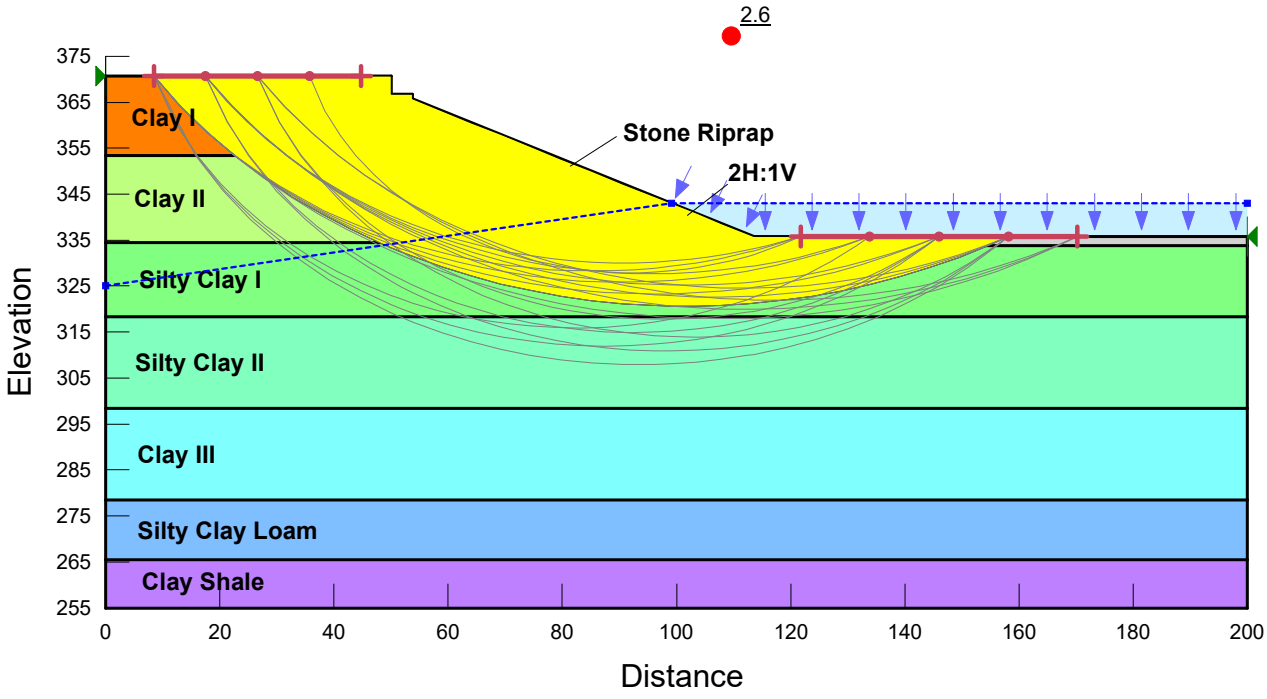
Name: Sand Loam
Unit Weight: 110 pcf
Cohesion': 200 psf
Phi': 34 °

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

Name: Concrete
Unit Weight: 150 pcf

Name: Rip Rap
Unit Weight: 145 pcf
Phi': 42 °

US 45 over N Fork Saline River
SN 083-0001 South Abutment - Boring 2-S
End-of-construction (Undrained Condition)



Unit Weight: 125 pcf
Cohesion': 1,300 psf
Phi': 0 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 4,400 psf
Phi': 0 °

Name: Silty Clay I
Unit Weight: 120 pcf
Cohesion': 700 psf
Phi': 0 °

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 2,700 psf
Phi': 0 °

Name: Clay III
Unit Weight: 125 pcf
Cohesion': 1,600 psf
Phi': 0 °

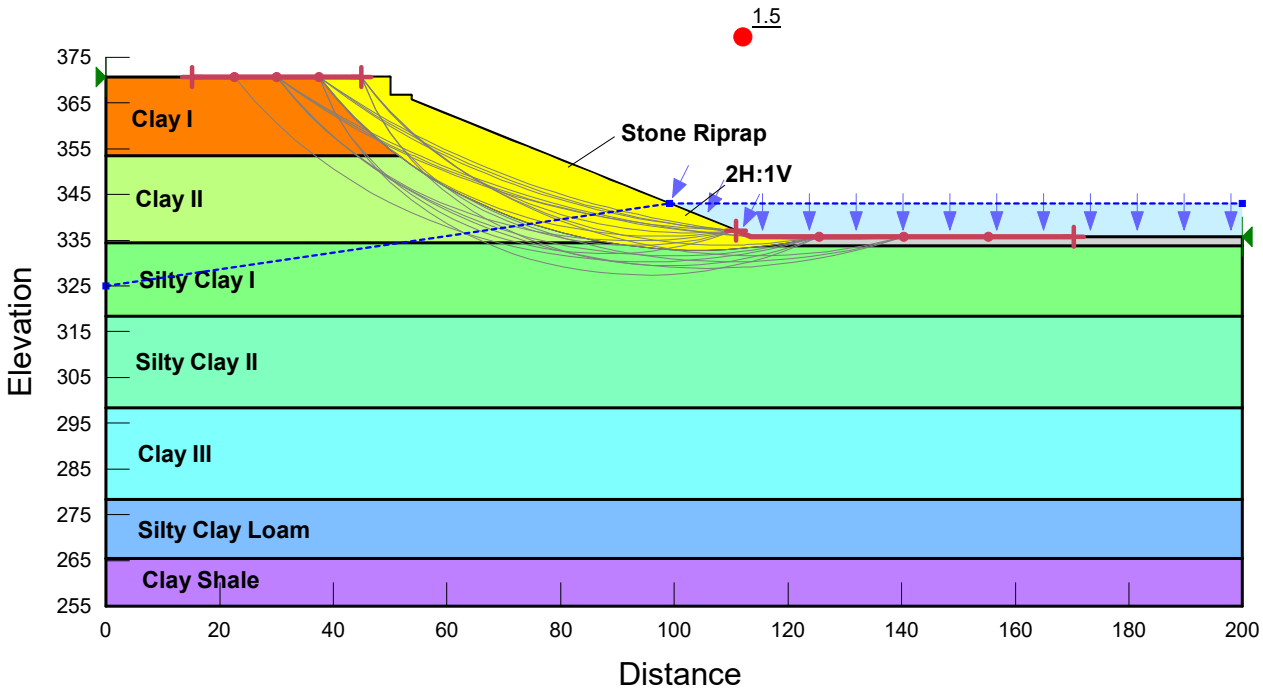
Name: Silty Clay Loam
Unit Weight: 110 pcf
Cohesion': 200 psf
Phi': 0 °

