STRUCTURE GEOTECHNICAL REPORT

IL 3 over Miller Creek

S.N. 002-0037

SBI ROUTE 150C
SECTION 133B-1
ALEXANDER COUNTY, ILLINOIS
JOB NO. D-99-064-17
PTB 184/034
KEG NO. 17-1095.06

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03/09/2022
Exp 11/30/2023

Prepared for:
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Springfield, Illinois 62703

August 26, 2019
REVISED April & October 14, 2021
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Kaskaskia
Engineering Group, LLC

TABLE OF CONTENTS

EXHIBITS

1.0 PROJECT DESCRIPTION AND SCOPE

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed bridge at IL 3 over Miller Creek located in Alexander County, Illinois. The bridge is located approximately 0.8 miles southeast from the intersection of Old IL 3 and the Great River Road. The purpose of the report is to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of replacement of the existing bridge (SN 002-0010) located at IL 3 over Miller Creek. The general location of the bridge is shown on a Location Map, Exhibit A. The site lies within the limits of the Third Principal Meridian, (T. 15S, R. 4W, Section 4) within the Salem Plateau Section of the Ozark Plateaus Province.

1.3 Proposed Bridge Information

The proposed structure will consist of a two-span bridge with a 0 degree skew from the centerline of IL 3. The proposed structure will measure 140’-8” from back-to-back of abutments, with an out-to-out width of 28 ft.-0 inches. The bridge spans from Station 1175+93.67 to 1177+34.33 along IL 3. The bridge will carry two, 10-foot traffic lanes with 4-foot outside shoulders. The anticipated substructure units include fixed abutments and one, solid concrete pier. The Type, Size, and Location Plan (TS&L) is included in Exhibit B. Further substructure details will be based on the findings of this SGR.

2.0 EXISTING BRIDGE INFORMATION

The original structure was built in 1933. Bridge repairs were made in 2005. It consists of three spans with reinforced concrete piers and spill-through abutments supported on piles. The two end spans are 33’-3” in length from the abutments to the piers and consist of steel girders and a concrete deck. The center span is 81’-6” in length and consists of a Pratt Pony Through Truss.

3.0 FIELD EXPLORATION

The site investigation plan was performed by IDOT District 9 Geotechnical personnel. A representative of KEG did not conduct a site visit or observe the drilling operations.

Two (2) standard penetration test (SPT) borings, designated 1-S and 2-S were drilled on October 3 and 4, 2017. The boring locations are shown on the TS&L in Exhibit B. 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 C. The soil profile for the above mentioned borings can be found in Subsurface Profile, Exhibit D.

Table 3.0 - Boring Stations and Offsets

Designation	Stationing	Offset (ft.)	Surface Elevation (ft.)
1-S	1175+69	6.0 LT	346.5
2-S	1177+42	6.0 RT	346.3

3.1 Subsurface Conditions

From the surface, both borings generally encountered medium-stiff to stiff, silty clay loams and clay loams to depths of approximately 20 feet below the approach pavements. N-values in the upper soils typically ranged from 2 to 6 blows per foot (bpf) with field Rimac (Qu) strength values ranging from 0.3 to 1.8 tons per square foot (tsf) and moisture contents of 20 to 34 percent. Below the stiff surficial soils, soft or very soft, silty clay and clay loams continued to depths of 45 feet below the approach pavements. N-values of these soils ranged from 0 to 3 bpf, with field Qu values ranging from 0.2 to 0.8 tsf, and moisture contents of 27 to 46 percent. Below the soft soils, stiff to very stiff clays were encountered in each boring to depths of approximately 65 feet. N-values of the clays were 4 to 22 bpf, with Qu values of 1.5 to 2.9 tsf, and moisture contents of 24 to 36 percent. Below the stiff clays, the clays transitioned into clays with limestone fragments and/or sand and gravel layers, prior to clay shale and limestone bedrock. The limestone was cored in each boring and resulted in core recoveries of 100 percent and RQDs ranging from 15 to 100 percent with depth. Boring 1-S was terminated in limestone at 77.5 feet, and Boring 2-S was terminated in limestone at 81 feet.

3.3 Groundwater

Groundwater was encountered in both borings. Table 3.3 shows the elevation that groundwater was encountered during drilling. A surface water elevation was also noted on each boring at El. 318.7 for Miller Creek at the time of drilling.

It should be noted that the groundwater level is subject to seasonal and climatic variations. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

Table 3.3 - Groundwater Elevations

Boring	Stationing	Offset (ft.)	Elevation (ft.)
1-S	1175+69	6.0 LT	282.1
2-S	1177+42	6.0 RT	290.8

4.0 GEOTECHNICAL EVALUATIONS

4.1 Settlement

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

4.2 Slope Stability

The proposed structure will result in endslopes with inclinations of 1 Vertical to 2 Horizontal (1V:2H).

Slope stability of the south endslope and of the north side slope were analyzed using SLOPE-W, the soil properties of 1-S and 2-S, and the endslope geometrics. Three conditions were modeled: end-of-construction,long-term, and seismic. A critical factor of safety (FOS) was calculated for each condition. According to current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability. The target FOS is 1.0 for the seismic condition. A peak ground acceleration of 0.833g was used.

In order to model the end-of-construction condition, undrained soil parameters were used with a friction angle of 0 degrees assumed for cohesive soils. Drained soil parameters with assumed friction angles ranging from 26 to 34 degrees were used to model the long-term conditions to analyze where excess pore water pressure from construction has dissipated. For cohesive materials, a nominal cohesion value between 50 and 250 psf was included in the drained strength parameters.

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

Table 4.2 - Slope Stability Critical FOS

Location	Reference Boring	End-of-Construction	Long-Term (Drained)	Seismic
South Abutment End Slope	1-S	1.8	2.5	1.0
North Abutment Side Slope	2-S	1.5	2.6	1.1

The results of the analysis, as provided in Table 4.2, indicate an acceptable FOS will exist under all three analyzed conditions at all locations.

4.3 Scour

The design scour elevations for the proposed structure are shown in Table 4.4. Class A5 stone riprap will be placed on the surface of the proposed abutment endslopes and the surface of the streambed to reduce the potential for future scour.

Table 4.3 - Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)			Item 113
	North Abutment	Pier 1	South Abutment	
Q_{100}	338.6	303.3	338.8	5
Q_{200}	338.6	302.0	338.8	
Design	338.6	303.3	338.8	
Check	338.6	302.0	338.8	

4.4 Seismic Considerations

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

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. The USGS published information and mapping software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to determine the parameters for the project site location. The values, based on a 1000-Year Return Period, with a Probability of Exceedance (PE) of 7 percent in 75 years, and the Soil Site Class D are summarized below in Table 4.4.

