STRUCTURE GEOTECHNICAL REPORT

IL 13 over North Fork Saline River

Existing S.N. 030-0015
Proposed S.N. 030-0026

05/29/2024
Exp. 11/30/2025

F.A.P. RTE. 331
SECTION (10-1,10-3-1)B-2
GALLATIN COUNTY, ILLINOIS
PTB 203-048
KEG NO. 22-1060.04

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1.0 PROJECT DESCRIPTION AND SCOPE

1.1 Introduction

The geotechnical study summarized in this report was performed by Kaskaskia Engineering Group, LLC (KEG) for a proposed bridge carrying IL-13 over the North Fork Saline River in Gallatin County, Illinois. The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of replacing a five-span bridge (existing SN 030-0015) over the North Fork Saline River in Gallatin County, Illinois. The general location of the proposed structure is shown on a Location Map, Exhibit A. The existing structure was built in 1964. The bridge is 252 ft. long and 36 ft. wide. The project is located near Equality, IL. The site lies within the limits of the Third Principal Meridian (T. 9S R. 8 E) within the Mt.Vernon Hill County of the Till Plains section of the Central Lowland Province.

1.3 Proposed Structure Information

The proposed structure (proposed SN 030-0026) will consist of a three-span superstructure, which will be built on a 0°-degree skew and will provide two 12 ft.-wide driving lanes and two ten ft.-wide outer shoulders with a total width of 46 ft.-10 in. out-to-out. The proposed bridge centerline station will be at 1690+10 on IL-13. The bridge will measure 275 ft. back-to-back abutments. A Type, Size, and Location Plan (TS&L) is included in Exhibit C.

Further substructure details will be based on the findings of this SGR.

2.0 FIELD EXPLORATION

2.1 Subsurface Exploration and Testing

Information regarding the site exploration was provided by IDOT District 9 and Veenstra & Kimm, Inc. (V & K). According to the information provided, four borings designated 1-S, 2-S, 3-S, and 4-S were drilled on November 3rd, 2021, May 31st, 2022, June 1st, 2022, and November 2nd, 2021, respectively. The boring locations are shown on Exhibit B – Boring Map. Detailed information regarding the nature and thickness of the soils encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit D. The soil profile for the borings can be found in Subsurface Profile, Exhibit E.

2.2 Subsurface Conditions

The profiles at the four (4) borings exhibit a mix of the following soil types: clays, silts, sands, and loams. Bedrock was encountered on all borings. Shale layers were found between elevations of El. 316 to El. 326 ft. MSPT samples were obtained on shale layers in borings 2-S and 3-S, and a 10 ft rock core was obtained on boring 4-S. Table 2.2.1 summarizes the pavement structure, depth of drilling, top of rock, and ground surface elevation (GSE) of the borings. A Summary of the general condition of the subsurface is described in Table 2.2.2.

Table 2.2.1 – Borings Depths and GSE

Boring	HMA (in)	Depth (ft)	Top of Rock Elevation (ft.)	Ground Surface Elevation (ft)
1-S	8.0	50.70	321.3	371.8
2-S	-	38.60	326.1	345.9
3-S	-	38.80	317.2	341.7
4-S	8.0	64.75	316.6	371.1

Table 2.2.2 – Subsurface Profile Summary

Soil Type	N-Values (bpf)	Q_u (tsf)	WC (%)	Boring
Clay	5 to 24	0.4 to 4.9	15 to 25	1-S, 3-S,4-S
Gravel Fill	76	-	22	2-S
Sandy Clay	58	1	20	3-S
Silty Clay	3 to 10	0.2 to 2.6	17 to 25	1-S, 3-S,4-S
Silty Clay Loam	2 to 8	0.9 to 2.7	20 to 27	2-S
Silty Clay/Clay Fill	2 to 8	0.6 to 2.2	21 to 29	2-S,3-S

2.3 Groundwater

Groundwater was encountered at the time of drilling in Boring 2-S and 3-S. Table 2.3.1 shows the elevation that the groundwater was encountered during drilling. It should be noted that the groundwater level is subject to seasonal and climatic variations. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

Table 2.3.1 – Groundwater Elevations

Boring No.	Depth (ft)	Elevation (ft)
2-S	33.5	312.4
3-S	17.2	324.5

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

Since no significant grading or changes to the existing embankments are expected at the proposed structure, it is estimated that the existing embankments will experience no settlement. Therefore, no settlement calculations were performed for the proposed structure.

3.2 Slope Stability

A stability analysis using SLOPE/W was performed using the proposed roadway and bridge geometry on the TS&L and soil characteristics from Boring 1-S and 4-S. Three conditions were modeled for each scenario: end-of-construction, long-term and seismic. A critical factor of safety

(FOS) was calculated for each condition. According to the current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability. The target FOS is 1.0 for the seismic condition. A peak ground acceleration of 0.121g was used for both abutments.

Full cohesion and a friction angle of 0 degrees were assumed to model the end-of-construction condition for cohesive materials. Nominal values for cohesion were used with full friction angle to model the long-term condition to analyze the theoretical condition where pore water pressure has dissipated. Nominal values were 100 psf for the cohesive soils, with friction angles of 26 degrees.

The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis is shown in Table 3.2.1. SLOPE/W program output from this analysis can be found in SLOPE/W Slope Stability Analysis, Exhibit F.

The analysis results, as provided in Table 3.2.1, indicate an acceptable FOS will exist under all three conditions.

Table 3.2.1 – Slope Stability Critical FOS

Structure (Boring)	Critical FOS		
	End-of Construction	Long Term	Seismic
West Abutment (Boring 1-S)	3.0	2.0	2.1
East Abutment (Boring 4-S)	4.3	1.9	3.0

3.3 Seismic Considerations

Seismic Site Class was determined based on the method described by the IDOT Seismic Manual, updated in 2024 as described in IDOT AGMU Memo 24.1 – IDOT Seismic Manual Update – Planning Requirements. The updated IDOT Seismic Manual uses the 2023 AASHTO Seismic Hazard which requires the use of shear wave velocity to determine site class. See Table 3.3.1 for the shear wave velocities calculated for each individual layer in each boring, as well as the accompanying site classes found in Table 3.2.3-1 of the IDOT Seismic Manual. The shear wave velocities were calculated using the SPT correlations found in Table 3.2.1-1 of the IDOT Seismic Manual. Table 3.3.2 shows the weighted average of the shear wave velocities for each boring calculated for the top 100 feet encountered. As the boring spacing for the site does not exceed 200 ft, the shear wave velocities for each boring were averaged to determine a global site class for the structure.

Table 3.3.1 – Shear Wave Velocities and Site Class by Soil Layer

Boring	Soil Type	Elev at Bot. (ft.)	Epoch (Holocene or Pleistocene)	σ'_v (psf)	N Value (Avg.)	N60 Values	Shear Wave Velocity, v_s (ft/s)	Soil Site Class
1-S	Clay	364.8	H	420	10	8	279	E
	Silty Clay	354.8	H	1440	5	4	1932	C
	Clay	337.3	H	3090	7	7	517	DE
	Silty Clay	327.3	H	4740	9	8	607	DE
	Clay	321.3	H	5700	17	14	708	D
	Shale	--	--	--	--	--	2500	BC
2-S	Clay	341.6	H	258	2	1	168	E
	Gravel	340.4	H	591	48	42	646	DE
	Clay	339.2	H	738	3	2	264	E
	Silty Clay Loam	326.1	H	1596	6	5	395	E
	Shale	--	--	--	--	--	2500	BC
3-S	Silty Clay	333.7	H	480	7	6	278	E
	Silty Clay	321.7	H	1680	5	4	387	E
	Clay	317.7	H	2640	24	21	593	DE
	Sandy Clay	317.2	H	2910	58	50	709	D
	Shale	--	--	--	--	--	2500	BC
4-S	Clay	349.1	H	1320	8	8	403	E
	Silty Clay	341.6	H	3090	8	7	517	DE
	Clay	316.6	H	5040	12	13	672	DE
	Shale	--	--	--	--	--	2500	BC

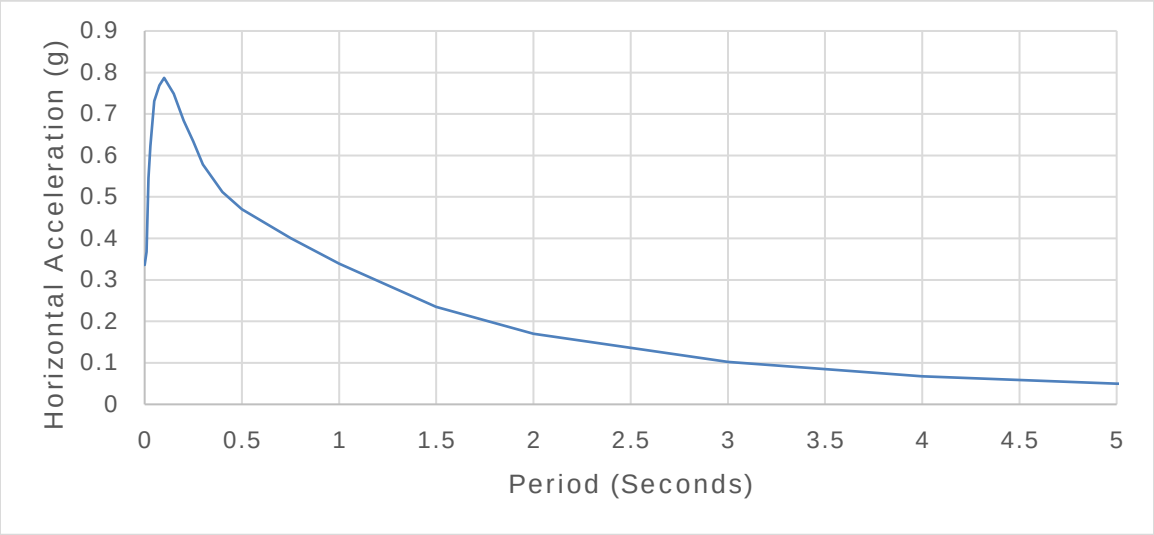
Table 3.3.2 – Weighted Average Shear Wave Velocity and Site Class by Boring

Boring	Weighted Average Shear Wave Velocity, v_s (ft/s)	Boring Soil Site Class
1-S	924	D
2-S	1028	CD
3-S	1026	CD
4-S	803	D
Global	**945**	**D**

The Seismic Design Category (SDC) in the AASHTO Guide Specifications for LRFD Seismic Bridge Design is based on the seismic acceleration for a structure with a period of one second, which has been modified for site class. For locations with a overall global site shear wave velocity less than 1,450 ft/s, S_{D1} is taken as the larger of the spectral acceleration coefficient, S_a at 1 second, or 90% of the maximum value of the product TS_a for periods from 1.0 seconds to 5.0 seconds. Figure 3.3.3 shows the required seismic data to be shown on the TSL plans.

Figure 3.3.3 - Summary of Seismic Data

2023 AASHTO Seismic Hazard
Site Class D
Latitude 37.7439, Longitude -88.3301



Vertical Acceleration = 2/3 * Horizontal Acceleration
S_{D1}= 0.339g
SDC = C

As indicated in the figure above, the Seismic Design Category (SDC) is C, based on the Soil Site Class D, and Figure 3.5-5 in the IDOT Seismic Manual.

3.4 Scour

The design scour elevations for the proposed structure were developed by V & K and are included below in Table 3.4.1.

Table 3.4.1 – Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	West Abutment	Pier 1	Pier 2	East Abutment	
Q_{100}	364.5	334.9	302.4	364.5	5
Q_{200}	364.5	333.6	297.1	364.5	
Design	364.5	334.9	302.4	364.5	
Check	364.5	333.6	297.1	364.5	

The design scour elevation for Pier 2 was estimated too large for the relatively shallow bedrock conditions, as it is about 25 feet below the existing streambed into shale as indicated by Boring

3-S. For the analysis in this report, a scour elevation of 317.20, which represents the top of the shale layer in Boring 3-S was assumed for the design scour elevation.

3.5 Liquefaction

A liquefaction analysis was performed using the worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis.

The PGA and Mw to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website: https://earthquake.usgs.gov/hazards/interactive/ for both NMSZ (far source-site) and CEUS (near source-site) models. The deaggregation data indicated three NMSZ sources and one near source-site contributing at least 5% to the hazard for this site; hence, PGA maximums from the NMSZ Model and the CEUS Model were necessary. The Peak Horizontal Ground Surface Acceleration value was set to the PGA calculated in the IDOT Liquefaction Analysis Spreadsheet.

The results from the analysis for the soil profile encountered in Borings 2-S and 3-S showed no potential for liquefaction from any source, contributing at least 5% to the hazard for the site. Therefore, no reduction for liquefaction was considered for the pile design capacity or other foundation considerations. A summary of the liquefaction analysis, including each specific run, is included in Exhibit G, Liquefaction Analysis.

4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

4.1 Driven Piles

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads. The IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit H).

The factored reactions and the preliminary design loads, as provided by V & K, are provided in Table 4.1.1.

Table 4.1.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
Abutments	1370
Piers	3385

The estimated pile lengths for applicable H-pile types are shown in Tables 4.1.2 through 4.1.6 below. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

Table 4.1.2 - Estimated Pile Lengths for HP 10x42 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (1-S)	335	184	49	366.5
Pier 1 (2-S)	335	184	45	366.5
Pier 2 (3-S)	335	184	54	366.5
East Abutment (4-S)	335	184	51	366.5

Table 4.1.3 - Estimated Pile Lengths for HP 12x53 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (1-S)	418	230	48	366.5
Pier 1 (2-S)	418	230	46	366.5
Pier 2 (3-S)	418	230	54	366.5
East Abutment (4-S)	418	230	51	366.5

Table 4.1.4 - Estimated Pile Lengths for HP 12x63 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (1-S)	497	273	50	366.5
Pier 1 (2-S)	497	273	48	366.5
Pier 2 (3-S)	497	273	58	366.5
East Abutment (4-S)	497	273	52	366.5

Table 4.1.5 - Estimated Pile Lengths for HP 14x73 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (1-S)	578	318	49	366.5
Pier 1 (2-S)	578	318	47	366.5
Pier 2 (3-S)	578	318	55	366.5
East Abutment (4-S)	578	318	52	366.5

Table 4.1.6 – Estimated Pile Lengths for HP 14x89 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (1-S)	705	388	51	366.5
Pier 1 (2-S)	705	388	49	366.5
Pier 2 (3-S)	705	388	57	366.5
East Abutment (4-S)	705	388	54	366.5

As shown in the Tables above and in Pile Length/Pile Type, Exhibit H, scour has been included at the substructure locations.

KEG recommends one test pile be performed, at a minimum. A test pile is performed prior to production driving so that actual, on-site field data can be gathered to determine pile driving requirements for the project. This is also the manner in which the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

The piles are expected to be driven into penetrable shale and pre-coring should not be required to reach estimated embedment depths. KEG recommends using pile shoes to facilitate driving and to protect piles from damage.

4.2 Drilled Shafts

Based on the subsurface exploration, competent shale is encountered around elevation El. 326.1 and 317.2, near the piers. Recommendations for drilled shafts with sockets extending to various depths into the underlying shale, developing capacity from side and/or tip resistance, are provided for design support of the piers. The provided capacities are based on boring information and utilizing the IDOT Drilled Shaft Axial Capacity in Soft Rock spreadsheet as provided by IDOT BBS Foundations and Geotechnical Unit. LRFD Resistance Factors of 0.5 for side and tip resistance are incorporated into the allowable capacities, respectively.

Tables 4.2.1 and 4.2.2 – Estimated Drilled Shaft Axial Capacity below contain a summary of Factored Shaft Resistances available for various shaft diameters based on socket depths into the underlying shale for each substructure. IDOT Drilled Axial Capacity Input sheets and Design Tables are included in Exhibit J, Drilled Shaft Design.

Table 4.2.1 - Estimated Drilled Shaft Axial Capacity for Pier 1 (2-S)

Diameter Socket (in.)	Socket Depth (ft.)	Nominal SIDE Resistance Available (kips)	Nominal TIP Resistance Available (kips)	Nominal Shaft Resistance Available (kips)	Factored Shaft Resistance Available (kips)	Tip Elev. (ft.)
36	2	276	1161	1436	718	324.1
	4	552	1272	1824	912	322.1
	6	827	1311	2138	1069	320.1
42	2	322	1586	1908	954	324.1
	4	644	1693	2337	1168	322.1
	6	965	1674	2639	1319	320.1
48	2	368	2064	2431	1216	324.1
	4	735	2251	2987	1493	322.1
	6	1103	2054	3157	1579	320.1
60	2	460	3133	3593	1796	324.1
	4	919	3134	4053	2027	322.1
	6	1379	3507	4886	2443	320.1

Table 4.2.2 - Estimated Drilled Shaft Axial Capacity for Pier 2 (3-S)

Diameter Socket (in.)	Socket Depth (ft.)	Nominal SIDE Resistance Available (kips)	Nominal TIP Resistance Available (kips)	Nominal Shaft Resistance Available (kips)	Factored Shaft Resistance Available (kips)	Tip Elev. (ft.)
36	2	550	1587	2137	1069	315.2
	4	1055	1144	2199	1100	313.2
	6	1461	978	2439	1220	311.2
42	2	642	1934	2577	1288	315.2
	4	1231	1506	2737	1369	313.2
	6	1705	1395	3100	1550	311.2
48	2	734	2311	3045	1522	315.2
	4	1407	2067	3474	1737	313.2
	6	1949	1755	3704	1852	311.2
60	2	917	3425	4342	2171	315.2
	4	1759	3077	4836	2418	313.2
	6	2436	2590	5025	2513	311.2

As indicated above under Driven Pile recommendations and due to an anticipated Scour depth of El. 297.10 as noted in Table 3.4.1 – Design Scour Elevations for Pier 2; drilled shafts for that substructure should be extended to bear below the proposed Scour depth.

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 4.3.1 and Table 4.3.2 are included for the structural engineer's use in determining lateral pile response.

Table 4.3.1 - Soil Parameters for Lateral Pile Load Analysis

Boring	Soil Type	Elev at Bot. (ft.)	γ (pcf)	Undrained		Drained		N Value (Ave.)	Assumed % Fines < #200	K (pci)	ε50
				c (psf)	Φ (deg)	c (psf)	Φ (deg)				
1-S	Clay	364.80	120	3200	0	100	26	10	85	1000	0.005
	Silty Clay	354.80	120	900	0	100	26	5	65	100	0.01
	Clay	337.30	120	1500	0	100	26	7	85	500	0.007
	Silty Clay	327.30	120	1350	0	100	26	9	65	500	0.007
	Clay	321.30	120	2000	0	100	26	17	85	500	0.007
2-S	Clay	341.60	120	700	0	50	26	2	85	100	0.01

	Gravel	340.40	125	-	42	-	38	48	3	-	-
	Clay	339.20	120	900	0	50	26	3	85	100	0.01
	Silty Clay Loam	326.10	120	1800	28	100	28	6	65	500	0.007
3-S	Silty Clay	333.70	120	1900	0	100	26	7	65	500	0.007
	Silty Clay	321.70	120	1100	0	100	26	5	65	500	0.007
	Clay	317.70	120	4800	0	150	26	24	85	2000	0.004
	Sandy Clay	317.20	120	1000	0	150	30	58	45	100	0.01
4-S	Clay	349.10	120	2600	0	100	26	8	85	1000	0.005
	silty clay	341.60	120	2300	0	100	26	8	65	1000	0.005
	clay	316.60	120	3000	0	100	26	12	85	1000	0.005

Table 4.3.2 - Rock Parameters for Lateral Pile Load Analysis

Rock Type	Weak Rock			Strong Rock		
	y (psf)	RQD	Qu (tsf)	y (psf)	RQD(%)	Qu (tsf)
Shale	135	5	30	145	21	220

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.

Should any design considerations assumed by KEG change, KEG should be contacted to determine if the recommendations stated in this report still apply.