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

Name: Concrete
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °

Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

US 45 over N Fork Saline River
SN 083-0001 South Abutment - Boring 2-S
Long Term Analysis (Drained Condition)



Unit Weight: 125 pcf
Cohesion': 200 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 26 °

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

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

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

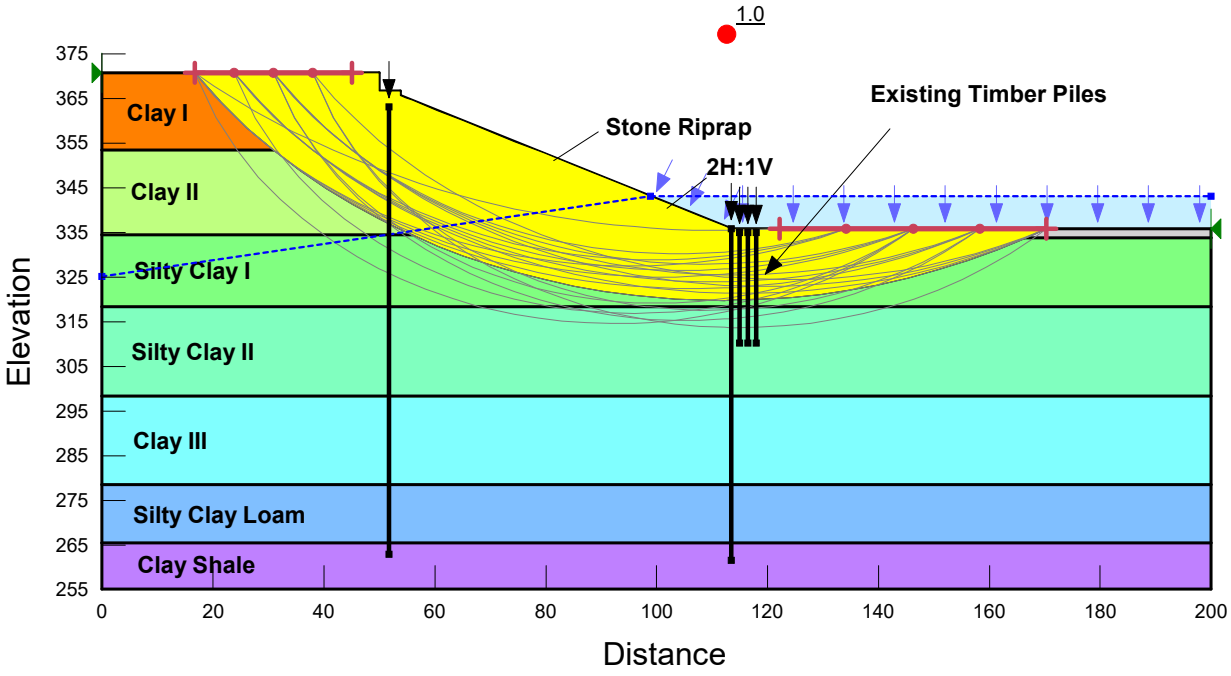
Name: Silty Clay Loam
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 28 °

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

Name: Concrete
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °

Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

US 45 over N Fork Saline River
SN 083-0001 South Abutment - Boring 2-S
Long Term Analysis (Drained Condition)
Seismic PGA 0.292g
8' Pile Spacing (Abutment and Pier)