Table 4.4 - Summary of Seismic Parameters

Parameter	Value
Soil Site Class	D
Spectral Response Acceleration, 0.2 Sec, S_{DS}	1.249 g
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.572 g
Seismic Performance Zone	4

As indicated in the table above, the Seismic Performance Zone (SPZ) is 4, based on S_{D1} and Table 3.15.2-1 in the IDOT Bridge Manual, the Soil Site Class D, and Figure 2.3.10-2 in the IDOT Bridge Manual.

4.5 Liquefaction

Per the Geotechnical Manual, due to the location of this structure and the seismic conditions resulting in an SPZ 4; a liquefaction analysis was performed using the liquefaction analysis worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis. The PGA and Mw pairs to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website for both New Madrid Seismic Zone (NMSZ) and Central Eastern United States (CEUS) models. The deaggregation data indicated a NMSZ maximum Magnitude of 7.52, contributing 29.98% to the hazard for this site. The Peak Horizontal Ground Surface Acceleration coefficient was set to the NMSZ PGA (0.523g), calculated in the IDOT Liquefaction Analysis Spreadsheet.

The soil profiles for Borings 1-S and 2-S were analyzed for the north and south abutments, respectively. The results from the analysis for the soil profile encountered in both borings showed no potential for liquefaction. 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 F, Liquefaction Analyses Results.

5.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

5.1 General Feasibility

According to the TS&L, fixed abutments are to be used for the proposed structure.

5.2 Pile Supported Foundations

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 (IDOT Static Method of Estimating Pile Length, Exhibit G).

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

Table 5.2 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
North Abutment	750
Pier 1	1,560
South Abutment	615

The estimated pile lengths for applicable H pile types are shown in Tables 5.2.1 thru 5.2.5 below. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving, and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings. A Geotechnical Loss due to scour, based off of the Check Scour elevations in Table 4.4, was applied to each substructure unit.

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

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment 2-S	335	184	64	340.6
Pier 1 1-S	335	138	36	312.0
South Abutment 1-S	335	184	65	340.8

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

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment 2-S	418	230	64	340.6
Pier 1 1-S	418	216	37	312.0
South Abutment 1-S	418	230	65	340.8

Table 5.2.3 - 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.)
North Abutment 2-S	497	273	65	340.6
Pier 1 1-S	497	259	38	312.0
South Abutment 1-S	497	273	65	340.8

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

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment 2-S	578	318	65	340.6
Pier 1 1-S	578	301	38	312.0
South Abutment 1-S	578	318	65	340.8

Table 5.2.5 - 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.)
North Abutment 2-S	705	388	65	340.6
Pier 1 1-S	705	371	38	312.0
South Abutment 1-S	705	388	66	340.8

Table 5.2.6 - Estimated Pile Lengths for HP 14x117 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment 2-S	929	511	67	340.6
Pier 1 1-S	929	494	40	312.0
South Abutment 1-S	929	511	67	340.8

As shown in the Tables above and in IDOT Static Method of Estimating Pile Length, Exhibit HG, downdrag and liquefaction have not been included at the substructure locations. The Factored Resistance Available listed in Tables 5.2.1-5.2.6 include the capacity loss due to scour.

KEG recommends one test pile be performed at an abutment location and one test pile at one of the pier locations, at 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 also is the manner in which the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

5.3 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 5.3 is included for the structural engineer's use in determining lateral pile response.

Table 5.3 - Soil Parameters for Lateral Pile Load Analysis

Boring	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term		N	Assumed % fines < #200	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)				
1-S	332.0	120	0	1200	26	100	3	80	500	0.02
	329.5	120	0	300	28	50	2	85	100	0.01
	327.0	120	0	900	26	50	4	85	500	0.007
	314.5	120	0	500	28	50	1	85	100	0.01
	306.5	120	0	550	26	50	0	85	500	0.007
	287.0	125	0	800	26	100	9	80	1000	0.005
	282.0	125	0	2900	28	150	20	65	2000	0.004
	278.5	125	0	0	34	0	36	10	--	--
	275.5	130	12	250	12	250	--	--	--	--
	269.0	150	45	25000	45	25000	--	--	--	0.001
2-S	329.3	120	0	1100	28	100	8	85	1000	0.005
	325.8	125	0	1200	26	50	4	80	1000	0.005
	301.8	120	0	400	28	50	0	85	100	0.01
	290.8	125	0	2000	26	100	9	80	1000	0.005
	281.8	125	0	2700	26	150	22	80	2000	0.004
	277.3	125	0	0	34	0	62	10	--	--
	275.3	130	12	250	12	250	--	--	--	--
	265.3	150	45	25000	45	25000	--	--	--	0.001

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Construction Activities

Construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction, all applicable Supplemental Specifications and Recurring Special Provisions, and any pertinent Special Provisions or Policies.

6.2 Cofferdams

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

6.3 Temporary Sheeting and Soil Retention

Temporary sheeting should not be required since the proposed structure will be constructed and traffic maintained using road closure.