5.2 Temporary Sheeting and Soil Retention

Temporary shoring may be required at various stages of this project due to the proposed staged construction layout shown in the TS&L.

Temporary Soil Retention Systems may be required versus Temporary Shoring, depending upon the surcharge loading and retained heights required to be supported during construction. An Illinois-licensed Structural Engineer is required to seal the design of Temporary Soil Retention Systems if deemed necessary.

5.3 Cofferdams and Seal Coats

Cofferdams will be required at the proposed pier locations. The estimated water surface elevation (E.W.S.E.) is listed as El. 340.3, making it greater than six ft. above the bottom elevation of the substructure. Therefore, a Type 2 cofferdam will be required. All cofferdams are required to be dewatered. A seal coat will be required to reduce the potential for water to seep beneath the sheet piling in the dewatered cofferdam. Per the IDOT Bridge Manual, General Note 28 shall be added to the plans when a seal coat is specified.

The contractor is required to retain an Illinois-licensed structural engineer to design the cofferdams. Per the Bridge Manual, the plans and computations shall be submitted to the Bureau of Bridges and Structures for review and final approval before beginning any work on the structure.

5.4 Site and Soil Conditions

Provisions of the Standard Specifications should adequately address site and soil conditions.

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

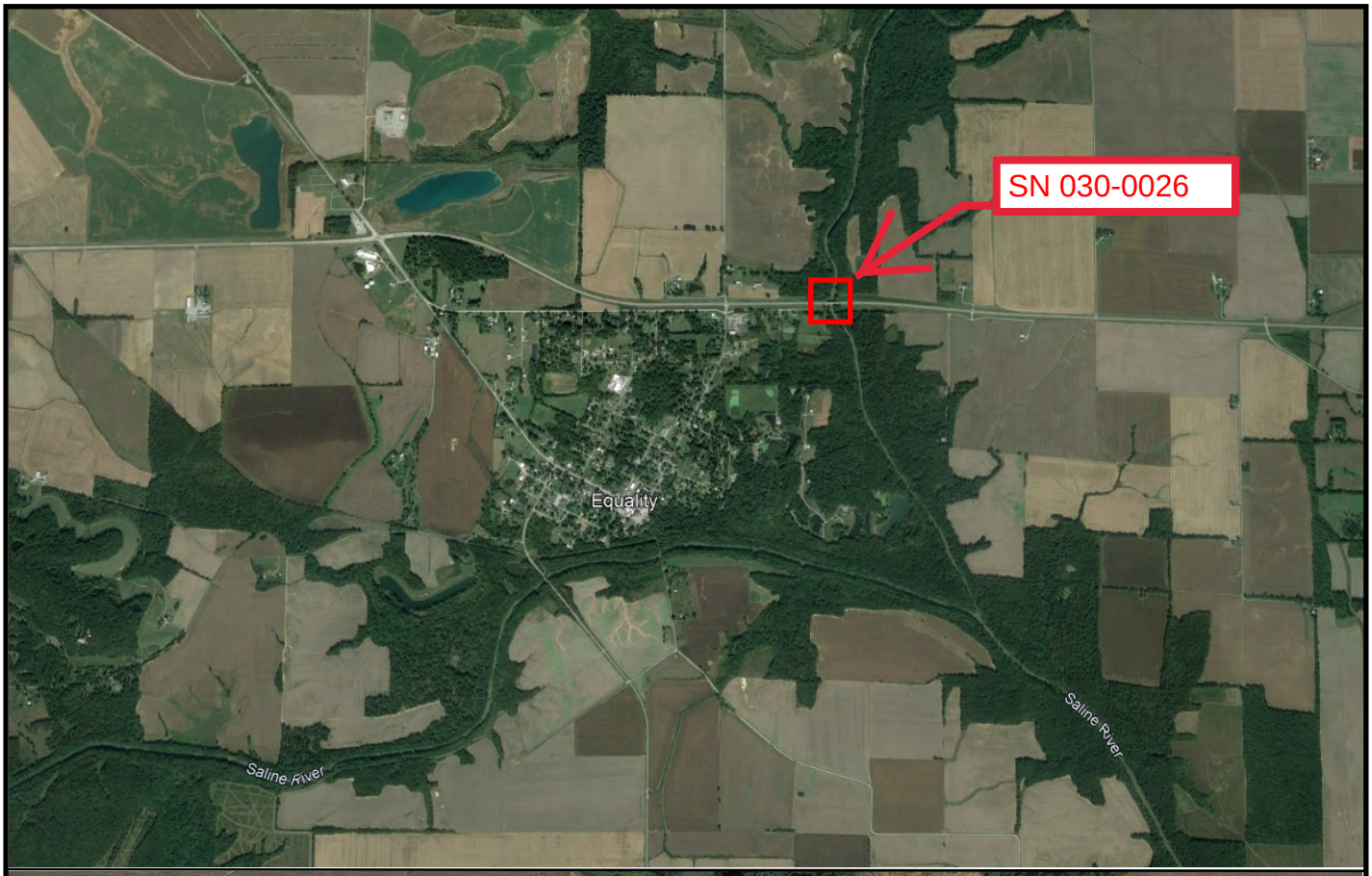
Soil boring logs can be found in Exhibit D. The Subsurface Profile can be found in Exhibit E.

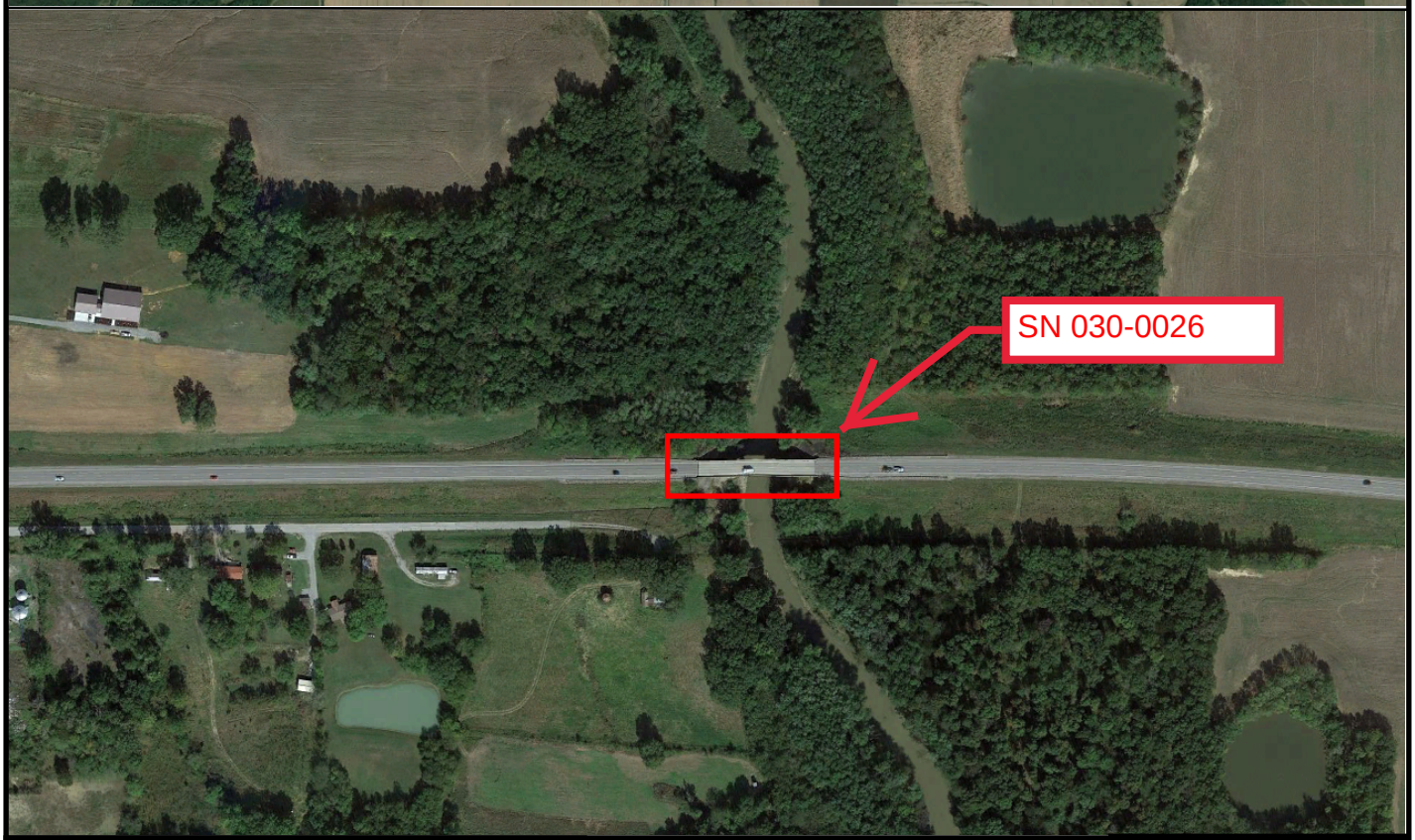
8.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of V & K., and the Illinois Department of Transportation (IDOT) District 9. They are specific only to the project described and are based on the subsurface information obtained by IDOT at four boring locations within the structure area. 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

IL-13 over North Fork Saline River
Gallatin County, Illinois

Exhibit No.

A

KEG JOB #22-1060.04

EXHIBIT B

BORING MAP

Kaskaskia Engineering Group, LLC

BORING LOCATION MAP

IL-13 over North Fork Saline River
Gallatin County,
Illinois

Exhibit No.

B

KEG JOB #22-1060.04

EXHIBIT C

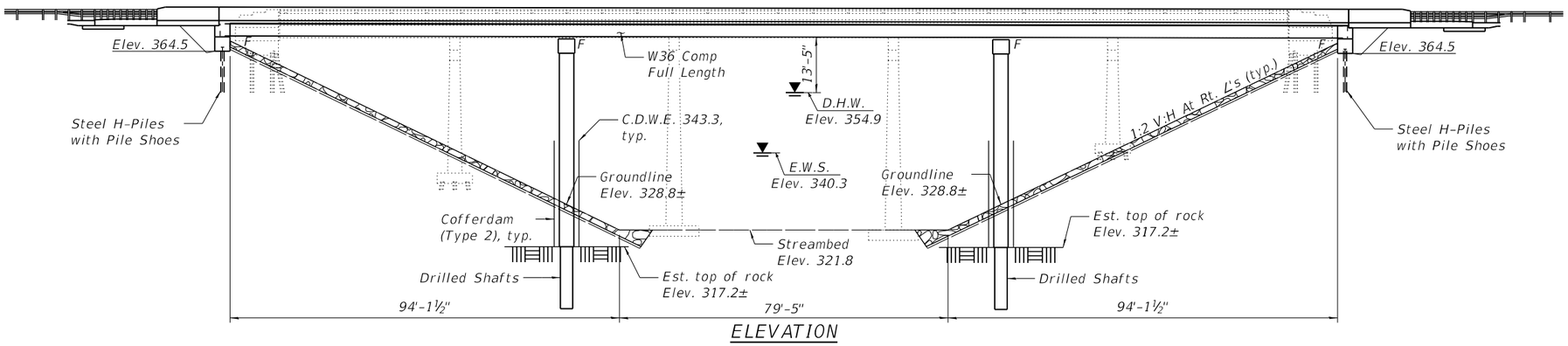
TYPE, SIZE, AND LOCATION PLAN (TS&L)

Benchmark:

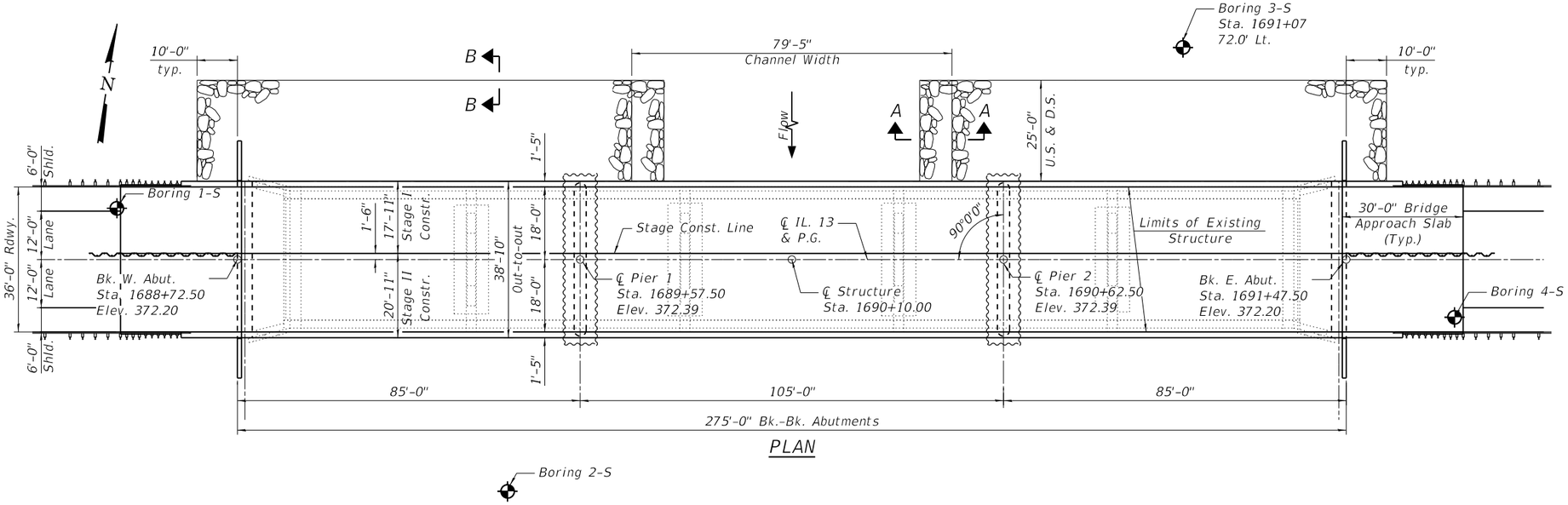
Existing Structure:
SN 030-0015 was originally built in 1964 to carry (F.A.P. 331) IL 13 over North Fork Saline River. The structure is a five-span, non-composite, continuous W30x108 wide flange steel beam bridge and was originally constructed with a 7" thick concrete deck. In 2003, there was a ½" scarification of the concrete deck with a ±3" variable depth micro-silica concrete wearing surface added. The superstructure rests on stub abutments founded on steel H-piles and solid wall piers founded on either steel H-piles or on rock. The structure is square and an overall length of 252'-0" from back-to-back of abutments. The out-to-out width of the structure is 36'-0". The deck consists of 3'-0" wide curbs with a clear width of 30'-0". Existing structure is to be removed and replaced.

The structure will be replaced utilizing stage construction.

No salvage.



ELEVATION



PLAN

Boring 2-S

LOADING HL-93

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

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

DESIGN STRESSES

FIELD UNITS

f'c = 4,000 psi (Superstructure)
f'c = 3,500 psi (Substructure)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

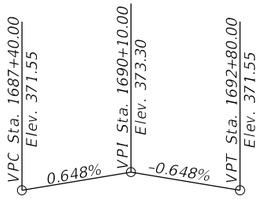
SEISMIC DATA

Seismic Design Category (SDC) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.243 g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.666 g
Soil Site Class = C

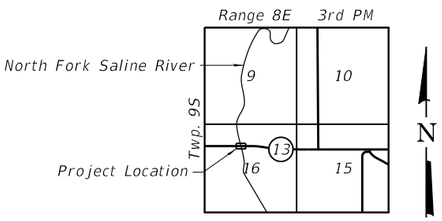
HIGHWAY CLASSIFICATION

F.A.P. 331 - IL 13
Functional Class: Other Principal Arterial
ADT: 3,680 (2026); 4,490 (2046)
ADTT: 425 (2026); 510 (2046)
DHV: 405 (2046)
Design Speed: 60 MPH
Posted Speed: 55 MPH
2-Way Traffic
Directional Distribution: 50:50

Note:
All structural steel shall be galvanized.



PROFILE GRADE
(Along ℄ IL-13)



LOCATION SKETCH

GENERAL PLAN & ELEVATION
IL 13 OVER NORTH FORK SALINE RIVER
PUBLIC WATERS
F.A.P. ROUTE 331
SECTION (10-1, 10-3-1)B-2
GALLATIN COUNTY
STATION 1690+10.00
STRUCTURE NO. 030-0026

MODEL: Default
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EFK•Moen
Civil Engineering Design

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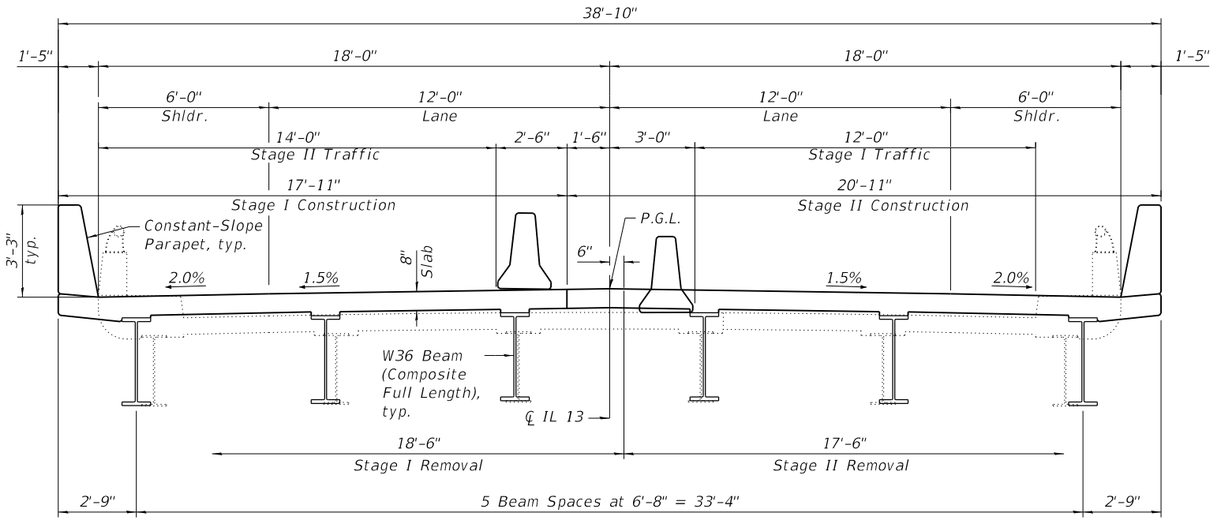
	CHECKED - CDL	REVISED -
PLOT SCALE =	DRAWN - ACB	REVISED -
PLOT DATE = 5/24/2024	CHECKED - CDL	REVISED -

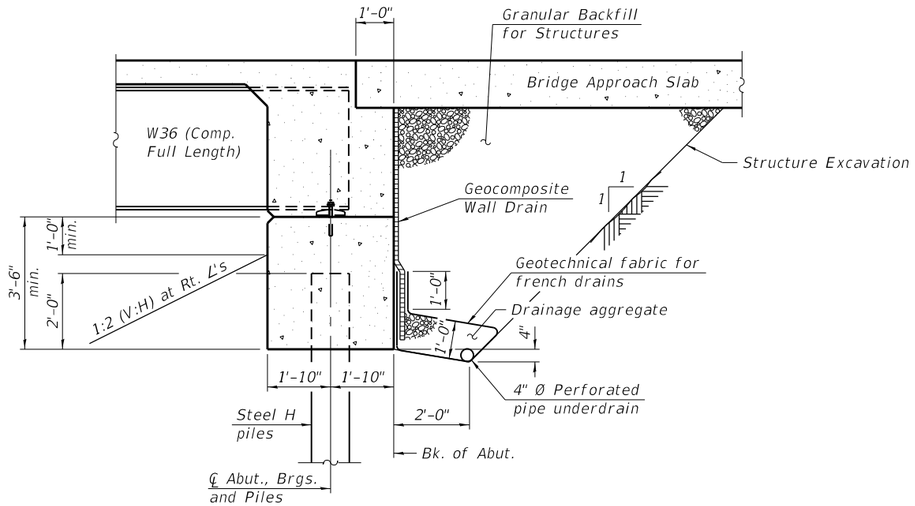
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	(10-1, 10-3-1)B-2	GALLATIN		
		CONTRACT NO. 78969		
	ILLINOIS FED. AID PROJECT			

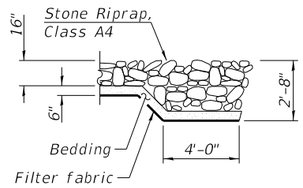


PROPOSED CROSS SECTION

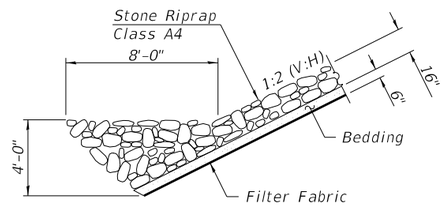


SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. at Rt. ℒ's)



SECTION A-A



SECTION B-B

WATERWAY INFORMATION

Drainage Area = 450.0 Sq. Mi.