Name: Clay I
Unit Weight: 125 pcf
Cohesion': 200 psf
Phi': 26 °

Name: Clay II
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 26 °

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

Name: Silty Clay II
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

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

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

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

Name: Concrete
Unit Weight: 150 pcf

Name: Rip Rap
Unit Weight: 145 pcf
Phi': 42 °

EXHIBIT F

LIQUEFACTION ANALYSES RESULTS

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 1-S N. Abut
ELEVATION OF BORING GROUND SURFACE ========== 369.10 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 35.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 35.00 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) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **483** 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. RESISTANCE $\frac{CRR_{7.5}}{CRR}$	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
367.1	2	14	2.6		12	14	24	0.133	0.266	30.051	30.051	0.471	0.133	0.266	0.266	1.500	**0.707**	0.988	**0.129**	**N.L. (1)**
364.6	4.5	7	2.1				27	0.130	0.591	12.066	12.066	0.132	0.130	0.591	0.591	1.366	**0.180**	0.971	**0.127**	**N.L. (1)**
362.1	7	5	1.2				27	0.124	0.901	7.814	7.814	0.094	0.124	0.901	0.901	1.205	**0.114**	0.950	**0.124**	**N.L. (1)**
359.6	9.5	4	0.6				31	0.116	1.191	6.183	6.183	0.081	0.116	1.191	1.191	1.127	**0.091**	0.926	**0.121**	**N.L. (1)**
357.1	12	5	1.4				27	0.125	1.504	7.555	7.555	0.092	0.125	1.504	1.504	1.077	**0.099**	0.899	**0.117**	**N.L. (1)**
354.6	14.5	14	2.4				22	0.132	1.834	21.280	21.280	0.232	0.132	1.834	1.834	1.045	**0.242**	0.868	**0.113**	**N.L. (1)**
352.1	17	15	6.1				18	0.144	2.194	21.650	21.650	0.237	0.144	2.194	2.194	0.990	**0.235**	0.835	**0.109**	**N.L. (1)**
349.6	19.5	18	4.1				20	0.139	2.541	25.072	25.072	0.293	0.139	2.541	2.541	0.943	**0.276**	0.800	**0.104**	**N.L. (1)**
347.1	22	18	4.1				21	0.139	2.889	23.587	23.587	0.266	0.139	2.889	2.889	0.907	**0.242**	0.764	**0.100**	**N.L. (1)**
344.6	24.5	21	5				23	0.142	3.244	26.423	26.423	0.323	0.142	3.244	3.244	0.868	**0.280**	0.730	**0.095**	**N.L. (1)**
342.1	27	24	5.4				23	0.143	3.601	28.965	28.965	0.409	0.143	3.601	3.601	0.831	**0.339**	0.697	**0.091**	**N.L. (1)**
339.6	29.5	16	4				28	0.139	3.949	17.332	17.332	0.184	0.139	3.949	3.949	0.842	**0.155**	0.666	**0.087**	**N.L. (1)**
337.1	32	20	3.7				19	0.138	4.294	21.059	21.059	0.229	0.138	4.294	4.294	0.809	**0.185**	0.639	**0.084**	**N.L. (1)**
334.6	34.5	9	1.2				22	0.124	4.604	8.807	8.807	0.103	0.124	4.604	4.604	0.841	**0.086**	0.616	**0.080**	**N.L. (1)**
332.1	37	2	0.2		12	12	22	0.042	4.709	1.935	1.935	0.053	0.042	4.709	4.833	0.852	**0.045**	0.595	**0.080**	**N.L. (2)**
329.6	39.5	2	0.2		12	19	19	0.042	4.814	1.913	1.913	0.052	0.042	4.814	5.094	0.849	**0.045**	0.579	**0.080**	**N.L. (2)**
324.6	44.5	2	0.2		12	10	20	0.042	5.024	1.871	1.871	0.052	0.042	5.024	5.616	0.842	**0.044**	0.554	**0.081**	**N.L. (2)**
319.6	49.5	5	0.8		12	13	23	0.057	5.309	4.529	4.529	0.069	0.057	5.309	6.213	0.832	**0.057**	0.538	**0.082**	**N.L. (2)**
314.6	54.5	14	1.5		12	8	18	0.064	5.629	12.230	12.230	0.133	0.064	5.629	6.845	0.787	**0.105**	0.527	**0.084**	**N.L. (2)**
309.6	59.5	24	3.5		12	11	21	0.074	5.999	20.666	20.666	0.224	0.074	5.999	7.527	0.733	**0.164**	0.521	**0.085**	**N.L. (2)**
304.6	64.5	12	1.6		12	15	25	0.065	6.324	9.688	9.688	0.110	0.065	6.324	8.164	0.778	**0.086**	0.518	**0.087**	**N.L. (2)**
299.6	69.5	10	1.9		12	16	26	0.067	6.659	7.781	7.781	0.094	0.067	6.659	8.811	0.780	**0.073**	0.506	**0.087**	**N.L. (2)**
294.6	74.5	24	3.5		12	14	24	0.074	7.029	18.237	18.237	0.194	0.074	7.029	9.493	0.712	**0.139**	0.499	**0.088**	**N.L. (2)**
289.6	79.5	8	2.3		12	18	28	0.069	7.374	5.788	5.788	0.078	0.069	7.374	10.150	0.774	**0.060**	0.492	**0.088**	**N.L. (2)**
279.6	89.5	2	0.6		12	14	24	0.053	7.904	1.374	1.374	0.050	0.053	7.904	11.304	0.769	**0.039**	0.478	**0.089**	**N.L. (2)**
269.6	99.5	1	0.2		12	15	25	0.042	8.324	0.649	0.649	0.049	0.042	8.324	12.348	0.761	**0.037**	0.464	**0.090**	**N.L. (2)**
259.6	109.5	54	2.5				22	0.070	9.024	31.046	31.046	0.564	0.070	9.024	13.672	0.591	**0.333**	0.450	**0.089**	**N.L. (3)**