6.4 Site and Soil Conditions

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

6.5 Foundation Construction

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

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

7.0 COMPUTATIONS

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

8.0 GEOTECHNICAL DATA

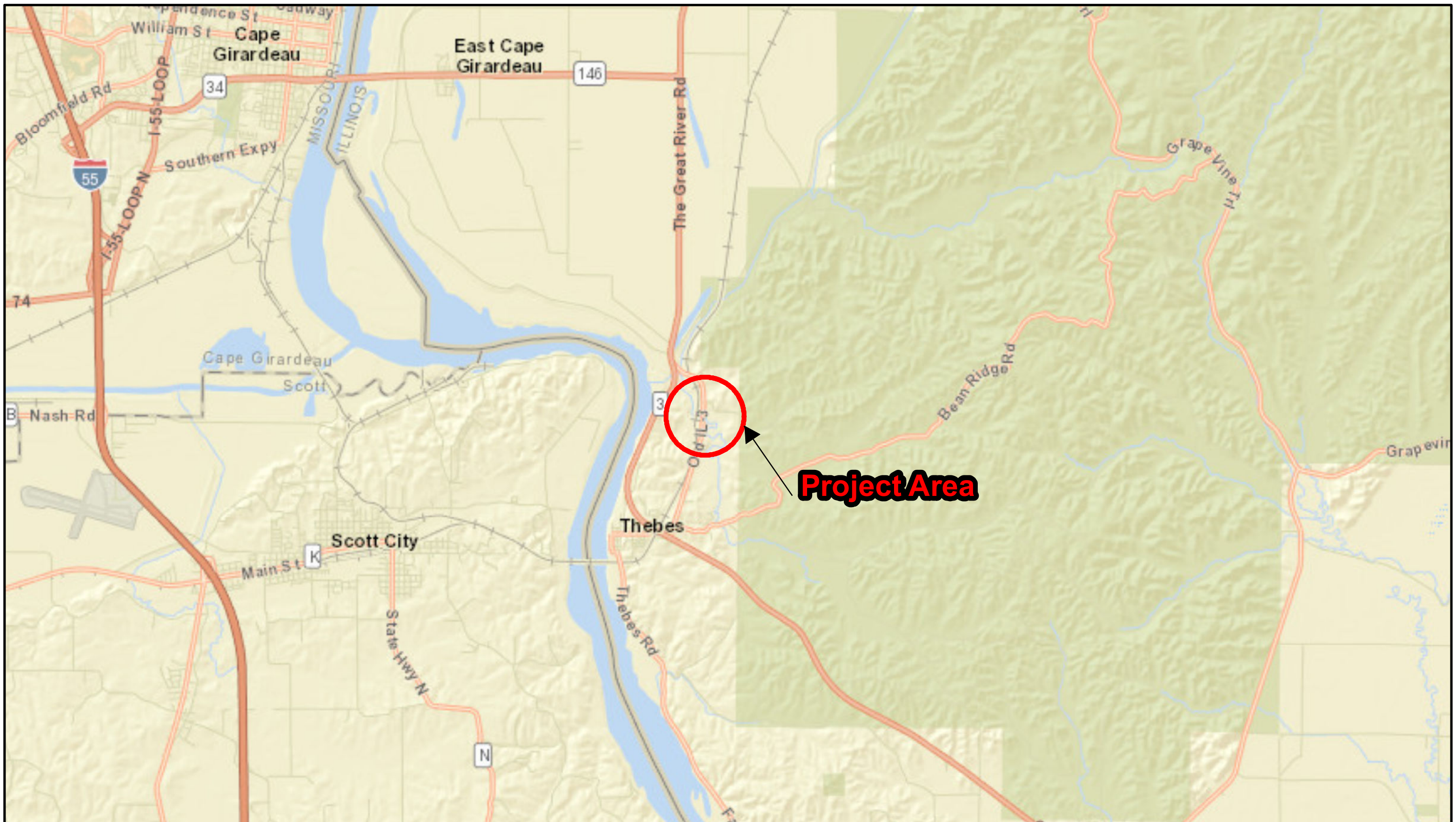
Soil boring logs can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

9.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of Veenstra & Kimm and IDOT. They are specific only to the project described and are based on the subsurface information obtained at two boring locations by IDOT within the proposed bridge 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



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

LOCATION MAP

IL 3 (SBI 150) over Miller Creek
Structure No. 002-0010
Section 133B-1
Alexander County, Illinois

Exhibit No.

A

KEG JOB #17-1095.06

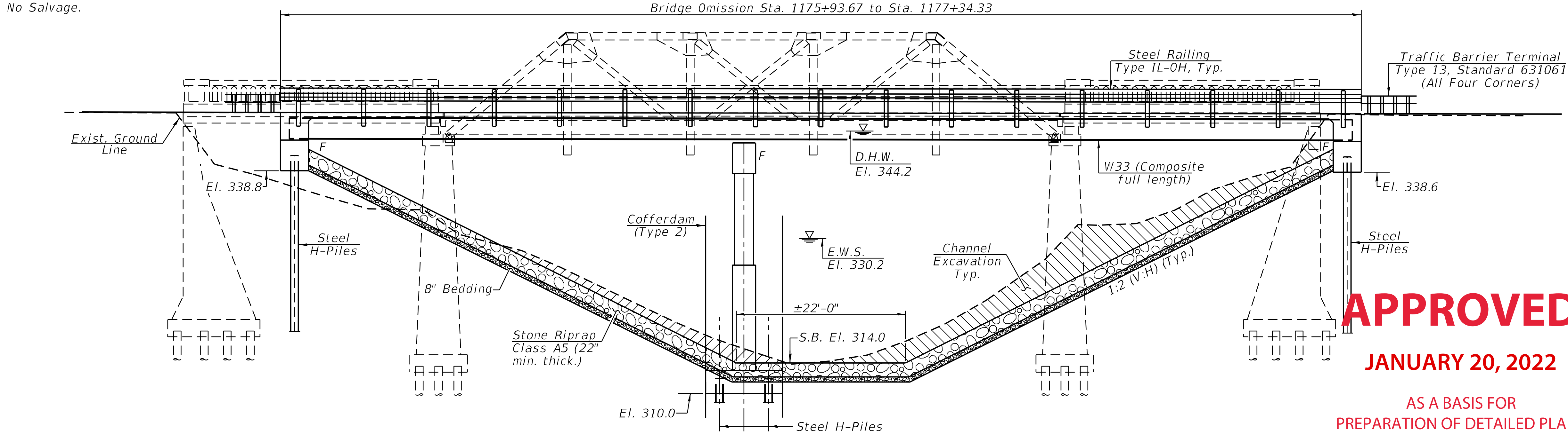
EXHIBIT B

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

Bench Mark: Chiseled "□" at the S.E. corner of bridge curb
S.N. 002-0010 - El. 347.53

Existing Structure: Structure number 002-0010, built in 1933 under S.B.I. Route 150, Section 133-C at Station 1176+55. The existing structure is a three span bridge having a back to back abutment length of 148'-0", a face to face of curb width of 22'-0", an out to out deck width of 23'-8". Spans 1 and 3 consist of a 4" wearing surface on concrete T-beams with an ornamental concrete railing. Spans 1 and 3 are 33'-3" long. The abutments consist of a concrete counterforts on concrete footings founded on timber piling. Span 2 consists of a Pratt Pony Truss supported by solid concrete piers on concrete footings. Span 2 has a 6" thick reinforced concrete deck with concrete curbs and steel channel railing. The structure is not skewed and will be replaced under road closure.

No Salvage.