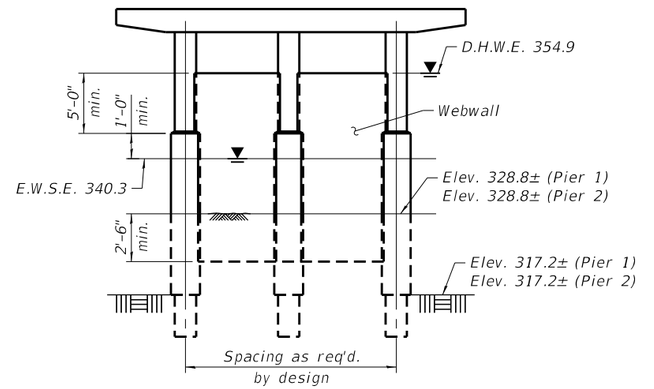
Exist. Overtopping Elev. = 369.90 @ Sta. 1698+00
Prop. Overtopping Elev. = 369.00 @ Sta. 1698+00

Flood Event		Discharge C.F.S.		Opening Ft²		Nat.	Head - Ft.		Headwater El.	
		Exist.	Prop.	Exist.	Prop.	H.W.E.	Exist.	Prop.	Exist.	Prop.
10	Main Channel	13988	13995	2508	2776	348.7	0.2	0.1	348.9	348.8
	Relief Structure	46	39	9	9	348.7	0.2	0.1	348.9	348.8
	TOTAL	14034	14034	2517	2785					
50	Main Channel	23739	23771	3573	4023	354.9	0.6	0.5	355.5	355.4
	Relief Structure	217	185	46	46	354.9	0.6	0.5	355.5	355.4
	TOTAL	23956	23956	3619	4069					
100	Main Channel	28636	28665	4007	4524	357.2	0.9	0.7	358.1	357.9
	Relief Structure	235	206	46	46	357.2	0.9	0.7	358.1	357.9
	TOTAL	28871	28871	4053	4570					
200	Main Channel	33746	33779	4382	4955	359.1	1.1	1.0	360.2	360.1
	Relief Structure	254	221	46	46	359.1	1.1	1.0	360.2	360.1
	TOTAL	34000	34000	4428	5001					
Existing Overtopping	Main Channel									
	Relief Structure									
	TOTAL									
Proposed Overtopping	Main Channel									
	Relief Structure									
	TOTAL									
500	Main Channel	41314	41349	4750	5376	360.9	1.5	1.3	362.4	362.2
	Relief Structure					360.9	1.5	1.3	362.4	362.2
	TOTAL	41595	41595	4796	5422					

10 Yr. Outlet Velocity through Exist. Main Structure = 5.6 ft/s
10 Yr. Outlet Velocity through Prop. Main Structure = 5.0 ft/s
10 Yr. Outlet Velocity through Prop. Relief Structure = 2.0 ft/s

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	364.5	334.9	302.4	364.5	5
Q200	364.5	333.6	297.1	364.5	
Design	364.5	334.9	302.4	364.5	
Check	364.5	333.6	297.1	364.5	



PIER SKETCH

DETAILS
IL 13 OVER NORTH FORK SALINE RIVER
PUBLIC WATERS
F.A.P. 331 -
SECTION (10-1, 10-3-1) B-2
GALLATIN COUNTY
STATION 1690+10.00
STRUCTURE NO. 030-0026

MODEL: Default
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EFK•Moen Civil Engineering Design

USER NAME = acb	DESIGNED - ACB	REVISED -	
	CHECKED - CDL	REVISED -	
PLOT SCALE =	DRAWN - ACB	REVISED -	
PLOT DATE = 5/24/2024	CHECKED - CDL	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	(10-1, 10-3-1)B-2	GALLATIN		
		CONTRACT NO. 78969		
		ILLINOIS FED. AID PROJECT		

EXHIBIT D

BORING LOGS

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 11/3/21

ROUTE IL 13 **DESCRIPTION** Bridge over the North Fork of the Saline River (near W. Abut.) **LOGGED BY** L. Estel

SECTION 10-2B (ex.) **LOCATION** 2.5 miles West of IL 1, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, **PM**

COUNTY Gallatin **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs (HE=86.5%)

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 1-S
Station 1688+41
Offset 13.0ft Lt
Ground Surface Elev. 371.8 ft

Surface Water Elev. 324.9 ft
Stream Bed Elev. 318.9 ft

Groundwater Elev.:
▽ **First Encounter** ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
				Cored Shoulder, 8 in. HMA
				371.13
				Hard dark Grey and Brown Laminate, Damp CLAY
	20			
	6	4.9	15	
	6	B		
				367.30
-5	3			Stiff dark Grey and Brown Laminate, Damp CLAY
	4	1.5	21	
	4	B		
				364.80
	3			Stiff dark Greyish Brown, Damp SILTY CLAY
	4	1.9	17	
	6	S		
				362.30
-10	2			M. Stiff dark Greyish Brown, Damp SILTY CLAY
	2	0.8	23	
	2	B		
	2			
	2	0.75	22	
	2	B		
				357.30
-15	2			V. Soft dark Greyish Brown, Moist SILTY CLAY
	2	0.2	25	
	3	B		
				354.80
	1			M. Stiff dark Grey, Moist CLAY
	2	1.0	23	
	3	B		
				352.30
-20	1			Soft Brown, Moist CLAY

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
	3	0.4	25	Soft Brown, Moist CLAY *(continued)*
	3	B		
				349.80
	3			V. Stiff dark Grey, Damp CLAY
	4	2.9	20	
	4	B		
				347.30
-25	2			Stiff dark Grey and Brown, Damp CLAY
	3	1.0	22	
	4	B		
				344.80
	2			V. Stiff dark Grey with streaks of Black, Damp CLAY
	3	2.2	19	
	4	B		
				342.30
-30	3			Stiff dark Grey and Brown with streaks of Black, Damp CLAY
	5	1.6	20	
	6	B		
	2			(dark Grey and Brown)
	3	1.4	22	
	5	B		
				337.30
-35	2			Stiff dark Grey and Brown, Damp SILTY CLAY
	4	1.5	18	
	5	B		
	3			(Grey)
	4	1.0	21	
	6	B		
				332.30
-40	2			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\GALLATIN\STRUCTURES\030-0015 IL 13 OVER N F SALINE R 2021\030-0015 IL 13 OVER N F SALINE R 2021.GPJ Data Template D6TEMPLT.GDT Date Printed 6/21/22
Latitude 37 44 38.32 Longitude -88 19 50.65 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 11/3/21

ROUTE IL 13 **DESCRIPTION** Bridge over the North Fork of the Saline River (near W. Abut.) **LOGGED BY** L. Estel

SECTION 10-2B (ex.) **LOCATION** 2.5 miles West of IL 1, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, **PM**

COUNTY Gallatin **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs (HE=86.5%)

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 1-S
Station 1688+41
Offset 13.0ft Lt
Ground Surface Elev. 371.8 ft

Surface Water Elev. 324.9 ft
Stream Bed Elev. 318.9 ft

Groundwater Elev.:
▽ **First Encounter** ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
	4 6	1.6 B	22	Stiff Grey with streaks of Brown, Damp CLAY - SILTY CLAY *(continued)*
327.30				
-45	5			Stiff Brownish Grey, Damp CLAY
	7 10	2.0 B	20	
-50	4			
321.30	8		3	
	100/3"			Hard Grey, Dry CLAY SHALE
-55				
-60				
-65				
				Bottom of hole @ 50.7 ft No free water encountered To convert "N" values to "N60", multiply by 1.44; Hammer efficiency = 86.5% Ground surface elevation referenced to BM 137, chiseled square on hub guard at SW corner of SN 030-0015, EL. 372.04
-70				
-75				
-80				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\GALLATIN\STRUCTURES\030-0015 IL 13 OVER N F SALINE R 2021\030-0015 IL 13 OVER N F SALINE R 2021.GPJ Data Template D6TEMPLT.GDT Date Printed 6/21/22
Latitude 37 44 38.32 Longitude -88 19 50.65 Datum NAD83 Job Number

SOIL BORING LOG

Date 05/31/22

ROUTE IL 13 **DESCRIPTION** 030-0015 Bridge over North Fork Saline River near Ex. Pier 1 **LOGGED BY** Gonzalez (NRK)

SECTION 10-2B (ex.) **LOCATION** 2.5 miles west of IL 1 on IL 13, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, 3rd **PM**, **Latitude** 37.744128, **Longitude** -88.329816

COUNTY Gallatin **DRILLING METHOD** Hollow Stem Auger(8"O.D.,3.25"I.D.) **HAMMER TYPE** Auto SPT 140lb HE 92

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 2-S
Station 1689+38
Offset 61.0 ft RT
Ground Surface Elev. 345.9 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 312.4 ft ▼
Upon Completion 325.9 ft ▽
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
	1			Soft to Medium Stiff, Brown, Moist, CLAY (FILL)
	1 1	0.6 B	29	
	1			
341.6				
-5	63 13	0.8 P	22	Medium Dense, Gray, GRAVEL, with clay (FILL)
340.4				
	2			Soft to Medium Stiff, Moist, Brown, CLAY (FILL)
339.2				
	1 2	0.9 B	27	Soft to Medium Stiff, Moist, Gray and Brown, SILTY CLAY LOAM; A-6(21) LL=40 PL=20 PI=20 3% Sand, 72%Silt, 26% Clay
	2			
-10	1 1	2.3 B	22	
	2			
	3 5	1.7 B	22	
	3			
-15	3 5	2.7 B	20	
	2			
	3 5	1.5 B	24	
	2			LL=37 PL=21 PI=16 4% Sand, 75%Silt, 22% Clay
326.1 ▽ -20	2 55	1.7 B	23	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
	100/3"			Gray, CLAY SHALE, Dry, Weathered, Soft Field Hardness *(continued)*
			4	
	100/6"			
-25			4	
		23.6	3	
		MSPT		
		27.7	4	
-30		MSPT		
		23.6	4	
		MSPT		
312.9				
		14.2	29	Black, COAL, Soft Field Hardness ▼
-35		MSPT		
309.9				
		47.1	11	Gray to Black, CLAY SHALE, Dry, Weathered, Soft Field Hardness
		MSPT		
307.3				
		88.1	14	Boring terminated at 38.6 feet.
-40		MSPT		

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

Modified SPT Log

Route: IL 13 Structure No.: 030-0015 (Exist.) (Prop.) Date: 5/31/22 Page: 1 of 1

Section: 10-2B Description: IL 13 over the North Fork of the Saline River

County: Gallatin Logged by: NRK (Gonzalez) Sampler Tube Length: 30 in.

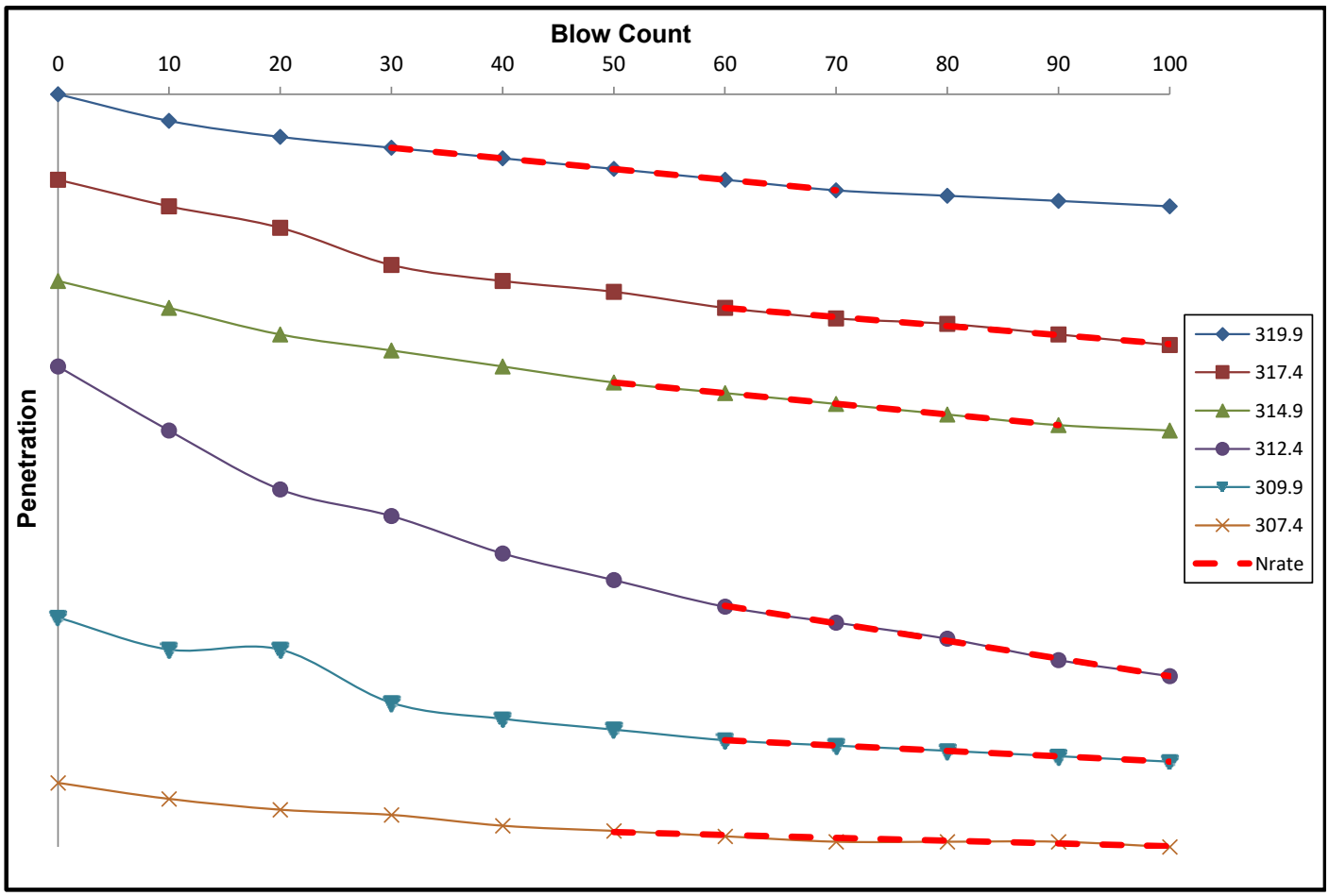
Boring No.: 2-S Station: 1689+38 Offset: 61 ft RT Latitude: 37.744128 Longitude: -88.329816

Drill Rig: CME 750X Hammer Type: Auto 140# Hammer Efficiency (%): 92 Surface Elevation: 345.90

Borehole Diameter. (in.) 8 Split-barrel Sampler Description: 1.375-in. I.D.

Measured Rod Length (in.)	Blows where exposed rod length is measured (blows)											$N_{rate,90}$	q_u	Young's Modulus
Test Elevation	0	10	20	30	40	50	60	70	80	90	100	(bpf)	(ksf)	(ksi)
319.90	25.5	24.9	24.5	***24.3***	***24***	***23.8***	***23.5***	***23.3***	23.1	23	22.9	490.7	47.1	11.63
317.40	25.6	25	24.5	23.63	23.3	23	***22.6***	***22.4***	***22.3***	***22***	***21.8***	577.3	55.4	14.36
314.90	26.3	25.6	25	24.63	24.3	***23.9***	***23.6***	***23.4***	***23.1***	***22.9***	22.8	490.7	47.1	11.63
312.40	26.1	24.6	23.25	22.63	21.8	21.13	***20.5***	***20.1***	***19.8***	***19.3***	***18.9***	297.4	28.5	6.43
309.90	25.6	24.9	24.88	23.63	23.3	23	***22.8***	***22.6***	***22.5***	***22.4***	***22.3***	981.3	94.2	30.11
307.40	26	25.6	25.38	25.25	25	***24.9***	***24.8***	24.6	***24.6***	***24.6***	***24.5***	1835	176	209.94

Note: "***Values***" indicates data used to calculate $N_{rate,90}$.



SOIL BORING LOG

Date 05/31-06/01/22

ROUTE IL 13 **DESCRIPTION** 030-0015 Bridge over North Fork Saline River Near Ex. Pier 4 **LOGGED BY** Gonzalez (NRK)

SECTION 10-2B (ex.) **LOCATION** 2.5 miles west of IL 1 on IL 13, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, 3rd **PM**, **Latitude** 37.74376447, **Longitude** -88.33039705

COUNTY Gallatin **DRILLING METHOD** Hollow Stem Auger(8"O.D.,3.25"I.D.) **HAMMER TYPE** Auto SPT 140lb HE 92

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 3-S
Station 1691+07
Offset 72.0 ft LT
Ground Surface Elev. 341.7 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 324.5 ft ▼
Upon Completion 325.7 ft ▽
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Stiff to Stiff, Moist, Brown and Gray, SILTY CLAY (FILL)		2		
		3 5	1.8 B	21
		2		
		3 4	1.8 S	23
	-5	3		
A-7-6(29) LL=50 PL=23 PI=27 5% Sand, 53%Silt, 42% Clay		3 4	2.2 B	21
	333.7	1		
Medium Stiff, Moist, Brown to Gray, SILTY CLAY, with iron nodules; A-7-6(25) LL=43 PL=18 PI=25 4% Sand, 60%Silt, 36% Clay		2 3	1.3 B	22
	-10	2		
		2 2	1.1 B	23
		1		
		1 2	0.7 B	25
	-15	1		
	▽	2 3	1.3 B	22
	▼	1		
with Gravel	321.7	3 6	1.5 B	22
	-20			
Very Stiff, Dry, Brown, CLAY		8		
		10 14	4.8 B	23
		4		
	317.7			
Medium Stiff, Dry, Brown, SANDY CLAY	317.2	14 44	1.0 B	20
	-25			
Brown to Gray, CLAY SHALE, Dry, Weathered, Soft Field Hardness			47.1 MSPT	15
			39.3 MSPT	10
	-30		21.1 MSPT	9
			12.4 MSPT	5
	-35		26.7 MSPT	12
	306.2			
Black, COAL, Soft Field Hardness				
	303.7			
Dark Gray, CLAY SHALE, Dry, Weathered, Soft Field Hardness	302.9		31.4 MSPT	8
Boring terminated at 38.8 feet.	-40			

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

Modified SPT Log

Route: IL 13 Structure No.: 030-0015 (Exist.) (Prop.) Date: 6/1/22 Page: 1 of 1

Section: 10-2B Description: IL 13 over the North Fork of the Saline River

County: Gallatin Logged by: NRK (Gonzalez) Sampler Tube Length: 30 in.