* 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 ========== 368.40 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 37.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 37.50 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) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **496** 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. RESISTANCE $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
365.9	2.5	5	1.2				27	0.124	0.310	9.432	9.432	0.108	0.124	0.310	0.310	1.500	**0.162**	0.987	**0.129**	**N.L. (1)**
363.4	5	3	1.1				29	0.123	0.618	5.109	5.109	0.073	0.123	0.618	0.618	1.281	**0.093**	0.971	**0.127**	**N.L. (1)**
360.9	7.5	3	1.1				28	0.123	0.925	4.686	4.686	0.070	0.123	0.925	0.925	1.180	**0.082**	0.952	**0.124**	**N.L. (1)**
358.4	10	4	1.1				29	0.123	1.233	6.196	6.196	0.081	0.123	1.233	1.233	1.119	**0.091**	0.929	**0.121**	**N.L. (1)**
355.9	12.5	6	1.8				27	0.128	1.553	9.041	9.041	0.105	0.128	1.553	1.553	1.073	**0.112**	0.903	**0.118**	**N.L. (1)**
353.4	15	14	2.8				19	0.134	1.888	21.125	21.125	0.230	0.134	1.888	1.888	1.036	**0.238**	0.874	**0.114**	**N.L. (1)**
350.9	17.5	16	5.8				25	0.144	2.248	23.100	23.100	0.259	0.144	2.248	2.248	0.982	**0.254**	0.842	**0.110**	**N.L. (1)**
348.4	20	16	4.1				19	0.139	2.595	21.746	21.746	0.238	0.139	2.595	2.595	0.940	**0.224**	0.808	**0.106**	**N.L. (1)**
345.9	22.5	18	4				22	0.139	2.943	23.378	23.378	0.263	0.139	2.943	2.943	0.902	**0.237**	0.774	**0.101**	**N.L. (1)**
343.4	25	20	5				24	0.142	3.298	24.769	24.769	0.287	0.142	3.298	3.298	0.867	**0.249**	0.740	**0.097**	**N.L. (1)**
340.9	27.5	19	4.3				25	0.140	3.648	22.034	22.034	0.242	0.140	3.648	3.648	0.847	**0.205**	0.708	**0.092**	**N.L. (1)**
338.4	30	14	5				24	0.142	4.003	14.852	14.852	0.159	0.142	4.003	4.003	0.847	**0.134**	0.678	**0.089**	**N.L. (1)**
335.9	32.5	18	4.5				23	0.140	4.353	18.562	18.562	0.198	0.140	4.353	4.353	0.815	**0.161**	0.651	**0.085**	**N.L. (1)**
333.4	35	5	0.3				23	0.108	4.623	4.883	4.883	0.071	0.108	4.623	4.623	0.856	**0.061**	0.627	**0.082**	**N.L. (1)**
330.9	37.5	8	0.3				21	0.108	4.893	7.554	7.554	0.092	0.108	4.893	4.893	0.835	**0.077**	0.607	**0.079**	**N.L. (1)**
328.4	40	8	1.4	12	12	22	0.063	5.050	7.420	7.420	0.091	0.063	5.050	5.206	0.829	**0.076**	0.590	**0.080**	**N.L. (2)**
323.4	45	6	0.7	12	11	21	0.055	5.325	5.400	5.400	0.075	0.055	5.325	5.793	0.830	**0.062**	0.565	**0.080**	**N.L. (2)**
318.4	50	17	3.3	12	9	19	0.074	5.695	14.684	14.684	0.157	0.074	5.695	6.475	0.773	**0.121**	0.549	**0.081**	**N.L. (2)**
313.4	55	27	3.1	12	10	20	0.073	6.060	23.353	23.353	0.263	0.073	6.060	7.152	0.718	**0.189**	0.538	**0.083**	**N.L. (2)**
308.4	60	18	2.7	12	15	25	0.071	6.415	14.375	14.375	0.154	0.071	6.415	7.819	0.751	**0.116**	0.532	**0.085**	**N.L. (2)**
303.4	65	12	1.6	12	16	26	0.065	6.740	9.254	9.254	0.107	0.065	6.740	8.456	0.769	**0.082**	0.522	**0.086**	**N.L. (2)**
298.4	70	10	1.3	12	16	26	0.062	7.050	7.463	7.463	0.091	0.062	7.050	9.078	0.772	**0.071**	0.515	**0.087**	**N.L. (2)**
293.4	75	14	1.9	12	17	27	0.067	7.385	10.102	10.102	0.114	0.067	7.385	9.725	0.748	**0.085**	0.508	**0.087**	**N.L. (2)**
288.4	80	8	1.6	12	17	27	0.065	7.710	5.599	5.599	0.077	0.065	7.710	10.362	0.768	**0.059**	0.501	**0.088**	**N.L. (2)**
278.4	90	7	0.2	12	11	21	0.042	8.130	4.708	4.708	0.070	0.042	8.130	11.406	0.764	**0.053**	0.487	**0.089**	**N.L. (2)**