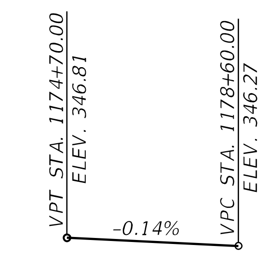


APPROVED

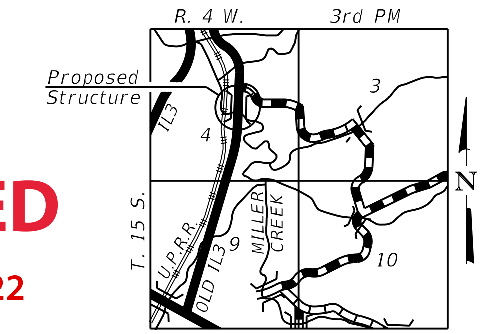
JANUARY 20, 2022

AS A BASIS FOR
PREPARATION OF DETAILED PLANS

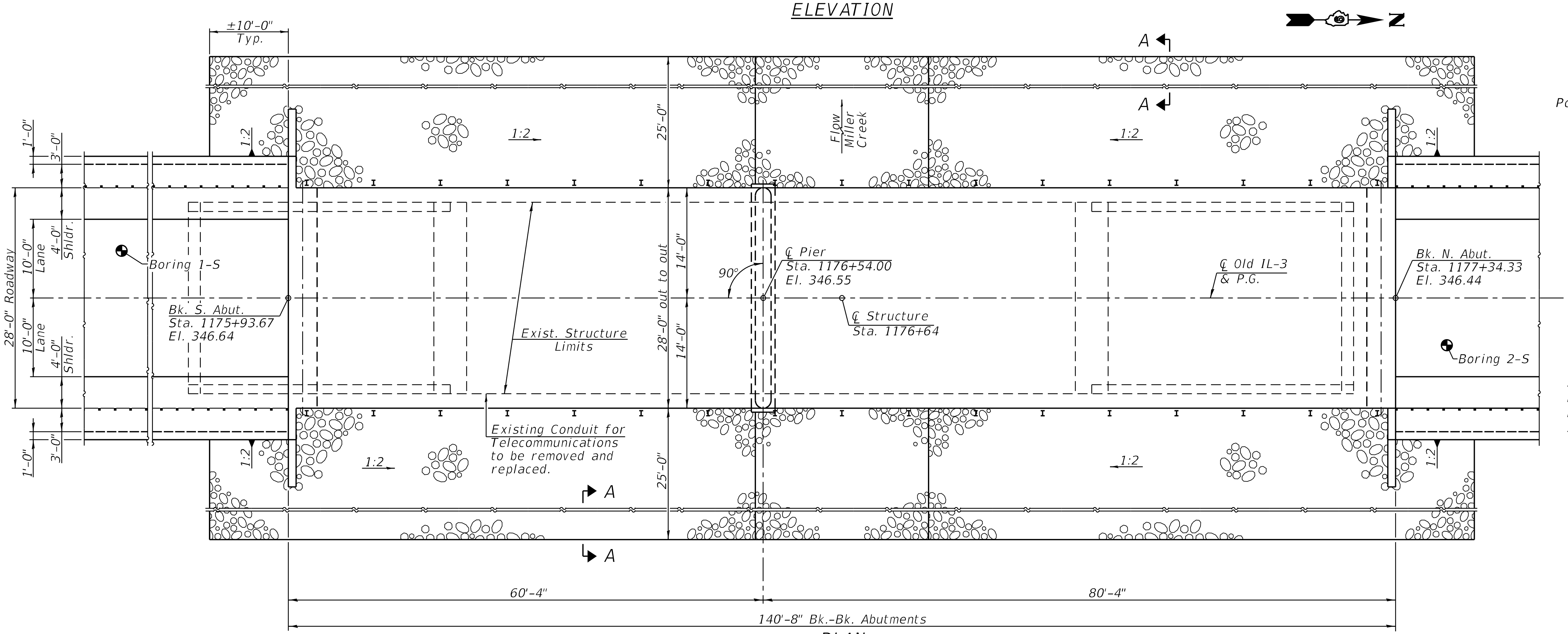
ELEVATION



PROFILE GRADE
(Along ℄ Old IL 3)



LOCATION SKETCH



PLAN

HIGHWAY CLASSIFICATION

Old IL-3 (SBI 150C)
Functional Class: Local Road
ADT: 175 (2017); 259 (2032)
ADTT: 12 (2017); 18 (2032)
DHV: 26(2032)
Posted Speed = 55 m.p.h.; Design Speed = 55 m.p.h.
Two-way Traffic Directional Dist. 50:50

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 = 3,500 psi
f'_c = 5,000 psi (Superstructure Concrete)
f_y = 60,000 psi (Reinforcement)
f_y = 50,000 psi (M270 Grade 50)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 4
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.572g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 1.249g
Soil Site Class = D

GENERAL PLAN & ELEVATION
OLD IL-3 OVER MILLER CREEK
SBI 150C - SECTION 133B-1
ALEXANDER COUNTY
STATION 1176+64
STRUCTURE NO. 002-0037

MODEL: 009
FILE NAME: Z:\0 V and K Jobs\5244-008 Old IL 3 over Miller Creek (Historic Bridge)\CADD Sheets\5244-008-sht-structure4.dgn

Veenstra & Kimm, Inc.
IL Design Firm License No. 184.001939

USER NAME =	DESIGNED - MAH	REVISED -
	CHECKED - KES	REVISED -
PLOT SCALE =	DRAWN - JRP	REVISED -
PLOT DATE = 1-20-2022	CHECKED - KES	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
S.N. 002-0037