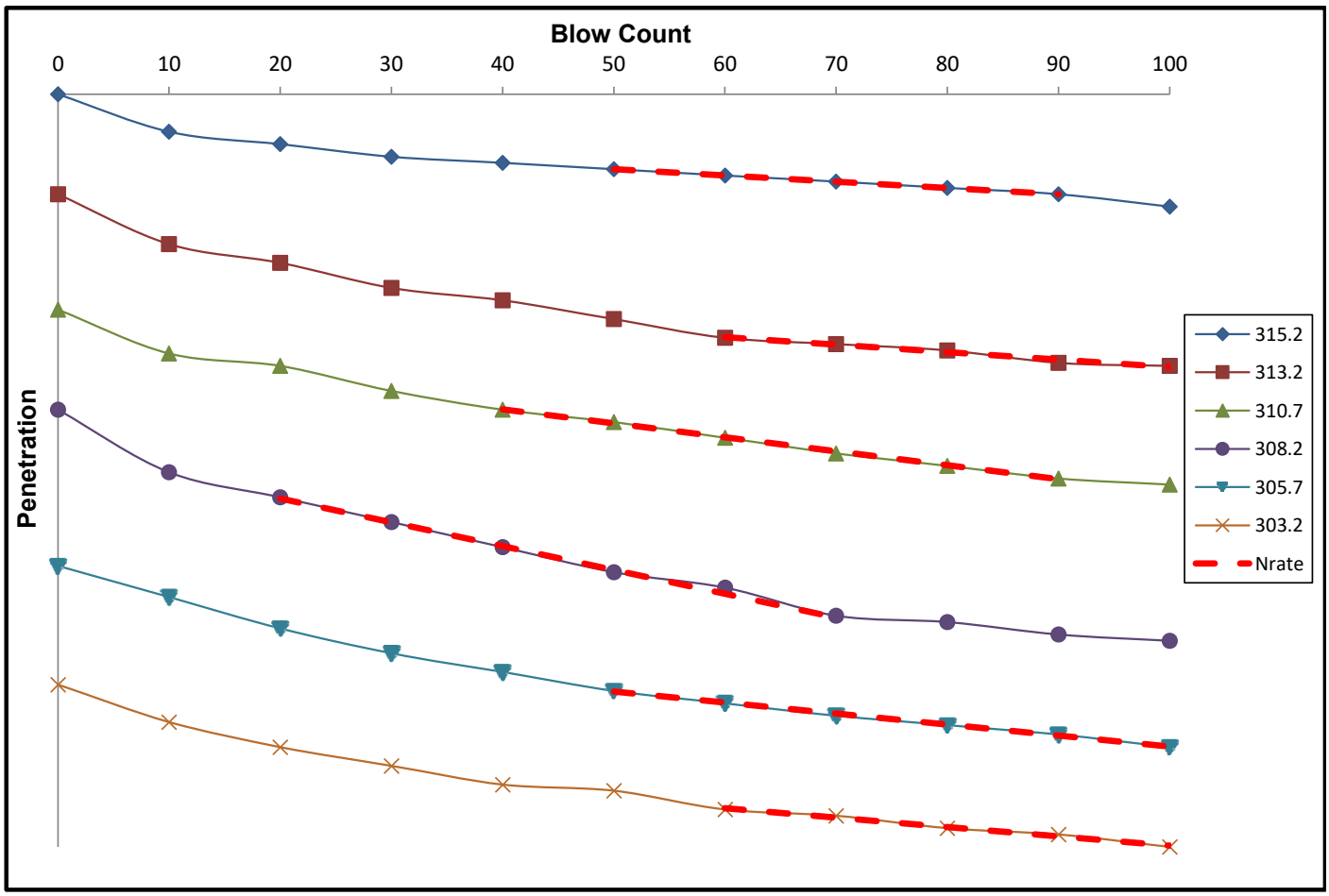
Boring No.: 3-S Station: 1691+07 Offset: 72 ft LT Latitude: 37.7437645 Longitude: -88.330397

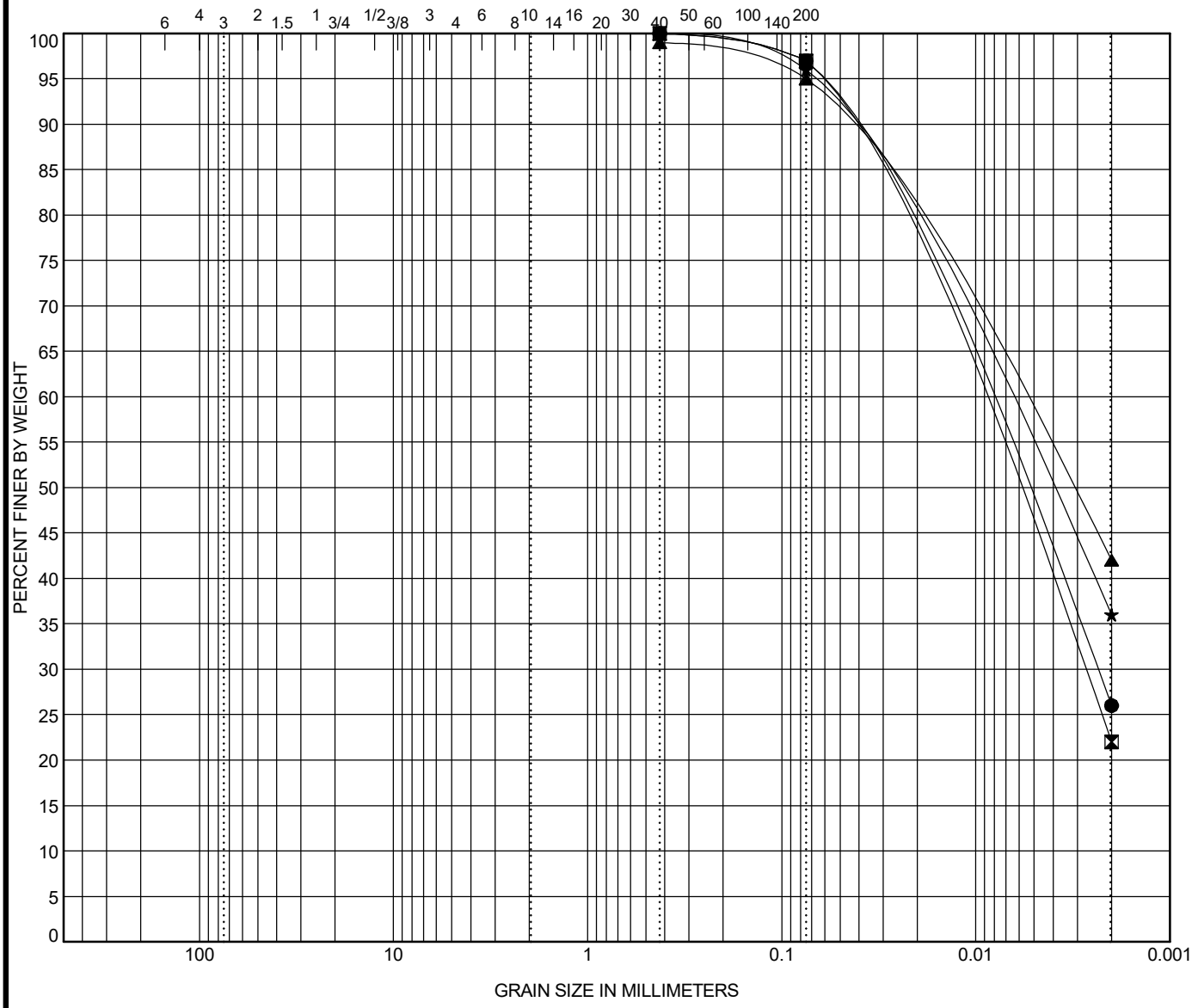
Drill Rig: CME 750X Hammer Type: Auto 140# Hammer Efficiency (%): 92 Surface Elevation: 341.70

Borehole Diameter. (in.) 8 Split-barrel Sampler Description: 1.375-in. I.D.

Measured Rod Length (in.)	Blows where exposed rod length is measured (blows)											$N_{rate,90}$	q_u	Young's Modulus
Test Elevation	0	10	20	30	40	50	60	70	80	90	100	(bpf)	(ksf)	(ksi)
315.20	19.3	18.5	18.25	18	17.9	***17.8***	***17.6***	***17.5***	***17.4***	***17.3***	17	981.3	94.2	30.11
313.20	25.6	24.6	24.25	23.75	23.5	23.13	***22.8***	***22.6***	***22.5***	***22.3***	***22.2***	817.8	78.5	23.05
310.70	25.8	24.9	24.63	24.13	***23.8***	***23.5***	***23.2***	22.9	***22.6***	***22.4***	22.3	439.6	42.2	10.13
308.20	26.8	25.5	***25***	***24.5***	***24***	***23.5***	23.2	***22.6***	22.5	22.3	22.1	257.5	24.7	5.52
305.70	24.3	23.6	23	22.5	22.1	***21.8***	***21.5***	21.3	***21.1***	***20.9***	***20.6***	555.2	53.3	13.64
303.20	26.3	25.5	25	24.63	24.3	24.13	***23.8***	***23.6***	***23.4***	***23.3***	***23***	654.2	62.8	16.97

Note: "***Values***" indicates data used to calculate $N_{rate,90}$.





COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	2-S	8.5	**A-6 (21) SILTY CLAY LOAM**	**40**	**20**	**20**		
⊠	2-S	18.5	**A-6 (16) SILTY CLAY LOAM**	**37**	**21**	**16**		
▲	3-S	3.5	**A-7-6 (29) SILTY CLAY**	**50**	**23**	**27**		
★	3-S	8.5	**A-7-6 (25) SILTY CLAY**	**43**	**18**	**25**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2-S	8.5	**0.425**	**0.011**	**0.002**		**0.0**	**3.0**	**71.0**	**26.0**
⊠	2-S	18.5	**0.425**	**0.013**	**0.003**		**0.0**	**3.0**	**75.0**	**22.0**
▲	3-S	3.5	**0.425**	**0.007**			**0.0**	**4.0**	**53.0**	**42.0**
★	3-S	8.5	**0.425**	**0.009**			**0.0**	**4.0**	**60.0**	**36.0**

gonzalez COMPANIES, LLC

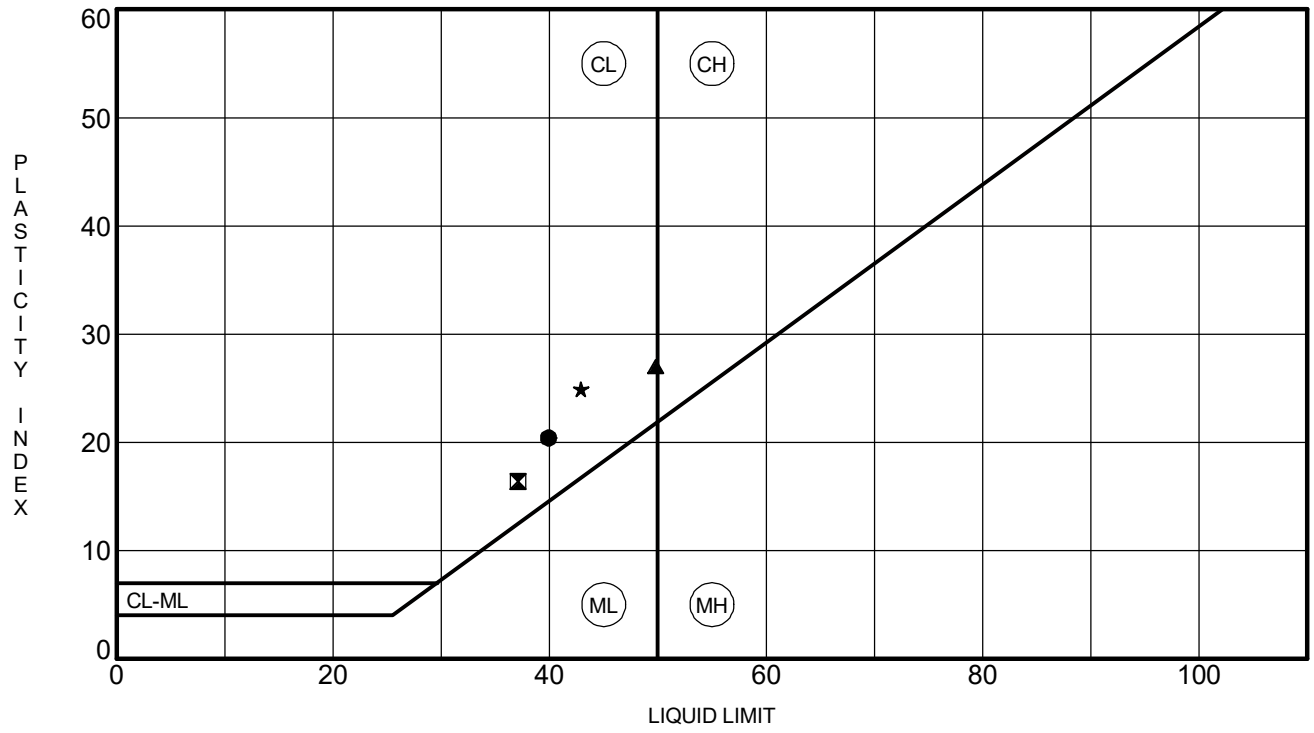
IDH GRAIN SIZE DISTRIBUTION

Route: IL 13 over North Fork of the Saline River

SN: 030-0015 (Ex) Section: 10-2B (ex.)

County: Gallatin

GRAIN_SIZE_IDH_3-18-11 21-123_2_6_IL 13 OVER N F SALINE R.GPJ IL_DOT.GDT 06/16/22



	Sample Identification	Depth	LL	PL	PI	Fines	Classification
●	**2-S**	**8.5**	**40**	**20**	**20**	**97**	**A-6 (21) SILTY CLAY LOAM**
⊠	**2-S**	**18.5**	**37**	**21**	**16**	**97**	**A-6 (16) SILTY CLAY LOAM**
▲	**3-S**	**3.5**	**50**	**23**	**27**	**95**	**A-7-6 (29) SILTY CLAY**
★	**3-S**	**8.5**	**43**	**18**	**25**	**96**	**A-7-6 (25) SILTY CLAY**

gonzalez COMPANIES, LLC

ATTERBERG LIMITS' RESULTS

Route: IL 13 over North Fork of the Saline River

SN: 030-0015 (Ex) Section: 10-2B (ex.)

County: Gallatin

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 11/2/21

ROUTE IL 13 **DESCRIPTION** Bridge over the North Fork of the Saline River (near E. Abut.) **LOGGED BY** L. Estel

SECTION 10-2B (ex.) **LOCATION** 2.5 miles West of IL 1, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, **PM**

COUNTY Gallatin **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs (HE=86.5%)

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 4-S
Station 1691+74
Offset 13.0ft Rt
Ground Surface Elev. 371.1 ft

Surface Water Elev. 324.9 ft
Stream Bed Elev. 318.9 ft

Groundwater Elev.:
▽ **First Encounter** ft
▽ **Upon Completion** ft
▼ **After** Hrs. ft

DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	Description
				Cored Shoulder, 8 in. HMA
				370.43
				V. Stiff dark Grey with specks of Black, Damp CLAY
	6			
	4 4	3.5 B	19	
				366.60
-5	2			V. Stiff dark Grey, Damp CLAY
	2 3	2.6 B	20	
	3			
	4 4	2.0 B	20	
-10	2			
	3 5	3.1 B	19	
	2			
	3 3	2.0 B	20	
-15	2			
	3 5	2.4 B	19	
	2			
	4 6	2.4 B	21	
-20	3			
	4 6	3.3 B	19	V. Stiff dark Grey, Damp CLAY *(continued)*
				349.10
	3			V. Stiff dark Grey, Damp SILTY CLAY
	3 5	2.6 B	19	
-25	2			
	3 4	2.4 B	20	
				344.10
	3			(Stiff)
	3 5	1.9 B	20	
				341.60
-30	3			Stiff dark Grey, Damp CLAY
	4 3	2.0 B	24	
				339.10
	3			Stiff Tannish Brown, Moist CLAY
	3 4	1.9 B	27	
				336.60
-35	4			V. Stiff Brownish Tan with specks of Black, Damp CLAY
	5 6	3.7 B	19	
	3			
	4 7	3.3 B	21	
-40	3			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\GALLATIN\STRUCTURES\030-0015 IL 13 OVER N F SALINE R 2021\030-0015 IL 13 OVER N F SALINE R 2021.GPJ Data Template D6TEMPLT.GDT Date Printed 6/21/22
Latitude 37 44 38.08 Longitude -88 19 46.57 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

SOIL BORING LOG

Date 11/2/21

ROUTE IL 13 **DESCRIPTION** Bridge over the North Fork of the Saline River (near E. Abut.) **LOGGED BY** L. Estel

SECTION 10-2B (ex.) **LOCATION** 2.5 miles West of IL 1, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, **PM**

COUNTY Gallatin **DRILLING METHOD** Hollow Stem Auger (8" O.D., 3.25" I.D.) **HAMMER TYPE** Auto SPT 140 lbs (HE=86.5%)

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 4-S
Station 1691+74
Offset 13.0ft Rt
Ground Surface Elev. 371.1 ft

Surface Water Elev. 324.9 ft
Stream Bed Elev. 318.9 ft

Groundwater Elev.:
▽ **First Encounter** ft
▽ **Upon Completion** ft
▽ **After** Hrs. ft

	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)	
V. Stiff Brownish Tan with specks of Black, Damp CLAY *(continued)*		6 6	2.0 B	25	
	-45	4			
		5 10	3.5 B	21	Bottom of hole @ 64.75 ft
321.60					No free water encountered
Hard Brown with specks of Black, Damp CLAY	-50	5			To convert "N" values to "N60", multiply by 1.44; Hammer efficiency = 86.5%
		6 13	4.9 B	18	Ground surface elevation referenced to BM 137, chiseled square on hub guard at SW corner of SN 030-0015, EL. 372.04
316.60					
Hard Grey, Dry CLAY SHALE Borehole continued with rock coring.	-55	100/3"		7	
	-60				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name S:\MATERIALS GEOTECHNICAL UNIT\GINT\PROJECTS\PROJECTS FILE\GALLATIN\STRUCTURES\030-0015 IL 13 OVER N F SALINE R 2021\030-0015 IL 13 OVER N F SALINE R 2021.GPJ Data Template D6TEMPLT.GDT Date Printed 6/21/22
Latitude 37 44 38.08 Longitude -88 19 46.57 Datum NAD83 Job Number

Illinois Department of Transportation
Division of Highways
District 9

ROCK CORE LOG

Date 11/2/21

ROUTE IL 13 **DESCRIPTION** Bridge over the North Fork of the Saline River (near E. Abut.) **LOGGED BY** L. Estel

SECTION 10-2B (ex.) **LOCATION** 2.5 miles West of IL 1, **SEC.** 16, **TWP.** 9S, **RNG.** 8E, **PM**

COUNTY Gallatin **CORING METHOD** Conventional rotary with polymer modified water

STRUCT. NO. 030-0015
Station 1690+10

BORING NO. 4-S
Station 1691+74
Offset 13.0ft Rt
Ground Surface Elev. 371.1 **ft**

CORING BARREL TYPE & SIZE NV3 5FT NWJ
Core Diameter 1.78 **in**
Top of Rock Elev. 316.60 **ft**
Begin Core Elev. 316.35 **ft**

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Hard Grey, Dry CLAY SHALE, Field Hardness: Moderately Hard	-55	1	92	0	22	*114.3
	311.35					
Hard Black, Dry COAL	-60	2	88	21	27	
	310.00					
Hard Grey, Dry CLAY SHALE, Field Hardness: Moderately Hard						*175.9 *370.2
	306.35					
	-65					
Bottom of hole @ 64.75 ft						
Ground surface elevation referenced to BM 137, chiseled square on hub guard at SW corner of SN 030-0015, EL. 372.04						
* Unconfined Compression Strength test results: desirable L/D ratios are between 2:1 and 2.5:1. Test specimens L/D ratios ranged between 1.5:1 and 1.7:1. Results may differ from results obtained from test specimens that meet the requirements.	-70					

Color pictures of the cores Yes, attached
Cores will be stored for examination until 5 Years after Construction
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 030-0015 IL 13 OVER N F SALINE R 2021.GPJ D6TEMPLT.GDT 6/21/22

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

IL 13
Gallatin Co. 030-0015
Boring 4-S
Lab #46 11-2-21

Boring #	Specimen#	Thickness	L/D ratio	Depth	Unconfined Compression Reading	psi
1-S	1	3.0”	*1.7:1	63’ 6”	12,785	5,141 psi
1-S	2	2.9”	*1.6:1	61’ 0”	6,075	2,443 psi
1-S	3	2.6”	*1.5:1	58’ 3”	3,950	1,588 psi

*Desirable specimen length to diameter ratios are between 2.0:1 and 2.5:1. The results may differ from results obtained from a test specimen that meets the requirements.