268.4	100	2	0.2	12	15	25	0.042	8.550	1.268	1.268	0.050	0.042	8.550	12.450	0.757	**0.038**	0.473	**0.090**	**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. ========== 365.31 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 363.31 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 363.31 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1100 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 ========== 205.46 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 77.05 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	**327** KIPS	**180** KIPS	**86** 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.)
361.91	1.40	2.10			5.5		17.0	8.2		***9.6***	10	0	0	5	3
359.41	2.50	1.20			6.8	11.4	***18.0***	10.0	1.4	18.8	18	0	0	10	6
356.91	2.50	0.60			3.8	5.7	29.4	5.6	0.7	***25.4***	25	0	0	14	8
354.41	2.50	1.40			7.6	13.3	46.5	11.1	1.7	***37.7***	38	0	0	21	11
351.91	2.50	2.40			10.8	22.9	92.6	15.9	2.9	***58.1***	58	0	0	32	13
349.41	2.50	6.10	15		17.1	58.2	90.7	25.2	7.4	***80.9***	81	0	0	45	16
346.91	2.50	4.10	18		15.9	39.1	106.7	23.5	4.9	***104.4***	104	0	0	57	18
344.41	2.50	4.10	18		15.9	39.1	131.2	23.5	4.9	***129.0***	129	0	0	71	21
341.91	2.50	5.00	21		17.1	47.7	***152.1***	25.2	6.0	154.7	152	0	0	84	23
339.41	2.50	5.40	24		17.1	51.5	***155.9***	25.2	6.5	178.3	156	0	0	86	26
336.91	2.50	4.00	16		15.6	38.1	***168.7***	23.0	4.8	200.9	169	0	0	93	28
334.41	2.50	3.70	20		14.7	35.3	***159.6***	21.7	4.5	219.6	160	0	0	88	31
331.91	2.50	1.20			6.8	11.4	***156.9***	10.0	1.4	228.4	157	0	0	86	33
329.41	2.50	0.20			1.4	1.9	***158.2***	2.0	0.2	230.3	158	0	0	87	36
324.41	5.00	0.20			2.7	1.9	***160.9***	4.0	0.2	234.3	161	0	0	89	41
319.41	5.00	0.20			2.7	1.9	***169.3***	4.0	0.2	239.1	169	0	0	93	46
314.41	5.00	0.80			9.7	7.6	***185.8***	14.3	1.0	254.2	186	0	0	102	51
309.41	5.00	1.50			15.9	14.3	***220.7***	23.4	1.8	280.0	221	0	0	121	56
304.41	5.00	3.50	24		28.3	33.4	***230.9***	41.6	4.2	319.3	231	0	0	127	61
299.41	5.00	1.60			16.6	15.3	***250.3***	24.4	1.9	344.1	250	0	0	138	66
294.41	5.00	1.90			18.6	18.1	***284.1***	27.4	2.3	373.4	284	0	0	156	71
289.41	5.00	3.50	24		28.3	33.4	***301.0***	41.6	4.2	413.6	301	0	0	166	76
279.41	10.00	2.30			42.0	21.9	***326.8***	61.9	2.8	473.4	327	0	0	180	86
269.41	10.00	0.60			15.2	5.7	***338.1***	22.3	0.7	495.2	~~338~~	~~0~~	~~0~~	~~186~~	~~96~~
259.41	10.00	0.20			5.4	1.9	***365.5***	8.0	0.2	506.0	~~365~~	~~0~~	~~0~~	~~201~~	~~106~~
256.91	2.50	2.50			11.1	23.8	***437.5***	16.4	3.0	530.1	~~438~~	~~0~~	~~0~~	~~241~~	~~108~~
255.91	1.00			Shale	41.1	84.8	***478.6***	60.5	10.7	590.6	~~479~~	~~0~~	~~0~~	~~263~~	~~109.4~~
254.91	1.00			Shale	41.1	84.8	***519.7***	60.5	10.7	651.1	~~520~~	~~0~~	~~0~~	~~286~~	~~110.4~~
253.91	1.00			Shale	41.1	84.8	***560.8***	60.5	10.7	711.6	~~561~~	~~0~~	~~0~~	~~308~~	~~111.4~~
252.91	1.00			Shale	41.1	84.8	***601.9***	60.5	10.7	772.2	~~602~~	~~0~~	~~0~~	~~331~~	~~112.4~~
251.91	1.00			Shale	41.1	84.8	***643.1***	60.5	10.7	832.7	~~643~~	~~0~~	~~0~~	~~354~~	~~113.4~~
250.91	1.00			Shale	41.1	84.8	***684.2***	60.5	10.7	893.2	~~684~~	~~0~~	~~0~~	~~376~~	~~114.4~~
249.91	1.00			Shale	41.1	84.8	***725.3***	60.5	10.7	953.7	~~725~~	~~0~~	~~0~~	~~399~~	~~115.4~~
248.91	1.00			Shale	41.1	84.8	***766.4***	60.5	10.7	1014.2	~~766~~	~~0~~	~~0~~	~~422~~	~~116.4~~
247.91	1.00			Shale	41.1	84.8	***807.5***	60.5	10.7	1074.8	~~807~~	~~0~~	~~0~~	~~444~~	~~117.4~~
246.91	1.00			Shale	41.1	84.8	***848.6***	60.5	10.7	1135.3	~~849~~	~~0~~	~~0~~	~~467~~	~~118.4~~
245.91	1.00			Shale	41.1	84.8	***889.7***	60.5	10.7	1195.8	~~890~~	~~0~~	~~0~~	~~489~~	~~119.4~~