SHEET 1 OF 2 SHEETS

S.B.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
150C	133B-1	ALEXANDER		

CONTRACT NO. 78610

ILLINOIS | FED. AID PROJECT

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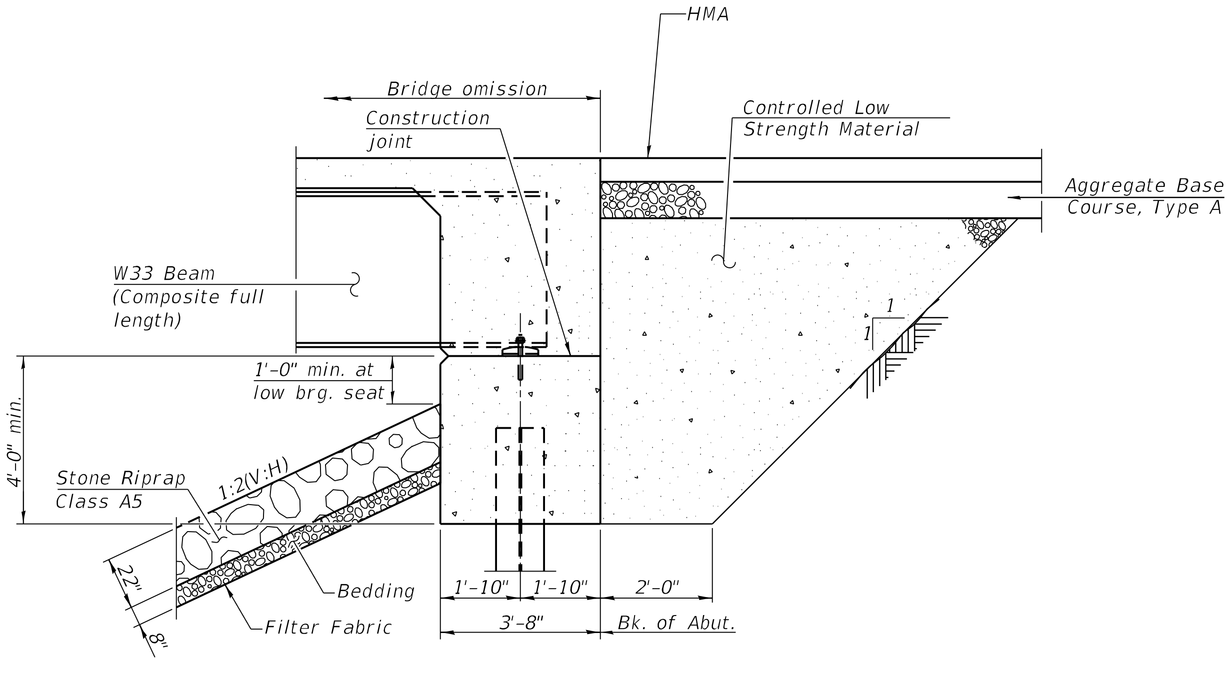
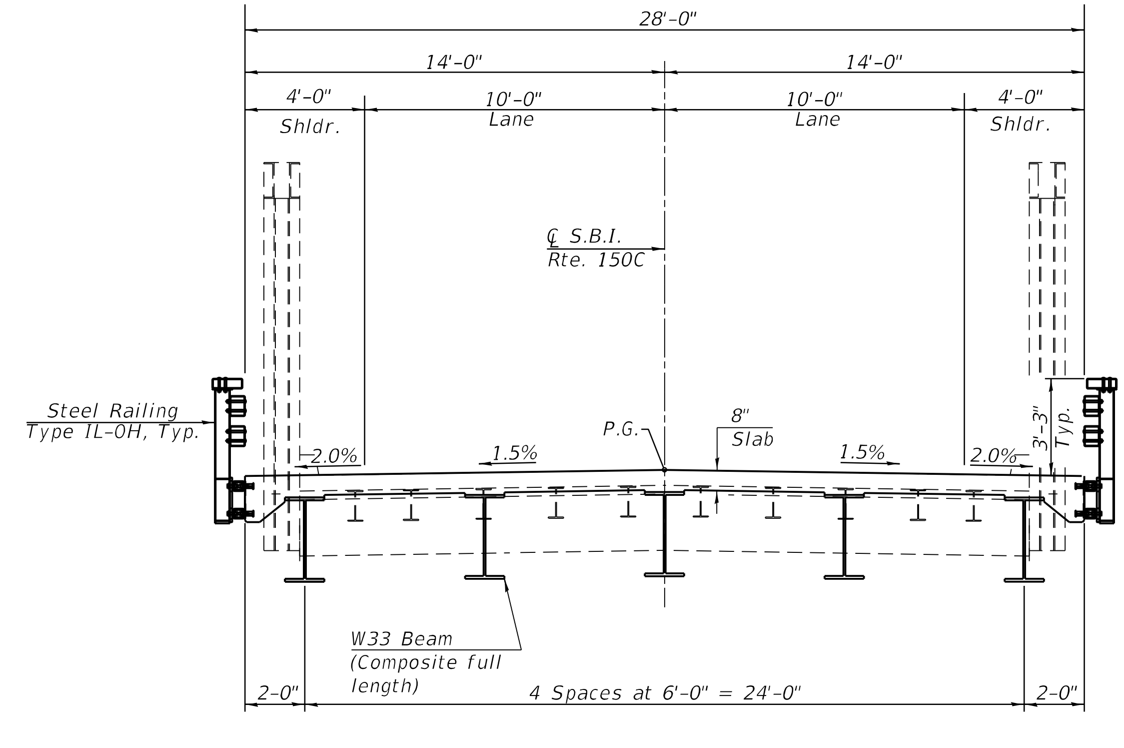


SECTION THRU INTEGRAL ABUTMENT

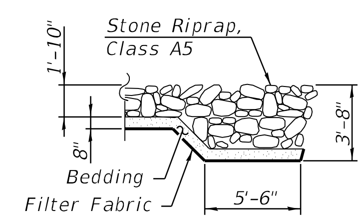


PROPOSED CROSS SECTION
(Looking North)

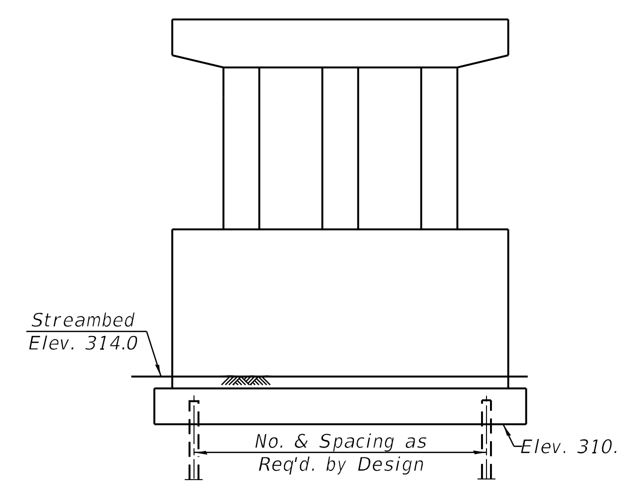
WATERWAY INFORMATION

Drainage Area = 13.9 mi^2			Exist. Low Grade Elev. 346.08 @ Sta. 1178+00 Prop. Low Grade Elev. 346.28 @ Sta. 1178+50						
Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft.		Nat. H.W.E.	Head - Ft.		Headwater El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
	10	3610	2200	2225	343.7	0.0	0.0	343.7	343.7
Design	20	4390	2269	2225	344.2	0.0	0.0	344.2	344.2
Base	100	6250	2343	2225	345.9	0.1	0.1	346.0	346.0
Scour Design Check	200	7150	2343	2225	347.0	0.1	0.1	347.1	347.1
Overtop. Existing	110	6380	2343		346.1	0.1		346.2	
Overtop. Proposed	125	6500		2225	346.2		0.1		346.3