Foundation Core Instructions
1.78" for the diameter
(Pounds divided by 2.487)=psi

Use

$$\frac{\pi d^2}{4} = 2.487$$

EXHIBIT E

SUBSURFACE PROFILE

Elevation (ft)

380
370
360
350
340
330
320
310
300

1-S
1690+41
13.0 ft Lt

N	Qu	w%		
			371.8	Cored Shoulder, 8 in. HMA
12	4.9	15		Hard dark Grey and Brown Laminate, Damp CLAY
		B		
8	1.5	21		Stiff dark Grey and Brown Laminate, Damp CLAY
		B		
10	1.9	17		Stiff dark Greyish Brown, Damp SILTY CLAY
		S		
4	0.8	23		
		B		M. Stiff dark Greyish Brown, Damp SILTY CLAY
4	0.8	22		
		B		
5	0.2	25		V. Soft dark Greyish Brown, Moist SILTY CLAY
		B		
5	1.0	23		M. Stiff dark Grey, Moist CLAY
		B		
6	0.4	25		Soft Brown, Moist CLAY
		B		
8	2.9	20		V. Stiff dark Grey, Damp CLAY
		B		
7	1.0	22		Stiff dark Grey and Brown, Damp CLAY
		B		
7	2.2	19		V. Stiff dark Grey with streaks of Black, Damp CLAY
		B		
11	1.6	20		
		B		Stiff dark Grey and Brown with streaks of Black, Damp CLAY
8	1.4	22		
		B		
9	1.5	18		
		B		Stiff dark Grey and Brown, Damp SILTY CLAY
10	1.0	21		
		B		
10	1.6	22		
		B		Stiff Grey with streaks of Brown, Damp CLAY - SILTY CLAY
17	2.0	20		
		B		Stiff Brownish Grey, Damp CLAY
100/3"		-		
			321.1	Grey, Dry CLAY SHALE

2-S
1690+10
61.0 ft Rt

N	Qu	w%		
			345.9	
2	0.6	29		Soft to Medium Stiff, Brown, Moist, CLAY (FILL)
		B		
76	0.8	22		Medium Dense, Gray, GRAVEL, with clay (FILL)
		P		
3	0.9	27		Soft to Medium Stiff, Moist, Brown, CLAY (FILL)
		B		
2	2.3	22		
		B		
8	1.7	22		
		B		Soft to Medium Stiff, Moist, Gray and Brown, SILTY CLAY LOAM; A-6(21)
8	2.7	20		LL=40
		B		PL=20
8	1.5	24		PI=20
		B		3% Sand, 72%Silt, 26% Clay
57	1.7	23		
		B		
		4		
		4		
23.6		3		
MSPT				Gray, CLAY SHALE, Dry, Weathered, Soft Field Hardness
27.7		4		
MSPT				
23.6		4		
MSPT				
14.2		29		
MSPT				Black, COAL, Soft Field Hardness
47.1		11		
MSPT				Gray to Black, CLAY SHALE, Dry, Weathered, Soft Field Hardness
88.1		14		
MSPT			307.3	

3-S
1691+07
72.0 ft Lt

N	Qu	w%		
			341.7	
8	1.8	21		
		B		
7	1.8	23		Medium Stiff to Stiff, Moist, Brown and Gray, SILTY CLAY (FILL)
		S		
7	2.2	23		
		B		
5	1.3	22		
		B		
4	1.1	23		
		B		
3	0.7	25		
		B		Medium Stiff, Moist, Brown to Gray, SILTY CLAY, with iron nodules; A-7-6(25)
5	1.3	22		LL=43
		B		PL=18
9	1.5	22		PI=25
		B		4% Sand, 60% Silt, 36% Clay
24	4.8	23		
		B		Very Stiff, Dry, Brown, CLAY
58	1.0	20		
		B		Medium Stiff, Dry, Brown, SANDY CLAY
47.1		15		
MSPT				
39.3		10		
MSPT				Brown to Gray, CLAY SHALE, Dry, Weathered, Soft Field Hardness
21.1		9		
MSPT				
12.4		5		
MSPT				
26.7		12		
MSPT				Black, COAL, Soft Field Hardness
31.4		8		
MSPT			302.9	Gray, CLAY SHALE, Dry, Weathered, Soft Field Hardness

4-S
1691+74
13.0 ft Rt

N	Qu	w%		
			371.1	Cored Shoulder, 8 in. HMA
8	3.5	19		V. Stiff dark Grey with specks of Black, Damp CLAY
		B		
5	2.6	20		
		B		
8	2.0	20		
		B		
8	3.1	19		
		B		
6	2.0	20		V. Stiff dark Grey, Damp CLAY
		B		
8	2.4	19		
		B		
10	2.4	21		
		B		
10	3.3	19		
		B		
8	2.6	19		
		B		
7	2.4	20		V. Stiff dark Grey, Damp SILTY CLAY
		B		
8	1.9	20		
		B		
7	2.0	24		Stiff dark Grey, Damp CLAY
		B		
7	1.9	27		Stiff Tannish Brown, Moist CLAY
		B		
11	3.7	19		
		B		
11	3.3	21		
		B		
12	2.0	25		
		B		V. Stiff Brownish Tan with specks of Black, Damp CLAY
15	3.5	21		
		B		
19	4.9	18		
		B		Hard Brown with specks of Black, Damp CLAY
		7		
				Hard Grey, Dry CLAY SHALE, Field Hardness: Moderately Hard
114.3				
				Hard Black, Dry COAL
175.9				
				Hard Grey, Dry CLAY SHALE, Field Hardness: Moderately Hard
370.2				
			306.4	

Illinois Department of Transportation
Division of Highways

NOT TO HORIZONTAL SCALE

SUBSURFACE PROFILE

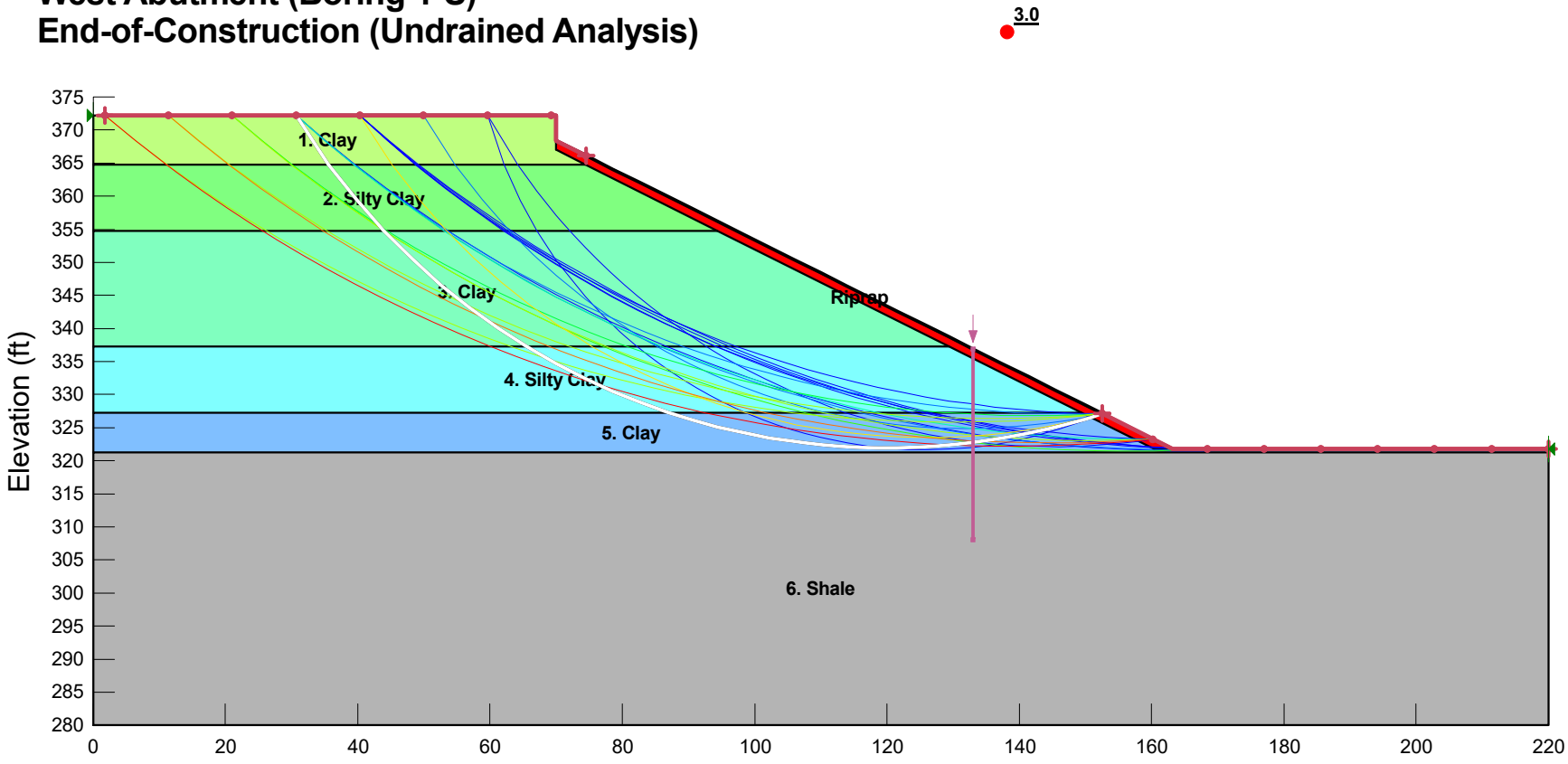
Route: IL 13
Section: (10--1,10-3-1)B-2
County: Gallatin

PRINTERMOD2 11X17 22-1060.04 IL 13 OVER NORTH FORK SALINE RIVER.GPJ IL_DOT.GDT 1/16/24

EXHIBIT F

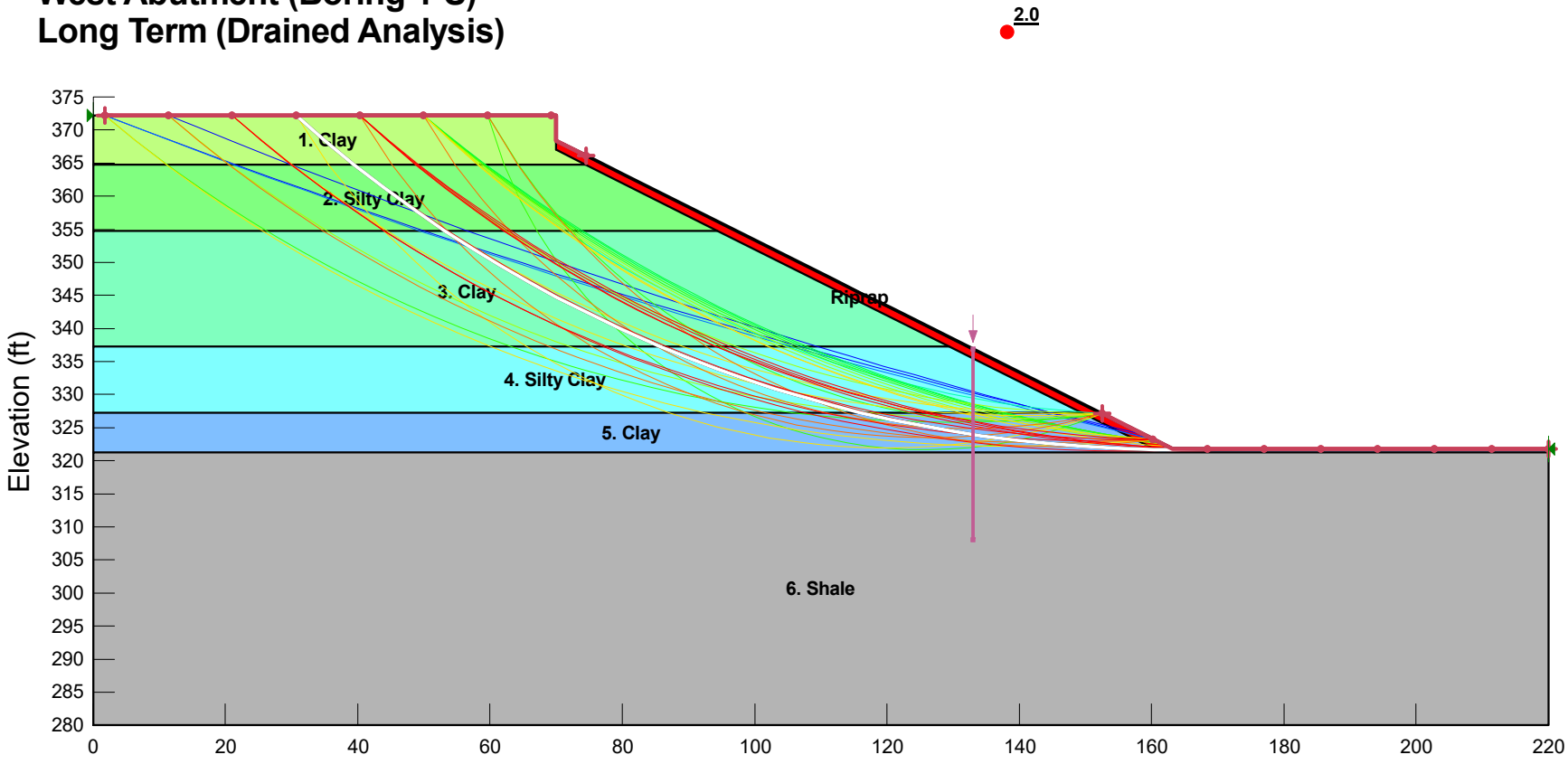
SLOPE/W SLOPE STABILITY ANALYSIS

IL 13 over North Fork Saline River
West Abutment (Boring 1-S)
End-of-Construction (Undrained Analysis)



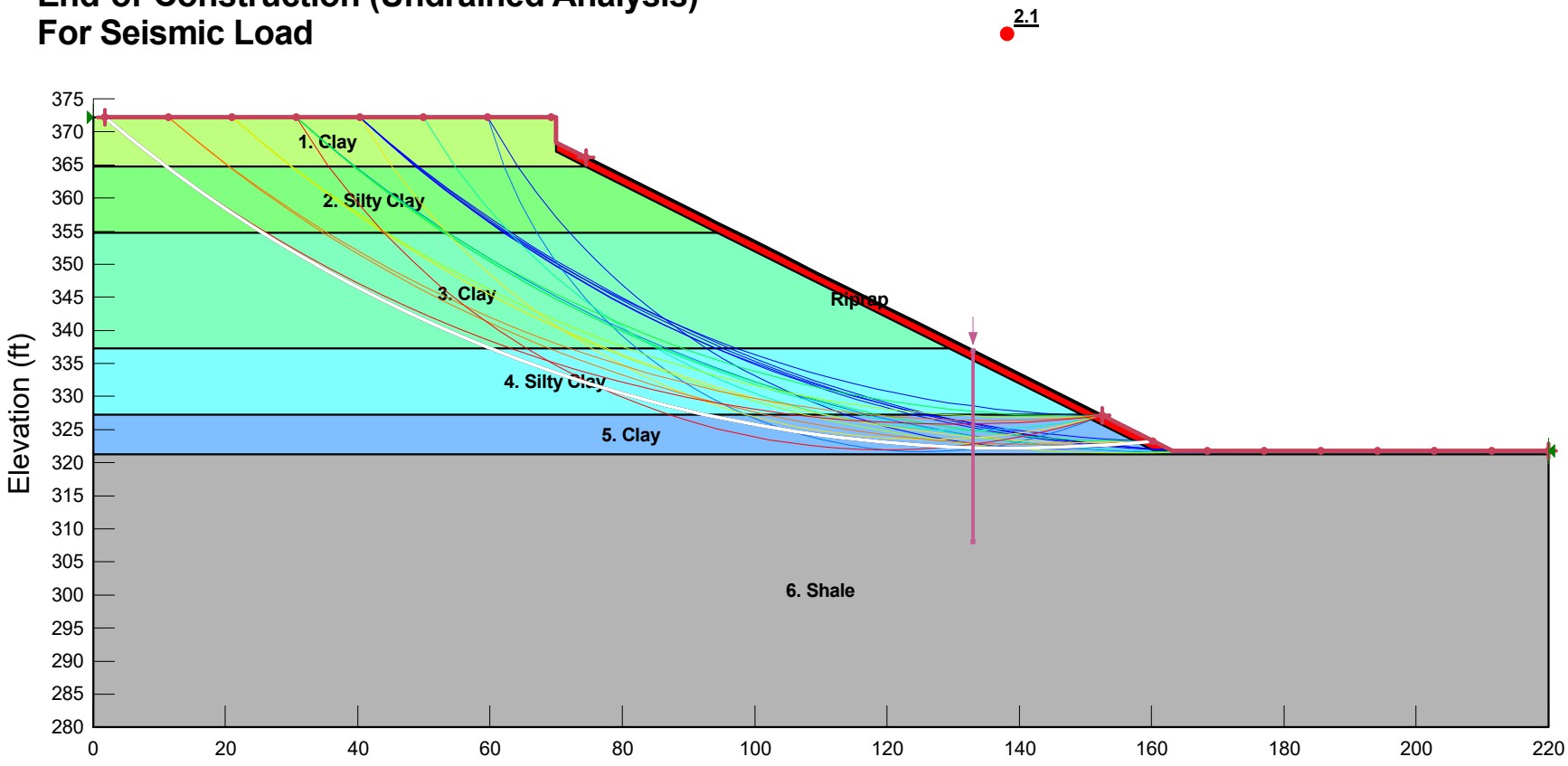
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1. Clay	Mohr-Coulomb	120	3,200	0
	2. Silty Clay	Mohr-Coulomb	120	900	0
	3. Clay	Mohr-Coulomb	120	1,500	0
	4. Silty Clay	Mohr-Coulomb	120	1,350	0
	5. Clay	Mohr-Coulomb	120	2,000	0
	6. Shale	Mohr-Coulomb	135	10,000	12
	Riprap	Mohr-Coulomb	145	0	45

IL 13 over North Fork Saline River
West Abutment (Boring 1-S)
Long Term (Drained Analysis)