244.91	1.00			Shale		84.8			10.7						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 335.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 333.50 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) ========== 0.00 ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 2600 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 ========== 161.88 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 60.71 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	**174** KIPS	**72** 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.)
330.90	2.60	0.30			2.1		4.9	3.1		***3.4***	3	1	0	1	5
328.40	2.50	0.30			2.0	2.9	17.4	2.9	0.4	***7.7***	8	2	0	2	7
323.40	5.00	1.40			15.1	13.3	***25.9***	22.3	1.7	29.1	26	11	0	4	12
318.40	5.00	0.70			8.7	6.7	59.4	12.8	0.8	***45.0***	45	11	0	14	17
313.40	5.00	3.30	17		27.1	31.5	***84.5***	39.8	4.0	84.6	85	11	0	36	22
308.40	5.00	3.10	27		25.8	29.6	***106.5***	38.1	3.7	122.2	107	11	0	48	27
303.40	5.00	2.70	18		23.4	25.7	***119.5***	34.5	3.3	155.4	119	11	0	55	32
298.40	5.00	1.60			16.6	15.3	***133.2***	24.4	1.9	179.4	133	11	0	63	37
293.40	5.00	1.30			14.3	12.4	***153.3***	21.1	1.6	201.3	153	11	0	74	42
288.40	5.00	1.90			18.6	18.1	***169.0***	27.4	2.3	228.3	169	11	0	82	47
278.40	10.00	1.60			33.2	15.3	***188.8***	48.8	1.9	275.4	189	11	0	93	57
268.40	10.00	0.20			5.4	1.9	***194.3***	8.0	0.2	283.4	194	11	0	96	67
265.40	3.00	0.20			1.6	1.9	***278.7***	2.4	0.2	296.3	279	11	0	143	70
264.40	1.00			Shale	41.1	84.8	***319.8***	60.5	10.7	356.8	320	11	0	165	71.1
263.40	1.00			Shale	41.1	84.8	***360.9***	60.5	10.7	417.3	~~361~~	~~11~~	~~0~~	~~188~~	~~72.1~~
262.40	1.00			Shale	41.1	84.8	***402.1***	60.5	10.7	477.9	~~402~~	~~11~~	~~0~~	~~211~~	~~73.1~~
261.40	1.00			Shale	41.1	84.8	***443.2***	60.5	10.7	538.4	~~443~~	~~11~~	~~0~~	~~233~~	~~74.1~~
260.40	1.00			Shale	41.1	84.8	***484.3***	60.5	10.7	598.9	~~484~~	~~11~~	~~0~~	~~256~~	~~75.1~~
259.40	1.00			Shale	41.1	84.8	***525.4***	60.5	10.7	659.4	~~525~~	~~11~~	~~0~~	~~278~~	~~76.1~~
258.40	1.00			Shale	41.1	84.8	***566.5***	60.5	10.7	719.9	~~566~~	~~11~~	~~0~~	~~301~~	~~77.1~~
257.40	1.00			Shale	41.1	84.8	***607.6***	60.5	10.7	780.5	~~608~~	~~11~~	~~0~~	~~324~~	~~78.1~~
256.40	1.00			Shale	41.1	84.8	***648.7***	60.5	10.7	841.0	~~649~~	~~11~~	~~0~~	~~346~~	~~79.1~~
255.40	1.00			Shale	41.1	84.8	***689.8***	60.5	10.7	901.5	~~690~~	~~11~~	~~0~~	~~369~~	~~80.1~~
254.40	1.00			Shale	41.1	84.8	***730.9***	60.5	10.7	962.0	~~731~~	~~11~~	~~0~~	~~391~~	~~81.1~~
253.40	1.00			Shale	41.1	84.8	***772.0***	60.5	10.7	1022.6	~~772~~	~~11~~	~~0~~	~~414~~	~~82.1~~
252.40	1.00			Shale	41.1	84.8	***813.1***	60.5	10.7	1083.1	~~813~~	~~11~~	~~0~~	~~437~~	~~83.1~~
251.40	1.00			Shale	41.1	84.8	***854.2***	60.5	10.7	1143.6	~~854~~	~~11~~	~~0~~	~~459~~	~~84.1~~
250.40	1.00			Shale	41.1	84.8	***895.4***	60.5	10.7	1204.1	~~895~~	~~11~~	~~0~~	~~482~~	~~85.1~~
249.40	1.00			Shale	41.1	84.8	***936.5***	60.5	10.7	1264.6	~~936~~	~~11~~	~~0~~	~~504~~	~~86.1~~
248.40	1.00			Shale	41.1	84.8	***977.6***	60.5	10.7	1325.2	~~978~~	~~11~~	~~0~~	~~527~~	~~87.1~~
247.40	1.00			Shale	41.1	84.8	***1018.7***	60.5	10.7	1385.7	~~1019~~	~~11~~	~~0~~	~~550~~	~~88.1~~
246.40	1.00			Shale	41.1	84.8	***1059.8***	60.5	10.7	1446.2	~~1060~~	~~11~~	~~0~~	~~572~~	~~89.1~~
245.40	1.00			Shale	41.1	84.8	***1100.9***	60.5	10.7	1506.7	~~1101~~	~~11~~	~~0~~	~~595~~	~~90.1~~
244.40	1.00			Shale	41.1	84.8	***1142.0***	60.5	10.7	1567.2	~~1142~~	~~11~~	~~0~~	~~618~~	~~91.1~~
243.40	1.00			Shale	41.1	84.8	***1183.1***	60.5	10.7	1627.8	~~1183~~	~~11~~	~~0~~	~~640~~	~~92.1~~
242.40	1.00			Shale	41.1	84.8	***1224.2***	60.5	10.7	1688.3	~~1224~~	~~11~~	~~0~~	~~663~~	~~93.1~~
241.40	1.00			Shale	41.1	84.8	***1265.3***	60.5	10.7	1748.8	~~1265~~	~~11~~	~~0~~	~~685~~	~~94.1~~