10 year velocity through existing bridge = 1.6 fps
10 year velocity through prop. bridge = 1.6 fps



SECTION A-A



PIER SKETCH

DESIGN SCOUR ELEVATION TABLE

Event/Limit State	Design Scour Elevations (ft.)			
	N. Abut.	Pier	S. Abut.	Item 113
Q100	338.6	301.0	338.8	5
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PREPARATION OF DETAILED PLANS

DETAILS
OLD IL-3 OVER MILLER CREEK
SBI 150C - SECTION 133B-1
ALEXANDER COUNTY
STATION 1176+64
STRUCTURE NO. 002-0037

MODEL: 010
FILE NAME: Z:\0 V and K Jobs\5244-008 Old IL 3 over Miller Creek (Historic Bridge)\CADD Sheets\5244-008-sht-structure4.dgn

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PLOT SCALE =	DRAWN - JRP	REVISED -
PLOT DATE = 1-20-2022	CHECKED - KES	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

DETAILS
S.N. 002-0037

SHEET 2 OF 2 SHEETS

S.B.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
150C	133B-1	ALEXANDER		

CONTRACT NO. 78610

ILLINOIS | FED. AID PROJECT

1/20/2022 6:14:01 AM

EXHIBIT C

BORING LOGS

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

Old IL Rte 3 Over Miller Creek

Route: Old IL Rte 3 **Structure Number:** 002-0010 **Date:** 10/3/2017

Section 133-B **Bored By:** R Moberly

County: Alexander **Location:** 1 mile North Thebes **Checked By:** A Hayes

Boring No 1-S
Station 1175+69
Offset 6' Lt CL
Ground Surface 346.5 Ft

Surf Wat Elev: 318.7
Ground Water Elevation
when Drilling 282.1
At Completion
At: Hrs:

		DEPTH	BLOWS	Qu tsf	W%
Asphalt over Concrete	345.5				
Stiff, moist, grey and brown, Silty Clay to Clay A-6			1		
			3	1.7B	24
			3		
		5.0	1		
			2	1.6B	24
			2		
			1		
			2	1.2B	23
			3		
	337.0				
Medium, moist to very moist, grey and brown, Clay A7-6 w/ Silt seams		10.0	`1		
			2	0.8S	32
			2		
			WH		
			1	0.8S	34
			2		
	332.0				
Soft, very moist, grey, Silty Clay Loam A-4		15.0	WH		
			1	0.3B	27
			1		
	329.5				
Medium, moist to very moist, grey Silty Clay Loam A-6			1		
			2	0.9S	23
			3		
	327.0				
Medium, moist to very moist, grey Silty Clay Loam A-4		20.0	1		
			2	0.7B	22
			2		
	324.5				
Very soft, very moist to wet, grey, Silty Clay Loam A-4			WH		
			WH	0.1B	31
			WH		
	322.0				
		25.0	WH		

		DEPTH	BLOWS	Qu tsf	W%
Soft, very moist to wet, brown Silty Clay Loam A-4			WH	0.3B	28
			1		
	319.5				
Medium, very moist, grey, Silty Clay Loam A-4			WH		
			1	0.8B	27
			2		
	317.0				
Soft, very moist, grey Silty Clay Loam A-4		30.0	WH		
			WH	0.4B	29
			WH		
	314.5				
Medium, very moist, grey Clay A7-6			WH		
			WH	0.6B	46
			WH		
	312.0				
Soft, very moist, grey, Silty Clay Loam A-6		35.0	WH		
			WH	0.4B	35
			1		
	309.5				
Medium, very moist, grey, Silty Clay Loam A-6 with 6" rotten wood layer			WH		
			WH	0.7B	30
			WH		
	306.5	40.0	WH		
Stiff, moist, grey, Clay A7-6			1	1.6B	31
			3		
	302.0				
Very stiff, moist, reddish grey Clay A7-6		45.0	2		
			4	2.3B	30
			6		
	297.0				
		50.0	1		

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

Route: Old IL Rte 3

Date: 10/3/2017

Section: 133-B

County: Alexander

Boring No: 1-S

Station: 1175+69

Offset: 6' Lt CL

Ground Surface: 346.5 Ft

Description	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, reddish grey, Clay		4	1.9B	26
A7-6		4		
	55.0	2		
		4	1.5B	36
		5		
287.0				
Very stiff, moist, grey	60.0	4		
Clay to Clay Loam w/ gravel		8	2.9B	25
A7-6		12		
282.0				
Dense, very moist, brown	65.0	10		
Sand and gravel w/ some Clay		18		
binder		18		
278.5				
Hard, dry, grey, Clay Shale				
	70.0	7		
		100/11"		
275.5				
Hard, dry, grey, Limestone				
Cored 71.0 to 76.0 feet				
100% Recovery; 70% RQD				
	75.0			

Description	DEPTH	BLOWS	Qu tsf	W%
270.5				
Hard, dry, grey, Limestone				
Cored 76.0 to 77.6 feet				
100% Rec; 100% RQD 269.0				
Mechanical problems at 77.6 ft				
Bore hole abandoned				
	80.0			
Bottom of hole = 77.6 feet				
Free water observed at 64.5 feet				
Elevation referenced to BM #3 at NE hub; Elevation = 347.2 ft				
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)	85.0			
To convert "N" values to "N60" multiply by 1.25				
	90.0			
	95.0			
	100.0			

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

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

Ol[illegible]L Rte 3 Over Miller Creek

Route: Old IL Rte 3 | Structure Number: 002-0010 | Date: 10/4/2017

Section 133-B | Bored By: R Moberly

County: Alexander | Location: 1 mile North Thebes | Checked By: A Hayes

Boring No 2-S
Station 1177+42
Offset 6' Rt CL
Ground Surface 346.3 Ft

Surf Wat Elev: 318.7
Ground Water Elevation
when Drilling 290.8
At Completion
At: Hrs:

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Asphalt over concrete					
	345.3				
Stiff, moist, brown, Silt Loam to					
Silty Clay Loam A-4					
			1		
			4	1.1S	20
			4		
		5.0	1		
			3	1.1S	22
			3		
	339.3				
Medium, moist to very moist, grey,			1		
Silty Clay Loam A-6			2	0.8B	26
			2		
		10.0	1		
			2	0.8B	26
			2		
			1		
			3	0.9B	24
			3		
	331.8				
Stiff, moist, grey, Silty Clay Loam		15.0	1		
A-6			4	1.8B	22
			4		
	329.3				
Stiff, moist, grey, Clay A7-6			1		
			2	1.2B	34
			2		
		20.0	2		
	325.8		2		
Soft, very moist, grey, Silty Clay			3	0.3B	32
Loam A-6					
			WH		
			WH	0.3B	31
			WH		
	321.8				
		25.0	WH		