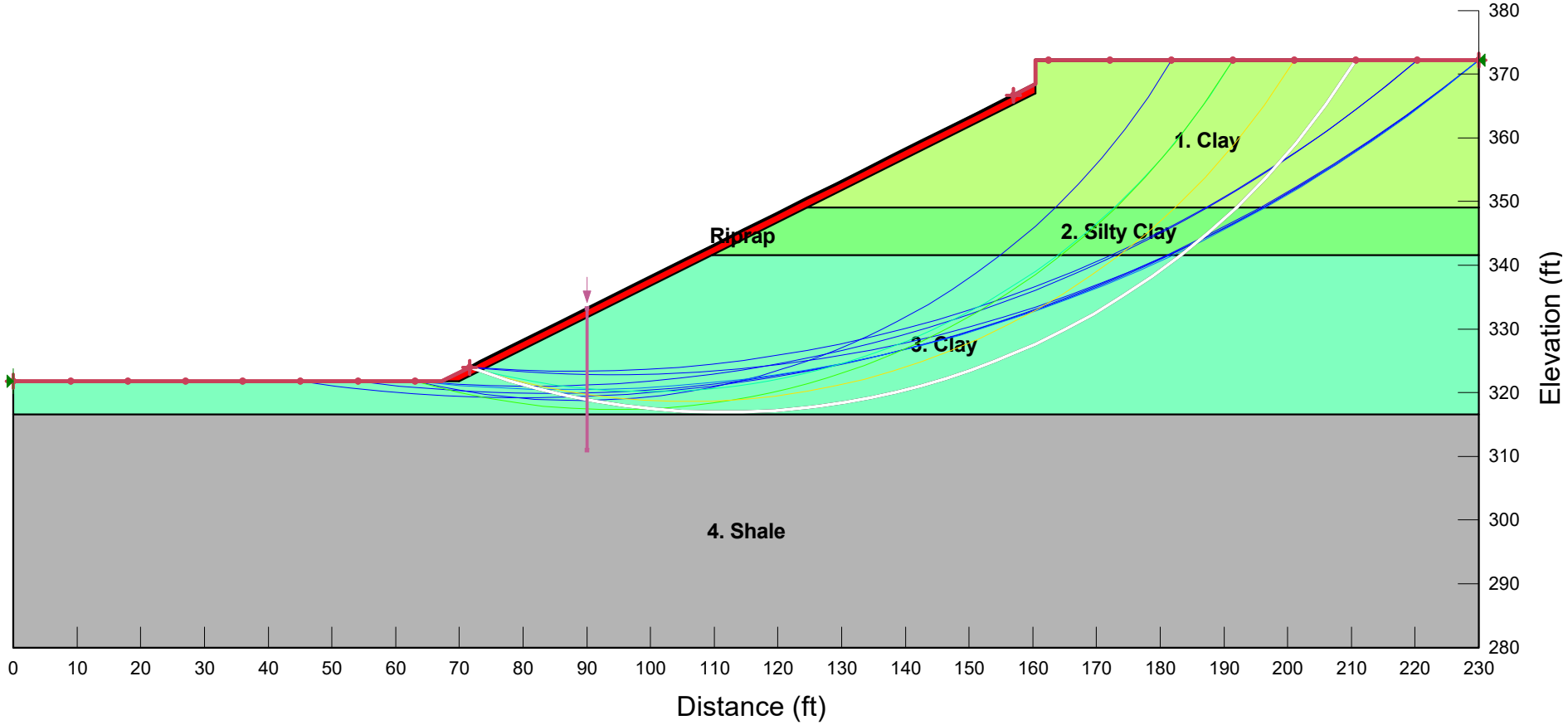
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1. Clay	Mohr-Coulomb	120	100	26
	2. Silty Clay	Mohr-Coulomb	120	100	26
	3. Clay	Mohr-Coulomb	120	100	26
	4. Silty Clay	Mohr-Coulomb	120	100	26
	5. Clay	Mohr-Coulomb	120	100	26
	6. Shale	Mohr-Coulomb	135	10,000	12
	Riprap	Mohr-Coulomb	145	0	45

IL 13 over North Fork Saline River
West Abutment (Boring 1-S)
End-of-Construction (Undrained Analysis)
For Seismic Load



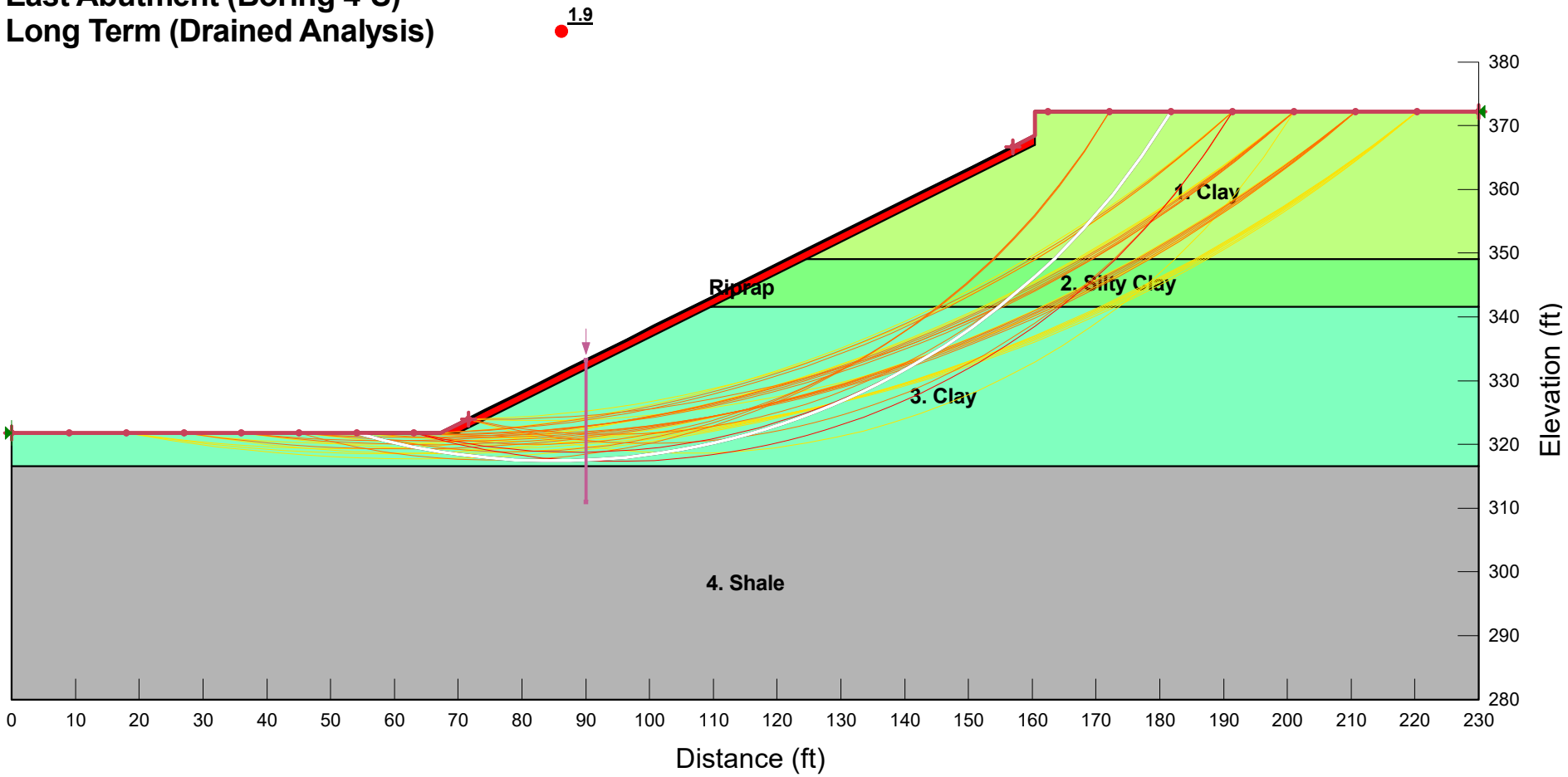
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1. Clay	Mohr-Coulomb	120	3,200	0
	2. Silty Clay	Mohr-Coulomb	120	900	0
	3. Clay	Mohr-Coulomb	120	1,500	0
	4. Silty Clay	Mohr-Coulomb	120	1,350	0
	5. Clay	Mohr-Coulomb	120	2,000	0
	6. Shale	Mohr-Coulomb	135	10,000	12
	Riprap	Mohr-Coulomb	145	0	45

IL 13 over North Fork Saline River
East Abutment (Boring 4-S)
End-of-Construction (Undrained Analysis)



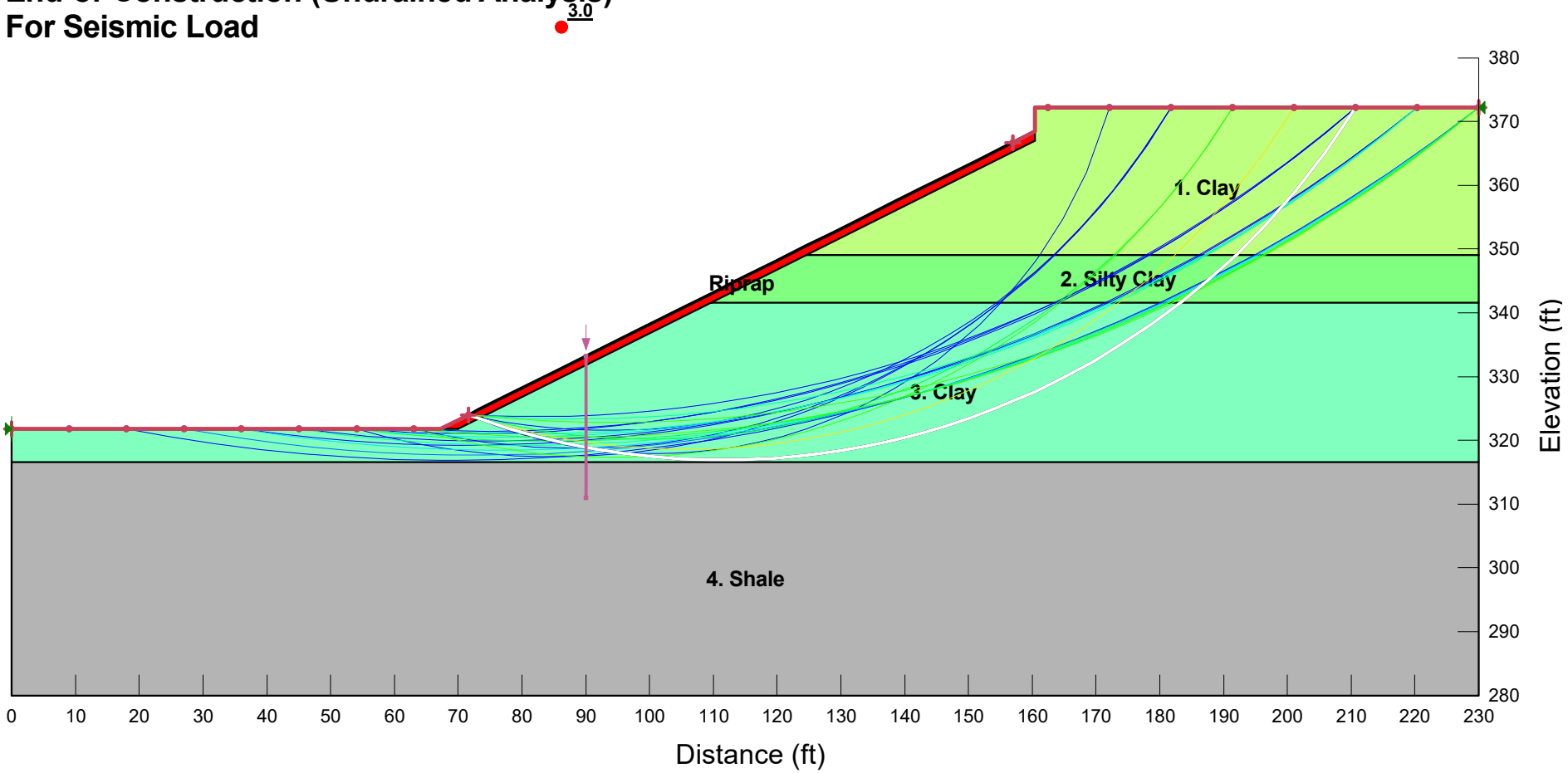
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1. Clay	Mohr-Coulomb	120	2,600	0
	2. Silty Clay	Mohr-Coulomb	120	2,300	0
	3. Clay	Mohr-Coulomb	120	3,000	0
	4. Shale	Mohr-Coulomb	135	10,000	12
	Riprap	Mohr-Coulomb	145	0	45

IL 13 over North Fork Saline River
East Abutment (Boring 4-S)
Long Term (Drained Analysis)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1. Clay	Mohr-Coulomb	120	100	26
	2. Silty Clay	Mohr-Coulomb	120	100	26
	3. Clay	Mohr-Coulomb	120	100	26
	4. Shale	Mohr-Coulomb	135	10,000	12
	Riprap	Mohr-Coulomb	145	0	45

IL 13 over North Fork Saline River
East Abutment (Boring 4-S)
End-of-Construction (Undrained Analysis)
For Seismic Load



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1. Clay	Mohr-Coulomb	120	2,600	0
	2. Silty Clay	Mohr-Coulomb	120	2,300	0
	3. Clay	Mohr-Coulomb	120	3,000	0
	4. Shale	Mohr-Coulomb	135	10,000	12
	Riprap	Mohr-Coulomb	145	0	45

EXHIBIT G

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 2-S
ELEVATION OF BORING GROUND SURFACE ========== 345.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 20.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.327
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -17.10 FT. (Cut Depth)
HAMMER EFFICIENCY========== 92 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/ Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{\cdot}_{s,40'}$ = **859** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 4.9
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.244**

	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
343.4	2.5	2	0.6	98	35	50	29	0.116	0.290	4.353	10.224	0.115								
341.6	4.3	2	0.8	98	35	50	29	0.119	0.504	4.047	9.856	0.112								
340.4	5.5	76					22	0.143	0.676	######	145.592	1.065								
339.2	6.7	3	0.9	98	20	40	27	0.120	0.820	5.501	11.601	0.128								
337.9	8	3	0.9	98	20	40	27	0.120	0.976	5.385	11.463	0.126								
335.4	10.5	2	2.3	98	20	40	22	0.132	1.306	3.525	9.230	0.106								
332.9	13	8	1.7	98	20	40	22	0.128	1.626	13.687	21.424	0.234								
330.4	15.5	8	2.7	98	20	40	20	0.134	1.961	13.124	20.748	0.225								
327.9	18	8	1.5	97	16	37	24	0.126	2.276	12.575	20.090	0.217	0.064	0.058	0.114	1.500	**0.325**	1.000	**0.420**	**N.L. (2)**
326.1	19.8	57	1.7				23	0.128	2.506	86.642	86.642	0.618	0.066	0.176	0.345	1.500	**0.927**	1.000	**0.415**	**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
ELEVATION OF BORING GROUND SURFACE ========== 345.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 20.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.327
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -17.10 FT. (Cut Depth)
HAMMER EFFICIENCY========== 92 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/ Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **859** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 110
Ground Motion Prediction Equations = NMSZ
PGA = **0.134**

	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
343.4	2.5	2	0.6	98	35	50	29	0.116	0.290	4.353	10.224	0.115								
341.6	4.3	2	0.8	98	35	50	29	0.119	0.504	4.047	9.856	0.112								
340.4	5.5	76					22	0.143	0.676	######	145.592	1.065								
339.2	6.7	3	0.9	98	20	40	27	0.120	0.820	5.501	11.601	0.128								
337.9	8	3	0.9	98	20	40	27	0.120	0.976	5.385	11.463	0.126								
335.4	10.5	2	2.3	98	20	40	22	0.132	1.306	3.525	9.230	0.106								
332.9	13	8	1.7	98	20	40	22	0.128	1.626	13.687	21.424	0.234								
330.4	15.5	8	2.7	98	20	40	20	0.134	1.961	13.124	20.748	0.225								
327.9	18	8	1.5	97	16	37	24	0.126	2.276	12.575	20.090	0.217	0.064	0.058	0.114	1.500	**0.325**	1.000	**0.420**	**N.L. (2)**
326.1	19.8	57	1.7	97	16	37	23	0.128	2.506	86.642	108.971	0.789	0.066	0.176	0.345	1.500	**1.183**	1.000	**0.415**	**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
ELEVATION OF BORING GROUND SURFACE ========== 345.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 20.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.327
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -17.10 FT. (Cut Depth)
HAMMER EFFICIENCY========== 92 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/ Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **859** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 170
Ground Motion Prediction Equations = NMSZ
PGA = **0.103**

	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
343.4	2.5	2	0.6	98	35	50	29	0.116	0.290	4.353	10.224	0.115								
341.6	4.3	2	0.8	98	35	50	29	0.119	0.504	4.047	9.856	0.112								
340.4	5.5	76					22	0.143	0.676	######	145.592	1.065								
339.2	6.7	3	0.9	98	20	40	27	0.120	0.820	5.501	11.601	0.128								
337.9	8	3	0.9	98	20	40	27	0.120	0.976	5.385	11.463	0.126								
335.4	10.5	2	2.3	98	20	40	22	0.132	1.306	3.525	9.230	0.106								
332.9	13	8	1.7	98	20	40	22	0.128	1.626	13.687	21.424	0.234								
330.4	15.5	8	2.7	98	20	40	20	0.134	1.961	13.124	20.748	0.225								
327.9	18	8	1.5	97	16	37	24	0.126	2.276	12.575	20.090	0.217	0.064	0.058	0.114	1.500	**0.308**	1.000	**0.420**	**N.L. (2)**
326.1	19.8	57	1.7	97	16	37	23	0.128	2.506	86.642	108.971	0.789	0.066	0.176	0.345	1.500	**1.122**	1.000	**0.415**	**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 ========== 3-S
ELEVATION OF BORING GROUND SURFACE ========== 341.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 17.20 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.327
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -12.90 FT. (Cut Depth)
HAMMER EFFICIENCY========== 92 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/ Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{\cdot}_{s,40'}$ = **491** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 4.9
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = CEUS
PGA = **0.244**

	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
339.2	2.5	8	1.8	95	27	50	21	0.128	0.320	17.229	25.675	0.306								
336.7	5	7	1.8	95	27	50	23	0.128	0.640	13.561	21.273	0.232								
333.7	8	7	2.2	95	27	50	21	0.131	1.033	12.365	19.838	0.213								
331.7	10	5	1.3	96	25	43	22	0.125	1.283	8.757	15.508	0.165								
329.2	12.5	4	1.1	96	25	43	23	0.123	1.591	6.842	13.211	0.143								
326.7	15	3	0.7	96	25	43	25	0.117	1.883	4.977	10.973	0.122	0.055	0.116	0.247	1.500	**0.183**	0.988	**0.448**	**N.L. (2)**
324.2	17.5	5	1.3	96	25	43	22	0.062	2.038	8.232	14.878	0.159	0.062	0.271	0.558	1.500	**0.238**	0.971	**0.425**	**N.L. (2)**
321.7	20	9	1.5	96	25	43	22	0.064	2.198	14.588	22.506	0.249	0.064	0.431	0.874	1.500	**0.374**	0.951	**0.410**	**N.L. (2)**
317.7	24	24	4.8	96	30	51	23	0.079	2.514	37.179	49.615	0.299	0.079	0.747	1.439	1.500	**0.448**	0.911	**0.373**	**N.L. (2)**
317.2	24.5	14	1	60	12	20	20	0.059	2.544	21.600	30.920	0.549	0.059	0.776	1.500	1.439	**0.790**	0.905	**0.372**	**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 ========== 3-S
ELEVATION OF BORING GROUND SURFACE ========== 341.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 17.20 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.327
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -12.90 FT. (Cut Depth)
HAMMER EFFICIENCY========== 92 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/ Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **1.000**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **491** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.5
Source-To-Site Distance, R (km) = 110
Ground Motion Prediction Equations = NMSZ
PGA = **0.134**