240.40	1.00			Shale		84.8			10.7						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 335.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 333.50 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 ========== 2600 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 ========== 161.88 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 60.71 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	**178** KIPS	**80** 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.)
332.10	1.40	1.20			3.8		***5.7***	5.6		5.8	6	2	0	1	3
329.60	2.50	0.20			1.4	1.9	***7.0***	2.0	0.2	7.8	7	3	0	1	6
324.60	5.00	0.20			2.7	1.9	***9.8***	4.0	0.2	11.8	10	4	0	1	11
319.60	5.00	0.20			2.7	1.9	18.2	4.0	0.2	***16.5***	17	6	0	3	16
314.60	5.00	0.80			9.7	7.6	34.6	14.3	1.0	***31.7***	32	6	0	12	21
309.60	5.00	1.50			15.9	14.3	69.5	23.4	1.8	***57.5***	57	6	0	26	26
304.60	5.00	3.50	24		28.3	33.4	***79.7***	41.6	4.2	96.8	80	6	0	38	31
299.60	5.00	1.60			16.6	15.3	***99.1***	24.4	1.9	121.6	99	6	0	49	36
294.60	5.00	1.90			18.6	18.1	***133.0***	27.4	2.3	150.9	133	6	0	67	41
289.60	5.00	3.50	24		28.3	33.4	***149.8***	41.6	4.2	191.0	150	6	0	77	46
279.60	10.00	2.30			42.0	21.9	***175.6***	61.9	2.8	250.9	176	6	0	91	56
269.60	10.00	0.60			15.2	5.7	***187.0***	22.3	0.7	272.7	187	6	0	97	66
259.60	10.00	0.20			5.4	1.9	***214.3***	8.0	0.2	283.5	214	6	0	112	76
257.10	2.50	2.50			11.1	23.8	***286.4***	16.4	3.0	307.5	286	6	0	152	78
256.10	1.00			Shale	41.1	84.8	***327.5***	60.5	10.7	368.1	327	6	0	174	79.4
255.10	1.00			Shale	41.1	84.8	***368.6***	60.5	10.7	428.6	~~369~~	~~6~~	~~0~~	~~197~~	~~80.4~~
254.10	1.00			Shale	41.1	84.8	***409.7***	60.5	10.7	489.1	~~410~~	~~6~~	~~0~~	~~220~~	~~81.4~~
253.10	1.00			Shale	41.1	84.8	***450.8***	60.5	10.7	549.6	~~451~~	~~6~~	~~0~~	~~242~~	~~82.4~~
252.10	1.00			Shale	41.1	84.8	***491.9***	60.5	10.7	610.1	~~492~~	~~6~~	~~0~~	~~265~~	~~83.4~~
251.10	1.00			Shale	41.1	84.8	***533.0***	60.5	10.7	670.7	~~533~~	~~6~~	~~0~~	~~287~~	~~84.4~~
250.10	1.00			Shale	41.1	84.8	***574.1***	60.5	10.7	731.2	~~574~~	~~6~~	~~0~~	~~310~~	~~85.4~~
249.10	1.00			Shale	41.1	84.8	***615.2***	60.5	10.7	791.7	~~615~~	~~6~~	~~0~~	~~333~~	~~86.4~~
248.10	1.00			Shale	41.1	84.8	***656.3***	60.5	10.7	852.2	~~656~~	~~6~~	~~0~~	~~355~~	~~87.4~~
247.10	1.00			Shale	41.1	84.8	***697.4***	60.5	10.7	912.7	~~697~~	~~6~~	~~0~~	~~378~~	~~88.4~~
246.10	1.00			Shale	41.1	84.8	***738.6***	60.5	10.7	973.3	~~739~~	~~6~~	~~0~~	~~400~~	~~89.4~~
245.10	1.00			Shale	41.1	84.8	***779.7***	60.5	10.7	1033.8	~~780~~	~~6~~	~~0~~	~~423~~	~~90.4~~
244.10	1.00			Shale	41.1	84.8	***820.8***	60.5	10.7	1094.3	~~821~~	~~6~~	~~0~~	~~446~~	~~91.4~~
243.10	1.00			Shale	41.1	84.8	***861.9***	60.5	10.7	1154.8	~~862~~	~~6~~	~~0~~	~~468~~	~~92.4~~
242.10	1.00			Shale	41.1	84.8	***903.0***	60.5	10.7	1215.3	~~903~~	~~6~~	~~0~~	~~491~~	~~93.4~~
241.10	1.00			Shale	41.1	84.8	***944.1***	60.5	10.7	1275.9	~~944~~	~~6~~	~~0~~	~~513~~	~~94.4~~
240.10	1.00			Shale	41.1	84.8	***985.2***	60.5	10.7	1336.4	~~985~~	~~6~~	~~0~~	~~536~~	~~95.4~~
239.10	1.00			Shale	41.1	84.8	***1026.3***	60.5	10.7	1396.9	~~1026~~	~~6~~	~~0~~	~~559~~	~~96.4~~
238.10	1.00			Shale	41.1	84.8	***1067.4***	60.5	10.7	1457.4	~~1067~~	~~6~~	~~0~~	~~581~~	~~97.4~~
237.10	1.00			Shale	41.1	84.8	***1108.5***	60.5	10.7	1518.0	~~1109~~	~~6~~	~~0~~	~~604~~	~~98.4~~
236.10	1.00			Shale	41.1	84.8	***1149.6***	60.5	10.7	1578.5	~~1150~~	~~6~~	~~0~~	~~626~~	~~99.4~~
235.10	1.00			Shale	41.1	84.8	***1190.7***	60.5	10.7	1639.0	~~1191~~	~~6~~	~~0~~	~~649~~	~~100.4~~