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Very soft, very moist to wet, grey,			WH	0.2B	31
Silty Clay Loam A-4			WH		
			WH		
			WH	0.2B	32
			WH		
	316.8				
Medium, very moist, grey, Silty		30.0	WH		
Clay Loam A-4 with Silt seams			1	0.8S	31
			2		
	314.3				
Soft, very moist, grey, Silty Clay			WH		
to Silty Clay Loam A-6			WH	0.4B	39
			WH		
	311.8				
Soft, very moist to wet, grey,		35.0	WH		
Silty Clay Loam A-6			WH	0.3B	30
			WH		
	309.3				
Very soft, very moist to wet, grey,			WH		
Silty Clay Loam A-6			WH	0.2B	32
			WH		
	306.8				
Soft, very moist, grey, Clay to		40.0	WH		
Silty Clay A-6			WH	0.4B	41
			WH		
	301.8				
Very stiff, moist, reddish brown,		45.0	2		
Clay A7-6			4	2.5B	29
			5		
	296.8				
		50.0	1		

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

Route: Old IL Rte 3 | Date: 10/4/2017

Section: 133-B

County: Alexander

Boring No: 2-S

Station: 1177+42

Offset: 6' Rt CL

Ground Surface: 346.3 Ft

Description	Elevation	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, reddish brown, Clay A7-6			3	1.5B	35
			5		
		55.0	1		
	290.8		5	1.9B	28
Stiff, moist, reddish brown, Clay A7-6 and broken Limestone gravel			14		
	286.8				
Very stiff, moist, grey, Clay A7-6 and broken Limestone gravel		60.0	6		
			14	3.5P	24
			8		
Washed 3.5 feet of Sand and Gravel blow-in	281.8				
Very dense, wet, brown, Coarse-grained Sand and Gravel		65.0	35		
			33		
			29		
	277.3				
Hard, dry, grey, Clay Shale		70.0	6		
			100/5"		
	275.3				
Hard, dry, grey, Limestone Cored 71.0 to 76.0 feet 100% Recovery; 15% RQD		75.0			

Description	Elevation	DEPTH	BLOWS	Qu tsf	W%
	270.3				
Hard, dry, grey, Limestone Cored 76.0 to 81.0 feet 100% Recovery; 92% RQD		80.0			
	265.3				
Bottom of hole = 81.0 feet Free water observed at 55.5 feet Washout procedures used from 61.0 to 64.5 feet		85.0			
Elevation referenced to BM #3 at NE hub; Elevation = 347.2 ft Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.) To convert "N" values to "N60" multiply by 1.25		90.0			
		95.0			
		100.0			

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

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

Old IL Route 13
Structure 002-0010 (Boring 1-S)
Alexander County

Boring #	Specimen#	Depth	Unconfined Compression
1-S	1	71'0"	7,342 psi
1-S	2	72'7"	12,817 psi
1-S	3	73'3"	9,910 psi
1-S	4	75'4"	9,453 psi
1-S	5	76'6"	6,361 psi

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

Old IL Route 13
Structure 002-0010 (Boring 2-S)
Alexander County

Boring #	Specimen#	Depth	Unconfined Compression
2-S	1	75'10"	7,604 psi
2-S	2	76'4"	8,579 psi
2-S	3	78'3"	9,584 psi
2-S	4	79'8"	10,587 psi