	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
339.2	2.5	8	1.8	95	27	50	21	0.128	0.320	17.229	25.675	0.306								
336.7	5	7	1.8	95	27	50	23	0.128	0.640	13.561	21.273	0.232								
333.7	8	7	2.2	95	27	50	21	0.131	1.033	12.365	19.838	0.213								
331.7	10	5	1.3	96	25	43	22	0.125	1.283	8.757	15.508	0.165								
329.2	12.5	4	1.1	96	25	43	23	0.123	1.591	6.842	13.211	0.143								
326.7	15	3	0.7	96	25	43	25	0.117	1.883	4.977	10.973	0.122	0.055	0.116	0.247	1.500	**0.183**	0.988	**0.448**	**N.L. (2)**
324.2	17.5	5	1.3	96	25	43	22	0.062	2.038	8.232	14.878	0.159	0.062	0.271	0.558	1.500	**0.238**	0.971	**0.425**	**N.L. (2)**
321.7	20	9	1.5	96	25	43	22	0.064	2.198	14.588	22.506	0.249	0.064	0.431	0.874	1.500	**0.374**	0.951	**0.410**	**N.L. (2)**
317.7	24	24	4.8	96	30	51	23	0.079	2.514	37.179	49.615	0.299	0.079	0.747	1.439	1.500	**0.448**	0.911	**0.373**	**N.L. (2)**
317.2	24.5	14	1	60	12	20	20	0.059	2.544	21.600	30.920	0.549	0.059	0.776	1.500	1.439	**0.790**	0.905	**0.372**	**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 ==========: 3-S
ELEVATION OF BORING GROUND SURFACE ==========: 341.70 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 17.20 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.327
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: -12.90 FT. (Cut Depth)
HAMMER EFFICIENCY==========: 92 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/ Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **491** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 170
Ground Motion Prediction Equations = NMSZ
PGA = **0.103**

	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
339.2	2.5	8	1.8	95	27	50	21	0.128	0.320	17.229	25.675	0.306								
336.7	5	7	1.8	95	27	50	23	0.128	0.640	13.561	21.273	0.232								
333.7	8	7	2.2	95	27	50	21	0.131	1.033	12.365	19.838	0.213								
331.7	10	5	1.3	96	25	43	22	0.125	1.283	8.757	15.508	0.165								
329.2	12.5	4	1.1	96	25	43	23	0.123	1.591	6.842	13.211	0.143								
326.7	15	3	0.7	96	25	43	25	0.117	1.883	4.977	10.973	0.122	0.055	0.116	0.247	1.500	**0.173**	0.988	**0.448**	**N.L. (2)**
324.2	17.5	5	1.3	96	25	43	22	0.062	2.038	8.232	14.878	0.159	0.062	0.271	0.558	1.500	**0.226**	0.972	**0.426**	**N.L. (2)**
321.7	20	9	1.5	96	25	43	22	0.064	2.198	14.588	22.506	0.249	0.064	0.431	0.874	1.500	**0.355**	0.952	**0.411**	**N.L. (2)**
317.7	24	24	4.8	96	30	51	23	0.079	2.514	37.179	49.615	0.299	0.079	0.747	1.439	1.500	**0.425**	0.913	**0.374**	**N.L. (2)**
317.2	24.5	14	1	60	12	20	20	0.059	2.544	21.600	30.920	0.549	0.059	0.776	1.500	1.439	**0.749**	0.907	**0.373**	**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

*** Deaggregation of Seismic Hazard at One Period of Spectral Acceleration ***
*** Data from Dynamic: Conterminous U.S. 2014 (update) (4.2.0) ****
PSHA Deaggregation. %contributions.
site: Test
longitude: 88.330°W
latitude: 37.744°E
imt: Peak Ground Acceleration
vs30 = 760 m/s (B/C boundary)
return period: 475 yrs.
#This deaggregation corresponds to: Total
Summary statistics for PSHA PGA deaggregation, r=distance, ε=epsilon:
Deaggregation targets:
 Return period: 475 yrs
 Exceedance rate: 0.0021052632 yr^{-1}
 PGA ground motion: 0.15038259 g
Recovered targets:
 Return period: 476.23677 yrs
 Exceedance rate: 0.0020997959 yr^{-1}
Totals:
 Binned: 100 %
 Residual: 0 %
 Trace: 1.04 %
Mean (over all sources):
 m: 6.44
 r: 76.19 km
 ε_0: 0.02 σ
Mode (largest m-r bin):
 m: 7.77
 r: 171.39 km
 ε_0: 0.37 σ
 Contribution: 7.23 %
Mode (largest m-r-ε_0 bin):
 m: 7.53
 r: 118.05 km
 ε_0: -0.25 σ
 Contribution: 3.58 %
Discretization:
 r: min = 0.0, max = 1000.0, Δ = 20.0 km
 m: min = 4.4, max = 9.4, Δ = 0.2
 ε: min = -3.0, max = 3.0, Δ = 0.5 σ
Epsilon keys:
 ε0: [-∞ .. -2.5)
 ε1: [-2.5 .. -2.0)
 ε2: [-2.0 .. -1.5)
 ε3: [-1.5 .. -1.0)
 ε4: [-1.0 .. -0.5)
 ε5: [-0.5 .. 0.0)
 ε6: [0.0 .. 0.5)
 ε7: [0.5 .. 1.0)
 ε8: [1.0 .. 1.5)
 ε9: [1.5 .. 2.0)
 ε10: [2.0 .. 2.5)
 ε11: [2.5 .. +∞]

Closest Distance, rRup (km)	Magnitude (Mw)	ALL_ε	ε=(-∞,-2.5)	ε=[-2.5,-2)	ε=[-2,-1.5)	ε=[-1.5,-1)	ε=[-1,-0.5)	ε=[-0.5,0)	ε=[0,0.5)	ε=[0.5,1)	ε=[1,1.5)	ε=[1.5,2)	ε=[2,2.5)	ε=[2.5,∞)
170	7.7	7.229	0	0	0	0	0	1.682	3.349	1.259	0.506	0.274	0.159	0
90	7.5	6.563	0	0	0	0.146	2.62	2.667	0.717	0.004	0.274	0.135	0	0
10	4.9	6.107	0	0	0.71	0.44	1.613	1.745	0.958	0.477	0.163	0	0	0
110	7.5	6.04	0	0	0	0	0.371	3.576	1.125	0.546	0.245	0.177	0	0
10	5.1	4.491	0	0.458	0.174	0.535	1.611	0.862	0.491	0.271	0.089	0	0	0
10	4.7	3.754	0	0	0.341	0.32	0.852	1.163	0.685	0.327	0	0.067	0	0
90	7.3	3.303	0	0	0	0	0.005	1.928	0.806	0.391	0	0.174	0	0
170	7.5	3.204	0	0	0	0	0	0	1.37	1.211	0.413	0.103	0.107	0
10	5.3	3.196	0.09	0.314	0.162	0.652	1.028	0.507	0.283	0.162	0	0	0	0
30	4.9	2.613	0	0	0	0	0	0	0.367	1.124	0.728	0.337	0.052	0.005
30	5.1	2.517	0	0	0	0	0	0.121	0.773	0.882	0.585	0.125	0.025	0.007
30	5.3	2.302	0	0	0	0	0	0.464	0.729	0.721	0.309	0.057	0.021	0.002
10	5.5	2.215	0.256	0.049	0.118	0.909	0.249	0.386	0.248	0	0	0	0	0
30	5.5	1.991	0	0	0	0	0.219	0.446	0.678	0.513	0.083	0.042	0.011	0
170	7.9	1.791	0	0	0	0	0.394	0.274	0.871	0.055	0.112	0.06	0.025	0
90	7.7	1.732	0	0	0	0.465	0.77	0.257	0.109	0.059	0.033	0.038	0	0
30	5.7	1.632	0	0	0	0.099	0.218	0.487	0.499	0.224	0.073	0.029	0.004	0
10	5.7	1.502	0.162	0.087	0.254	0.46	0.252	0.136	0.151	0	0	0	0	0
190	7.5	1.446	0	0	0	0	0	0	0.135	0.772	0.328	0.152	0.058	0
90	6.9	1.325	0	0	0	0	0	0.226	0.559	0.481	0.014	0.015	0.031	0
30	4.7	1.306	0	0	0	0	0	0	0	0.507	0.552	0.193	0.049	0.006
110	6.9	1.278	0	0	0	0	0	0	0.295	0.654	0.267	0	0.062	0
30	5.9	1.266	0	0	0.034	0.115	0.245	0.447	0.283	0.086	0.041	0.014	0	0
30	6.1	1.179	0	0.028	0.129	0.108	0.238	0.4	0.166	0.064	0.034	0.012	0	0
190	7.7	1.07	0	0	0	0	0	0.127	0.289	0.484	0.086	0.049	0.035	0
190	7.9	1.057	0	0	0	0	0.008	0.269	0.47	0.187	0.069	0.033	0.02	0
10	5.9	1	0.147	0.097	0.251	0.161	0.204	0.098	0.043	0	0	0	0	0
170	7.3	0.971	0	0	0	0	0	0	0	0.565	0.222	0.136	0.048	0
10	6.1	0.832	0.2	0.132	0.143	0.127	0.151	0.057	0.022	0	0	0	0	0
30	6.3	0.763	0	0.046	0.061	0.09	0.261	0.157	0.089	0.033	0.027	0	0	0
110	7.1	0.685	0	0	0	0	0	0.011	0.419	0.163	0.056	0.032	0.005	0
90	7.1	0.677	0	0	0	0	0	0.259	0.314	0.076	0	0.016	0.012	0
10	6.3	0.653	0.187	0.113	0.081	0.118	0.092	0.062	0	0	0	0	0	0

EXHIBIT H

PILE LENGTH/PILE TYPE

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== West Abutment
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 366.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 364.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 364.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1370 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 234.04 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 87.76 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	**49** 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.)
362.30	2.20	1.90			8.2		15.8	12.0		***13.0***	13	0	0	7	4
359.80	2.50	0.80			4.9	7.6	20.2	7.2	1.0	***20.1***	20	0	0	11	7
357.30	2.50	0.75			4.6	7.2	***19.6***	6.8	0.9	26.2	20	0	0	11	9
354.80	2.50	0.20			1.4	1.9	***28.6***	2.0	0.2	29.2	29	0	0	16	12
352.30	2.50	1.00			5.9	9.5	***28.7***	8.6	1.2	37.1	29	0	0	16	14
349.80	2.50	0.40			2.6	3.8	55.1	3.9	0.5	***44.0***	44	0	0	24	17
347.30	2.50	2.90			12.3	27.7	***49.4***	18.1	3.5	59.8	49	0	0	27	19
344.80	2.50	1.00			5.9	9.5	***66.7***	8.6	1.2	69.9	67	0	0	37	22
342.30	2.50	2.20			10.2	21.0	***71.1***	15.0	2.7	84.2	71	0	0	39	24
339.80	2.50	1.60			8.3	15.3	***77.5***	12.2	1.9	96.2	78	0	0	43	27
337.30	2.50	1.40			7.6	13.3	***86.0***	11.1	1.7	107.4	86	0	0	47	29
334.80	2.50	1.50			7.9	14.3	***89.2***	11.7	1.8	118.5	89	0	0	49	32
332.30	2.50	1.00			5.9	9.5	***100.8***	8.6	1.2	127.9	101	0	0	55	34
329.80	2.50	1.60			8.3	15.3	***109.1***	12.2	1.9	140.1	109	0	0	60	37
327.30	2.50	1.60			8.3	15.3	***121.2***	12.2	1.9	152.8	121	0	0	67	39
324.80	2.50	2.00			9.6	19.1	***130.8***	14.1	2.4	166.9	131	0	0	72	42
321.30	3.50	2.00			13.4	19.1	209.9	19.8	2.4	***195.0***	195	0	0	107	45
320.30	1.00			Shale	41.1	84.8	***251.0***	60.5	10.7	255.5	251	0	0	138	46.2
319.30	1.00			Shale	41.1	84.8	***292.1***	60.5	10.7	316.1	292	0	0	161	47.2
318.30	1.00			Shale	41.1	84.8	***333.3***	60.5	10.7	376.6	333	0	0	183	48.2
317.30	1.00			Shale	41.1	84.8	***374.4***	60.5	10.7	437.1	~~374~~	~~0~~	~~0~~	~~206~~	~~49.2~~
316.30	1.00			Shale	41.1	84.8	***415.5***	60.5	10.7	497.6	~~415~~	~~0~~	~~0~~	~~229~~	~~50.2~~
315.30	1.00			Shale	41.1	84.8	***456.6***	60.5	10.7	558.1	~~457~~	~~0~~	~~0~~	~~251~~	~~51.2~~
314.30	1.00			Shale	41.1	84.8	***497.7***	60.5	10.7	618.7	~~498~~	~~0~~	~~0~~	~~274~~	~~52.2~~
313.30	1.00			Shale	41.1	84.8	***538.8***	60.5	10.7	679.2	~~539~~	~~0~~	~~0~~	~~296~~	~~53.2~~
312.30	1.00			Shale	41.1	84.8	***579.9***	60.5	10.7	739.7	~~580~~	~~0~~	~~0~~	~~319~~	~~54.2~~
311.30	1.00			Shale	41.1	84.8	***621.0***	60.5	10.7	800.2	~~621~~	~~0~~	~~0~~	~~342~~	~~55.2~~
310.30	1.00			Shale	41.1	84.8	***662.1***	60.5	10.7	860.7	~~662~~	~~0~~	~~0~~	~~364~~	~~56.2~~
309.30	1.00			Shale	41.1	84.8	***703.2***	60.5	10.7	921.3	~~703~~	~~0~~	~~0~~	~~387~~	~~57.2~~
308.30	1.00			Shale	41.1	84.8	***744.3***	60.5	10.7	981.8	~~744~~	~~0~~	~~0~~	~~409~~	~~58.2~~
307.30	1.00			Shale	41.1	84.8	***785.4***	60.5	10.7	1042.3	~~785~~	~~0~~	~~0~~	~~432~~	~~59.2~~
306.30	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. ========== 366.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 328.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 333.60 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**300** KIPS	**165** KIPS	**45** FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 3385 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 46.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 578.26 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 216.85 KIPS

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

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED 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.)
326.10	2.70	1.70			9.3		94.1	13.7		***24.5***	24	0	0	13	40
325.10	1.00			Shale	41.1	84.8	135.2	60.5	10.7	***85.0***	85	0	0	47	41.4
324.10	1.00			Shale	41.1	84.8	176.3	60.5	10.7	***145.5***	146	0	0	80	42.4
323.10	1.00			Shale	41.1	84.8	217.4	60.5	10.7	***206.0***	206	0	0	113	43.4
322.10	1.00			Shale	41.1	84.8	***258.5***	60.5	10.7	266.5	259	0	0	142	44.4
321.10	1.00			Shale	41.1	84.8	***299.6***	60.5	10.7	327.1	300	0	0	165	45.4
320.10	1.00			Shale	41.1	84.8	***340.7***	60.5	10.7	387.6	~~341~~	~~0~~	~~0~~	~~187~~	~~46.4~~
319.10	1.00			Shale	41.1	84.8	***381.8***	60.5	10.7	448.1	~~382~~	~~0~~	~~0~~	~~210~~	~~47.4~~
318.10	1.00			Shale	41.1	84.8	***423.0***	60.5	10.7	508.6	~~423~~	~~0~~	~~0~~	~~233~~	~~48.4~~
317.10	1.00			Shale	41.1	84.8	***464.1***	60.5	10.7	569.2	~~464~~	~~0~~	~~0~~	~~255~~	~~49.4~~
316.10	1.00			Shale	41.1	84.8	***505.2***	60.5	10.7	629.7	~~505~~	~~0~~	~~0~~	~~278~~	~~50.4~~
315.10	1.00			Shale	41.1	84.8	***546.3***	60.5	10.7	690.2	~~546~~	~~0~~	~~0~~	~~300~~	~~51.4~~
314.10	1.00			Shale	41.1	84.8	***587.4***	60.5	10.7	750.7	~~587~~	~~0~~	~~0~~	~~323~~	~~52.4~~
313.10	1.00			Shale	41.1	84.8	***628.5***	60.5	10.7	811.2	~~628~~	~~0~~	~~0~~	~~346~~	~~53.4~~
312.10	1.00			Shale	41.1	84.8	***669.6***	60.5	10.7	871.8	~~670~~	~~0~~	~~0~~	~~368~~	~~54.4~~
311.10	1.00			Shale	41.1	84.8	***710.7***	60.5	10.7	932.3	~~711~~	~~0~~	~~0~~	~~391~~	~~55.4~~
310.10	1.00			Shale	41.1	84.8	***751.8***	60.5	10.7	992.8	~~752~~	~~0~~	~~0~~	~~414~~	~~56.4~~
309.10	1.00			Shale	41.1	84.8	***792.9***	60.5	10.7	1053.3	~~793~~	~~0~~	~~0~~	~~436~~	~~57.4~~
308.10	1.00			Shale	41.1	84.8	***834.0***	60.5	10.7	1113.8	~~834~~	~~0~~	~~0~~	~~459~~	~~58.4~~
307.10	1.00			Shale	41.1	84.8	***875.1***	60.5	10.7	1174.4	~~875~~	~~0~~	~~0~~	~~481~~	~~59.4~~
306.10	1.00			Shale	41.1	84.8	***916.3***	60.5	10.7	1234.9	~~916~~	~~0~~	~~0~~	~~504~~	~~60.4~~
305.10	1.00			Shale	41.1	84.8	***957.4***	60.5	10.7	1295.4	~~957~~	~~0~~	~~0~~	~~527~~	~~61.4~~
304.10	1.00			Shale	41.1	84.8	***998.5***	60.5	10.7	1355.9	~~998~~	~~0~~	~~0~~	~~549~~	~~62.4~~
303.10	1.00			Shale	41.1	84.8	***1039.6***	60.5	10.7	1416.4	~~1040~~	~~0~~	~~0~~	~~572~~	~~63.4~~
302.10	1.00			Shale	41.1	84.8	***1080.7***	60.5	10.7	1477.0	~~1081~~	~~0~~	~~0~~	~~594~~	~~64.4~~
301.10	1.00			Shale	41.1	84.8	***1037.0***	60.5	10.7	1526.8	~~1037~~	~~0~~	~~0~~	~~570~~	~~65.4~~
300.10	1.00					0.0			0.0						

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. ========== 366.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 328.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 317.20 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 3385 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 578.26 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 216.85 KIPS