234.10	1.00			Shale	41.1	84.8	***1231.9***	60.5	10.7	1699.5	~~1232~~	~~6~~	~~0~~	~~672~~	~~101.4~~
233.10	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. ========== 365.33 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 363.33 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 363.33 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1100 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 ========== 205.46 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 77.05 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	**325** KIPS	**179** 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.)
360.90	2.43	1.10			6.1		16.6	9.0		***10.4***	10	0	0	6	4
358.40	2.50	1.10			6.3	10.5	23.0	9.3	1.3	***19.7***	20	0	0	11	7
355.90	2.50	1.10			6.3	10.5	36.0	9.3	1.3	***29.8***	30	0	0	16	9
353.40	2.50	1.80			9.0	17.2	54.5	13.2	2.2	***44.3***	44	0	0	24	12
350.90	2.50	2.80			12.0	26.7	95.1	17.7	3.4	***65.6***	66	0	0	36	14
348.40	2.50	5.80	16		17.1	55.3	96.0	25.2	7.0	***88.8***	89	0	0	49	17
345.90	2.50	4.10	16		15.9	39.1	***111.0***	23.5	4.9	112.1	111	0	0	61	19
343.40	2.50	4.00	18		15.6	38.1	***136.2***	23.0	4.8	136.3	136	0	0	75	22
340.90	2.50	5.00	20		17.1	47.7	***146.7***	25.2	6.0	160.7	147	0	0	81	24
338.40	2.50	4.30	19		16.5	41.0	***169.9***	24.4	5.2	186.0	170	0	0	93	27
335.90	2.50	5.00	14		17.1	47.7	***182.3***	25.2	6.0	210.6	182	0	0	100	29
333.40	2.50	4.50	18		17.1	42.9	***159.4***	25.2	5.4	230.8	159	0	0	88	32
330.90	2.50	0.30			2.0	2.9	***161.4***	2.9	0.4	233.7	161	0	0	89	34
328.40	2.50	0.30			2.0	2.9	***173.9***	2.9	0.4	238.0	174	0	0	96	37
323.40	5.00	1.40			15.1	13.3	***182.3***	22.3	1.7	259.4	182	0	0	100	42
318.40	5.00	0.70			8.7	6.7	***215.8***	12.8	0.8	275.3	216	0	0	119	47
313.40	5.00	3.30	17		27.1	31.5	***240.9***	39.8	4.0	314.9	241	0	0	133	52
308.40	5.00	3.10	27		25.8	29.6	***263.0***	38.1	3.7	352.5	263	0	0	145	57
303.40	5.00	2.70	18		23.4	25.7	***275.9***	34.5	3.3	385.7	276	0	0	152	62
298.40	5.00	1.60			16.6	15.3	***289.6***	24.4	1.9	409.7	290	0	0	159	67
293.40	5.00	1.30			14.3	12.4	***309.7***	21.1	1.6	431.6	310	0	0	170	72
288.40	5.00	1.90			18.6	18.1	***325.4***	27.4	2.3	458.6	325	0	0	179	77
278.40	10.00	1.60			33.2	15.3	***345.3***	48.8	1.9	505.7	~~345~~	~~0~~	~~0~~	~~190~~	~~87~~
268.40	10.00	0.20			5.4	1.9	***350.7***	8.0	0.2	513.7	~~351~~	~~0~~	~~0~~	~~193~~	~~97~~
265.40	3.00	0.20			1.6	1.9	***350.4***	2.4	0.2	515.9	~~350~~	~~0~~	~~0~~	~~193~~	~~100~~
264.40	1.00				0.0	0.0	***435.2***	0.0	0.0	526.6	~~435~~	~~0~~	~~0~~	~~239~~	~~101~~
263.40	1.00			Shale	41.1	84.8	***476.3***	60.5	10.7	587.1	~~476~~	~~0~~	~~0~~	~~262~~	~~101.9~~
262.40	1.00			Shale	41.1	84.8	***517.4***	60.5	10.7	647.6	~~517~~	~~0~~	~~0~~	~~285~~	~~102.9~~
261.40	1.00			Shale	41.1	84.8	***558.5***	60.5	10.7	708.2	~~558~~	~~0~~	~~0~~	~~307~~	~~103.9~~
260.40	1.00			Shale	41.1	84.8	***599.6***	60.5	10.7	768.7	~~600~~	~~0~~	~~0~~	~~330~~	~~104.9~~
259.40	1.00			Shale	41.1	84.8	***640.7***	60.5	10.7	829.2	~~641~~	~~0~~	~~0~~	~~352~~	~~105.9~~
258.40	1.00			Shale	41.1	84.8	***681.8***	60.5	10.7	889.7	~~682~~	~~0~~	~~0~~	~~375~~	~~106.9~~
257.40	1.00			Shale	41.1	84.8	***722.9***	60.5	10.7	950.2	~~723~~	~~0~~	~~0~~	~~398~~	~~107.9~~
256.40	1.00			Shale	41.1	84.8	***764.0***	60.5	10.7	1010.8	~~764~~	~~0~~	~~0~~	~~420~~	~~108.9~~
255.40	1.00			Shale	41.1	84.8	***805.1***	60.5	10.7	1071.3	~~805~~	~~0~~	~~0~~	~~443~~	~~109.9~~
254.40	1.00			Shale	41.1	84.8	***846.2***	60.5	10.7	1131.8	~~846~~	~~0~~	~~0~~	~~465~~	~~110.9~~
253.40	1.00			Shale	41.1	84.8	***887.3***	60.5	10.7	1192.3	~~887~~	~~0~~	~~0~~	~~488~~	~~111.9~~
252.40	1.00			Shale		84.8			10.7						