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

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**334** KIPS	**160** KIPS	**54** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
325.70	3.10	0.70			5.4		17.8	7.9		***9.5***	9	3	0	2	41
323.20	2.50	1.30			7.2	12.4	26.9	10.6	1.6	***20.3***	20	7	0	4	43
321.70	1.50	1.50			4.8	14.3	63.1	7.0	1.8	***31.3***	31	10	0	8	45
318.20	3.50	4.80	24		24.0	45.8	***50.9***	35.3	5.8	62.1	51	23	0	5	48
317.70	0.50	1.00			1.2	9.5	***52.0***	1.7	1.2	63.8	52	23	0	5	49
317.20	0.50	1.00			1.2	9.5	128.4	1.7	1.2	***75.0***	75	24	0	17	49
316.20	1.00			Shale	41.1	84.8	169.5	60.5	10.7	***135.5***	136	24	0	51	50.3
315.20	1.00			Shale	41.1	84.8	210.6	60.5	10.7	***196.1***	196	24	0	84	51.3
314.20	1.00			Shale	41.1	84.8	***251.8***	60.5	10.7	256.6	252	24	0	114	52.3
313.20	1.00			Shale	41.1	84.8	***292.9***	60.5	10.7	317.1	293	24	0	137	53.3
312.20	1.00			Shale	41.1	84.8	***334.0***	60.5	10.7	377.6	334	24	0	160	54.3
311.20	1.00			Shale	41.1	84.8	***375.1***	60.5	10.7	438.2	~~375~~	~~24~~	~~0~~	~~182~~	~~55.3~~
310.20	1.00			Shale	41.1	84.8	***416.2***	60.5	10.7	498.7	~~416~~	~~24~~	~~0~~	~~205~~	~~56.3~~
309.20	1.00			Shale	41.1	84.8	***457.3***	60.5	10.7	559.2	~~457~~	~~24~~	~~0~~	~~227~~	~~57.3~~
308.20	1.00			Shale	41.1	84.8	***498.4***	60.5	10.7	619.7	~~498~~	~~24~~	~~0~~	~~250~~	~~58.3~~
307.20	1.00			Shale	41.1	84.8	***539.5***	60.5	10.7	680.2	~~540~~	~~24~~	~~0~~	~~273~~	~~59.3~~
306.20	1.00			Shale	41.1	84.8	***580.6***	60.5	10.7	740.8	~~581~~	~~24~~	~~0~~	~~295~~	~~60.3~~
305.20	1.00			Shale	41.1	84.8	***621.7***	60.5	10.7	801.3	~~622~~	~~24~~	~~0~~	~~318~~	~~61.3~~
304.20	1.00			Shale	41.1	84.8	***662.8***	60.5	10.7	861.8	~~663~~	~~24~~	~~0~~	~~341~~	~~62.3~~
303.20	1.00			Shale	41.1	84.8	***703.9***	60.5	10.7	922.3	~~704~~	~~24~~	~~0~~	~~363~~	~~63.3~~
302.20	1.00			Shale	41.1	84.8	***745.1***	60.5	10.7	982.8	~~745~~	~~24~~	~~0~~	~~386~~	~~64.3~~
301.20	1.00			Shale	41.1	84.8	***786.2***	60.5	10.7	1043.4	~~786~~	~~24~~	~~0~~	~~408~~	~~65.3~~
300.20	1.00			Shale	41.1	84.8	***827.3***	60.5	10.7	1103.9	~~827~~	~~24~~	~~0~~	~~431~~	~~66.3~~
299.20	1.00			Shale	41.1	84.8	***868.4***	60.5	10.7	1164.4	~~868~~	~~24~~	~~0~~	~~454~~	~~67.3~~
298.20	1.00			Shale	41.1	84.8	***909.5***	60.5	10.7	1224.9	~~909~~	~~24~~	~~0~~	~~476~~	~~68.3~~
297.20	1.00			Shale	41.1	84.8	***950.6***	60.5	10.7	1285.4	~~951~~	~~24~~	~~0~~	~~499~~	~~69.3~~
296.20	1.00			Shale	41.1	84.8	***991.7***	60.5	10.7	1346.0	~~992~~	~~24~~	~~0~~	~~521~~	~~70.3~~
295.20	1.00			Shale	41.1	84.8	***1032.8***	60.5	10.7	1406.5	~~1033~~	~~24~~	~~0~~	~~544~~	~~71.3~~
294.20	1.00			Shale	41.1	84.8	***1073.9***	60.5	10.7	1467.0	~~1074~~	~~24~~	~~0~~	~~567~~	~~72.3~~
293.20	1.00			Shale	41.1	84.8	***1115.0***	60.5	10.7	1527.5	~~1115~~	~~24~~	~~0~~	~~589~~	~~73.3~~
292.20	1.00			Shale	41.1	84.8	***1156.1***	60.5	10.7	1588.0	~~1156~~	~~24~~	~~0~~	~~612~~	~~74.3~~
291.20	1.00			Shale	41.1	84.8	***1197.3***	60.5	10.7	1648.6	~~1197~~	~~24~~	~~0~~	~~634~~	~~75.3~~
290.20	1.00			Shale	41.1	84.8	***1238.4***	60.5	10.7	1709.1	~~1238~~	~~24~~	~~0~~	~~657~~	~~76.3~~
289.20	1.00			Shale	41.1	84.8	***1279.5***	60.5	10.7	1769.6	~~1279~~	~~24~~	~~0~~	~~680~~	~~77.3~~
288.20	1.00			Shale	41.1	84.8	***1320.6***	60.5	10.7	1830.1	~~1321~~	~~24~~	~~0~~	~~702~~	~~78.3~~
287.20	1.00			Shale	41.1	84.8	***1361.7***	60.5	10.7	1890.7	~~1362~~	~~24~~	~~0~~	~~725~~	~~79.3~~
286.20	1.00			Shale	41.1	84.8	***1402.8***	60.5	10.7	1951.2	~~1403~~	~~24~~	~~0~~	~~748~~	~~80.3~~
285.20	1.00			Shale	20.6	84.8	***1338.6***	30.3	10.7	1970.7	~~1339~~	~~24~~	~~0~~	~~712~~	~~81.3~~
	1.00			Shale											

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== East Abutment
REFERENCE BORING ========== 4-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 366.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 364.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 364.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1370 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 46.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 234.04 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 87.76 KIPS

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

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
335 KIPS	**335** KIPS	**184** KIPS	**51** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
361.60	2.90	2.00			11.1		40.7	16.4		***20.1***	20	0	0	11	5
359.10	2.50	3.10	8		12.9	29.6	43.1	19.0	3.7	***37.8***	38	0	0	21	7
356.60	2.50	2.00			9.6	19.1	56.5	14.1	2.4	***52.5***	52	0	0	29	10
354.10	2.50	2.40			10.8	22.9	***67.4***	15.9	2.9	68.4	67	0	0	37	12
351.60	2.50	2.40			10.8	22.9	86.8	15.9	2.9	***85.4***	85	0	0	47	15
349.10	2.50	3.30	10		13.5	31.5	***93.6***	19.9	4.0	104.4	94	0	0	51	17
346.60	2.50	2.60			11.4	24.8	***103.1***	16.8	3.1	121.0	103	0	0	57	20
344.10	2.50	2.40			10.8	22.9	***109.2***	15.9	2.9	136.3	109	0	0	60	22
341.60	2.50	1.90			9.3	18.1	***119.4***	13.7	2.3	150.1	119	0	0	66	25
339.10	2.50	2.00			9.6	19.1	***128.1***	14.1	2.4	164.1	128	0	0	70	27
336.60	2.50	1.90			9.3	18.1	***154.5***	13.7	2.3	180.0	155	0	0	85	30
334.10	2.50	3.70	11		14.7	35.3	***165.4***	21.7	4.5	201.2	165	0	0	91	32
331.60	2.50	3.30	11		13.5	31.5	***166.6***	19.9	4.0	219.6	167	0	0	92	35
329.10	2.50	2.00			9.6	19.1	***190.5***	14.1	2.4	235.5	190	0	0	105	37
324.10	5.00	3.50	15		28.3	33.4	***218.7***	41.6	4.2	277.1	219	0	0	120	42
321.60	2.50	3.50	15		14.1	33.4	***246.2***	20.8	4.2	299.6	246	0	0	135	45
316.60	5.00	4.90	19		34.3	46.7	***318.5***	50.5	5.9	354.9	319	0	0	175	50
315.60	1.00			Shale	41.1	84.8	***359.6***	60.5	10.7	415.4	~~360~~	~~0~~	~~0~~	~~198~~	~~50.9~~
314.60	1.00			Shale	41.1	84.8	***400.8***	60.5	10.7	476.0	~~401~~	~~0~~	~~0~~	~~220~~	~~51.9~~
313.60	1.00			Shale	41.1	84.8	***441.9***	60.5	10.7	536.5	~~442~~	~~0~~	~~0~~	~~243~~	~~52.9~~
312.60	1.00			Shale	41.1	84.8	***483.0***	60.5	10.7	597.0	~~483~~	~~0~~	~~0~~	~~266~~	~~53.9~~
311.60	1.00			Shale	41.1	84.8	***524.1***	60.5	10.7	657.5	~~524~~	~~0~~	~~0~~	~~288~~	~~54.9~~
310.60	1.00			Shale	41.1	84.8	***565.2***	60.5	10.7	718.0	~~565~~	~~0~~	~~0~~	~~311~~	~~55.9~~
309.60	1.00			Shale	41.1	84.8	***606.3***	60.5	10.7	778.6	~~606~~	~~0~~	~~0~~	~~333~~	~~56.9~~
308.60	1.00			Shale	41.1	84.8	***647.4***	60.5	10.7	839.1	~~647~~	~~0~~	~~0~~	~~356~~	~~57.9~~
307.60	1.00			Shale		84.8			10.7						

EXHIBIT I

DRILLED SHAFTS

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

STRUCTURE ========== SN 030-0015
SUBSTRUCTURE & REFERENCE BORING ==== Pier 1 - Boring 2-S

ESTIMATED TOP OF SHALE ELEVATION ===== 326.10 FT
DRILLED SHAFT DIAMETER IN SHALE ======= 36 IN.
FACTORED AXIAL LOAD ================== 3385 KIPS

DRILLED SHAFT DIA.'S FOR DESIGN TABLE

36	IN.
42	IN.
48	IN.
60	IN.
	IN.
	IN.

SOCKET DEPTH (FT)	TIP ELEV. (FT)	LAYER THICK. (FT)	UNCONFINED COMPRESSIVE STRENGTH (q_u) (KSF)	AVG. q_u W/IN 2 - SHAFT DIA. (KSF)	NOMINAL SIDE RESIST. (KIPS)	CUMULATIVE SIDE RESIST. (KIPS)	DEPTH CORR. FACTORS k	DEPTH CORR. FACTORS d_c	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
1.00	325.10	1.00	47.2	47.2	138	138	0.333	1.07	1068	1206	603	300	0.11	500	0.20
2.00	324.10	1.00	47.2	48.3	138	276	0.667	1.13	1161	1436	718	350	0.10	600	0.19
2.20	323.90	0.20	47.2	48.6	28	303	0.733	1.15	1181	1484	742	350	0.10	600	0.18
3.20	322.90	1.00	47.2	49.9	138	441	0.818	1.16	1232	1673	837	400	0.09	700	0.18
4.00	322.10	0.80	47.2	50.6	110	552	0.927	1.19	1272	1824	912	450	0.10	750	0.17
4.70	321.40	0.70	47.2	50.6	97	648	1.003	1.20	1289	1937	968	475	0.09	800	0.17
5.70	320.40	1.00	47.2	50.6	138	786	1.086	1.22	1307	2093	1046	500	0.09	850	0.16
6.00	320.10	0.30	47.2	50.6	41	827	1.107	1.22	1311	2138	1069	500	0.09	900	0.17
7.20	318.90	1.20	47.2	47.5	165	993	1.176	1.24	1244	2237	1118	550	0.09	900	0.15
8.00	318.10	0.80	55.4	43.9	129	1122	1.212	1.24	1156	2279	1139	550	0.09	950	0.16
9.70	316.40	1.70	55.4	47.2	275	1398	1.271	1.25	1255	2653	1326	650	0.09	1100	0.16
10.95	315.15	1.25	47.2	57.0	172	1570	1.303	1.26	1524	3094	1547	750	0.09	1300	0.17
12.20	313.90	1.25	47.2		172	1742									
13.45	312.65	1.25	28.4		104	1846									
14.70	311.40	1.25	28.4		104	1950									
15.95	310.15	1.25	94.2		344	2294									
17.20	308.90	1.25	94.2		344	2638									

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table for Pier 1 - Boring 2-S

Estimated Top of Shale Elevation: 326.10

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	325.1	138	1068	1206	603	300	0.11	500	0.20
2	324.1	276	1161	1436	718	350	0.10	600	0.19
2.2	323.9	303	1181	1484	742	350	0.10	600	0.18
3.2	322.9	441	1232	1673	837	400	0.09	700	0.18
4	322.1	552	1272	1824	912	450	0.10	750	0.17
4.7	321.4	648	1289	1937	968	475	0.09	800	0.17
5.7	320.4	786	1307	2093	1046	500	0.09	850	0.16
6	320.1	827	1311	2138	1069	500	0.09	900	0.17
7.2	318.9	993	1244	2237	1118	550	0.09	900	0.15
8	318.1	1122	1156	2279	1139	550	0.09	950	0.16
9.7	316.4	1398	1255	2653	1326	650	0.09	1100	0.16
10.95	315.15	1570	1524	3094	1547	750	0.09	1300	0.17
42 in. Diameter Drilled Shaft									
1	325.1	161	1469	1630	815	400	0.13	700	0.25
2	324.1	322	1586	1908	954	475	0.12	800	0.23
2.2	323.9	354	1610	1964	982	475	0.12	800	0.22
3.2	322.9	515	1711	2226	1113	550	0.12	900	0.20
4	322.1	644	1693	2337	1168	550	0.11	950	0.20
4.7	321.4	756	1716	2472	1236	600	0.11	1000	0.19
5.7	320.4	917	1695	2612	1306	650	0.11	1100	0.20
6	320.1	965	1674	2639	1319	650	0.11	1100	0.19
7.2	318.9	1158	1581	2739	1370	650	0.10	1100	0.18
8	318.1	1309	1582	2891	1446	700	0.10	1200	0.18
9.7	316.4	1630	1937	3568	1784	850	0.10	1500	0.19
48 in. Diameter Drilled Shaft									
1	325.1	184	1941	2125	1063	500	0.14	900	0.29
2	324.1	368	2064	2431	1216	600	0.14	1000	0.26
2.2	323.9	405	2082	2487	1243	600	0.14	1000	0.25
3.2	322.9	588	2176	2765	1382	650	0.13	1200	0.26
4	322.1	735	2251	2987	1493	700	0.13	1200	0.23
4.7	321.4	864	2149	3013	1507	750	0.13	1300	0.24
5.7	320.4	1048	2077	3125	1563	750	0.12	1300	0.22
6	320.1	1103	2054	3157	1579	750	0.12	1300	0.22
7.2	318.9	1324	2141	3465	1732	850	0.12	1400	0.21
8	318.1	1497	2335	3831	1916	950	0.12	1600	0.22
60 in. Diameter Drilled Shaft									
1	325.1	230	3017	3247	1623	800	0.19	1300	0.35
2	324.1	460	3133	3593	1796	850	0.17	1500	0.34
2.2	323.9	506	3156	3662	1831	900	0.18	1500	0.33
3.2	322.9	735	3147	3883	1941	950	0.17	1600	0.31
4	322.1	919	3134	4053	2027	1000	0.17	1700	0.31
4.7	321.4	1080	3118	4198	2099	1000	0.16	1700	0.29
5.7	320.4	1310	3395	4705	2352	1100	0.15	1900	0.28
6	320.1	1379	3507	4886	2443	1200	0.16	2000	0.28
7.2	318.9	1655	3956	5610	2805	1400	0.16	2300	0.29

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

STRUCTURE ========== SN 030-0015
SUBSTRUCTURE & REFERENCE BORING ==== Pier 2 - Boring 3-S

ESTIMATED TOP OF SHALE ELEVATION ===== 317.20 FT
DRILLED SHAFT DIAMETER IN SHALE ======= 36 IN.
FACTORED AXIAL LOAD ========== 3385 KIPS

DRILLED SHAFT DIA.'S FOR DESIGN TABLE

36	IN.
42	IN.
48	IN.
60	IN.
	IN.
	IN.

SOCKET DEPTH (FT)	TIP ELEV. (FT)	LAYER THICK. (FT)	UNCONFINED COMPRESSIVE STRENGTH (q_u) (KSF)	AVG. q_u W/IN 2 - SHAFT DIA. (KSF)	NOMINAL SIDE RESIST. (KIPS)	CUMULATIVE SIDE RESIST. (KIPS)	DEPTH CORR. FACTORS k	DEPTH CORR. FACTORS d_c	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
1.00	316.20	1.00	94.2	74.7	275	275	0.333	1.07	1690	1965	982	475	0.10	800	0.19
2.00	315.20	1.00	94.2	66.0	275	550	0.667	1.13	1587	2137	1069	500	0.09	900	0.18
3.00	314.20	1.00	94.2	54.5	275	826	1.000	1.20	1386	2212	1106	550	0.09	900	0.16
4.00	313.20	1.00	78.6	45.5	230	1055	0.927	1.19	1144	2199	1100	500	0.08	900	0.15
5.50	311.70	1.50	78.6	36.8	344	1400	1.071	1.21	948	2348	1174	550	0.08	950	0.14
6.00	311.20	0.50	42.2	37.8	62	1461	1.107	1.22	978	2439	1220	600	0.08	1000	0.14
7.00	310.20	1.00	42.2	39.6	123	1585	1.166	1.23	1036	2621	1310	650	0.08	1100	0.15
8.00	309.20	1.00	42.2	37.8	123	1708	1.212	1.24	996	2704	1352	650	0.08	1100	0.14
9.25	307.95	1.25	24.8	39.2	91	1799	1.257	1.25	1040	2839	1419	700	0.09	1200	0.15
10.50	306.70	1.25	24.8	40.6	91	1889	1.292	1.26	1083	2972	1486	700	0.08	1200	0.15
11.75	305.45	1.25	53.4		195	2084									
13.00	304.20	1.25	53.4		195	2279									
14.25	302.95	1.25	31.4		115	2394									
15.50	301.70	1.25	31.4		115	2509									
16.50	300.70	1.00	31.4		92	2600									
17.50	299.70	1.00	31.4		92	2692									

Illinois Department of Transportation

DRILLED SHAFT AXIAL CAPACITY IN SHALE < 100 KSF

Drilled Shaft Design Table for Pier 2 - Boring 3-S

Estimated Top of Shale Elevation: 317.20

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL TOTAL SIDE RESIST. (KIPS)	NOMINAL TIP RESIST. (KIPS)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RANGE OF SERVICE LOADING AND CORRESPONDING SETTLEMENT			
						LOAD (KIPS)	SETTLEMENT (IN.)	LOAD (KIPS)	SETTLEMENT (IN.)
36 in. Diameter Drilled Shaft									
1	316.2	275	1690	1965	982	475	0.10	800	0.19
2	315.2	550	1587	2137	1069	500	0.09	900	0.18
3	314.2	826	1386	2212	1106	550	0.09	900	0.16
4	313.2	1055	1144	2199	1100	500	0.08	900	0.15
5.5	311.7	1400	948	2348	1174	550	0.08	950	0.14
6	311.2	1461	978	2439	1220	600	0.08	1000	0.14
7	310.2	1585	1036	2621	1310	650	0.08	1100	0.15
8	309.2	1708	996	2704	1352	650	0.08	1100	0.14
9.25	307.95	1799	1040	2839	1419	700	0.09	1200	0.15
10.5	306.7	1889	1083	2972	1486	700	0.08	1200	0.15
42 in. Diameter Drilled Shaft									
1	316.2	321	2138	2459	1229	600	0.12	1000	0.23
2	315.2	642	1934	2577	1288	600	0.11	1100	0.21
3	314.2	963	1698	2662	1331	650	0.11	1100	0.19
4	313.2	1231	1506	2737	1369	650	0.10	1100	0.17
5.5	311.7	1633	1358	2991	1496	700	0.09	1200	0.16
6	311.2	1705	1395	3100	1550	750	0.10	1300	0.17
7	310.2	1849	1355	3204	1602	800	0.10	1300	0.16
8	309.2	1993	1312	3304	1652	800	0.10	1400	0.17
9.25	307.95	2098	1365	3463	1732	850	0.10	1400	0.16
10.5	306.7	2204	1416	3620	1810	900	0.10	1500	0.17
48 in. Diameter Drilled Shaft									
1	316.2	367	2549	2916	1458	700	0.14	1200	0.27
2	315.2	734	2311	3045	1522	750	0.13	1300	0.24
3	314.2	1101	2117	3218	1609	800	0.12	1300	0.21
4	313.2	1407	2067	3474	1737	850	0.12	1400	0.20
5.5	311.7	1866	1774	3640	1820	900	0.11	1500	0.19
6	311.2	1949	1755	3704	1852	900	0.11	1500	0.19
7	310.2	2113	1714	3827	1913	950	0.11	1600	0.19
8	309.2	2277	1667	3945	1972	950	0.11	1600	0.19
9.25	307.95	2398	1731	4129	2064	1000	0.11	1700	0.19
60 in. Diameter Drilled Shaft									
1	316.2	459	3548	4006	2003	1000	0.18	1700	0.35
2	315.2	917	3425	4342	2171	1000	0.16	1800	0.30
3	314.2	1376	3282	4658	2329	1100	0.15	1900	0.28
4	313.2	1759	3077	4836	2418	1200	0.15	2000	0.26
5.5	311.7	2333	2608	4941	2470	1200	0.14	2000	0.24
6	311.2	2436	2590	5025	2513	1200	0.14	2100	0.25
7	310.2	2641	2547	5188	2594	1200	0.13	2100	0.24