EXHIBIT D

SUBSURFACE PROFILE

Illinois Department of Transportation
Division of Highways

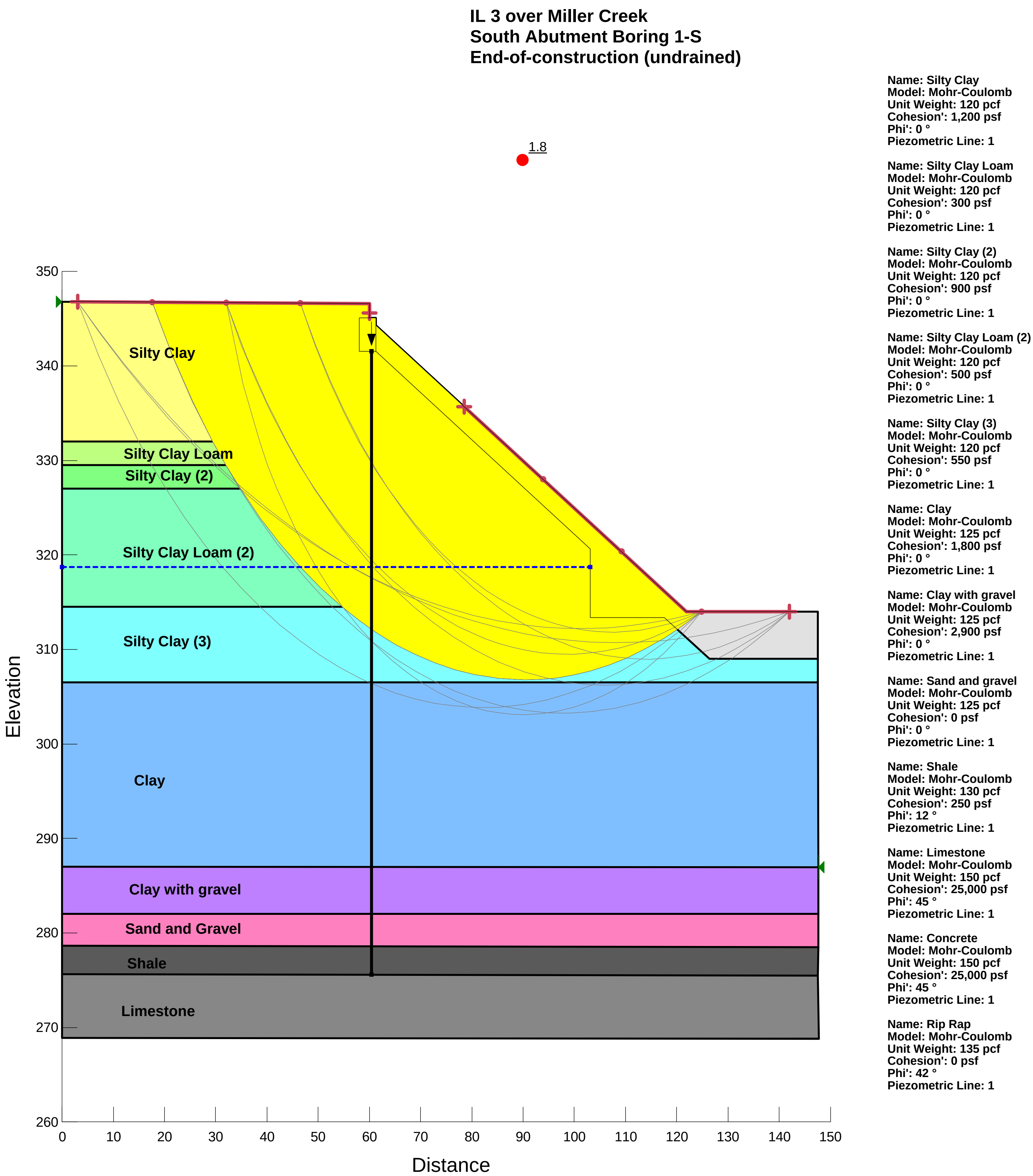
NOT TO HORIZONTAL SCALE

SUBSURFACE DATA PROFILE

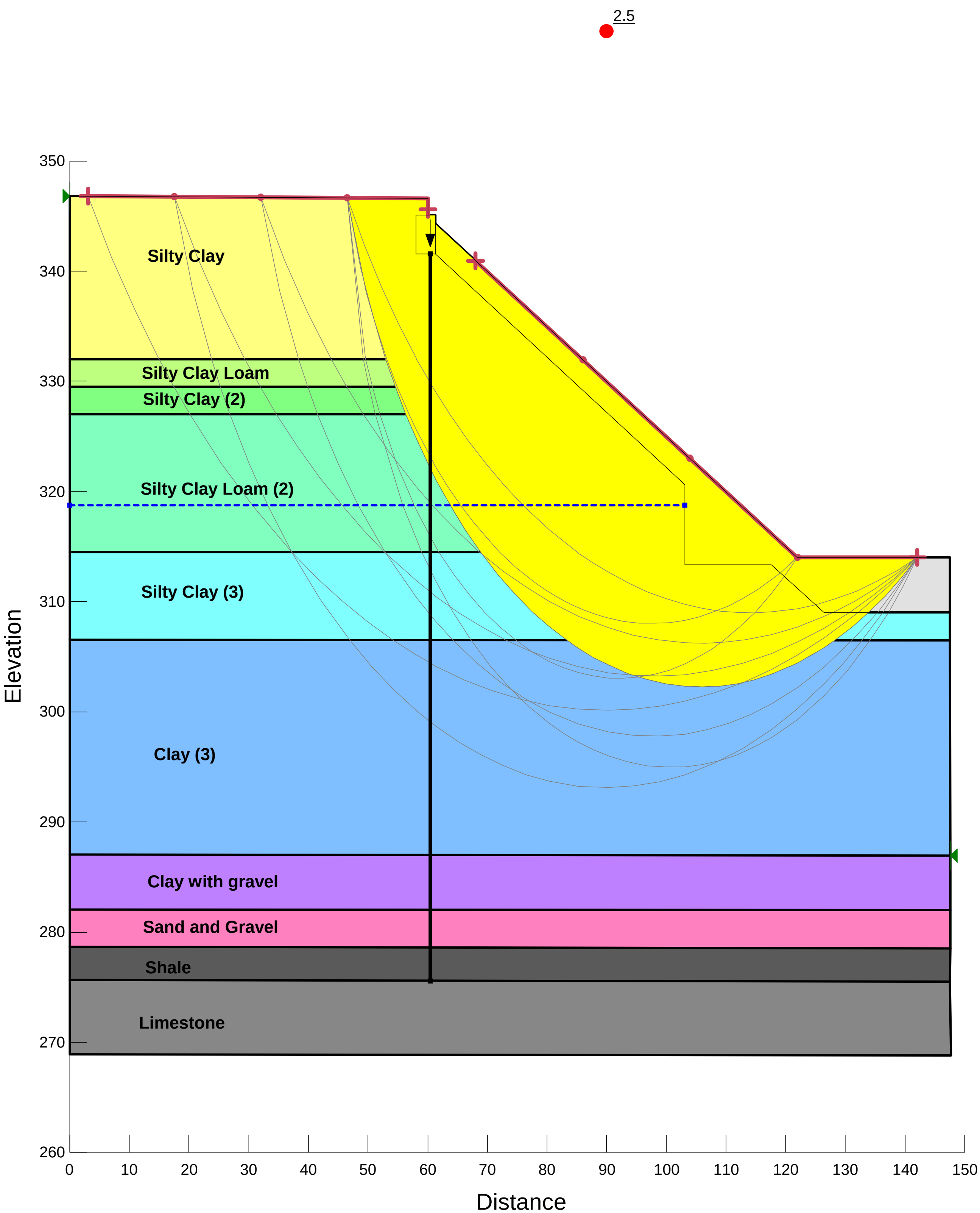
Route: IL Rte 3 over Miller Creek
Section: 133-B
County: Alexander

EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS


IL 3 over Miller Creek
South Abutment Boring 1-S
End-of-construction (undrained)
1.8
Silty Clay
Silty Clay Loam
Silty Clay (2)
Silty Clay Loam (2)
Silty Clay (3)
Clay
Clay with gravel
Sand and Gravel
Shale
Limestone
Elevation
350
340
330
320
310
300
290
280
270
260
Distance
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,200 psf
Phi': 0 °
Piezometric Line: 1
Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 300 psf
Phi': 0 °
Piezometric Line: 1
Name: Silty Clay (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 900 psf
Phi': 0 °
Piezometric Line: 1
Name: Silty Clay Loam (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 500 psf
Phi': 0 °
Piezometric Line: 1
Name: Silty Clay (3)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 550 psf
Phi': 0 °
Piezometric Line: 1
Name: Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,800 psf
Phi': 0 °
Piezometric Line: 1
Name: Clay with gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,900 psf
Phi': 0 °
Piezometric Line: 1
Name: Sand and gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 0 °
Piezometric Line: 1
Name: Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 250 psf
Phi': 12 °
Piezometric Line: 1
Name: Limestone
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1
Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1
Name: Rip Rap
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 42 °
Piezometric Line: 1

IL 3 over Miller Creek
South Abutment Boring 1-S
Long Term Analysis (drained)



Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Clay (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Silty Clay Loam (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Clay (3)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Clay with gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 28 °
Piezometric Line: 1

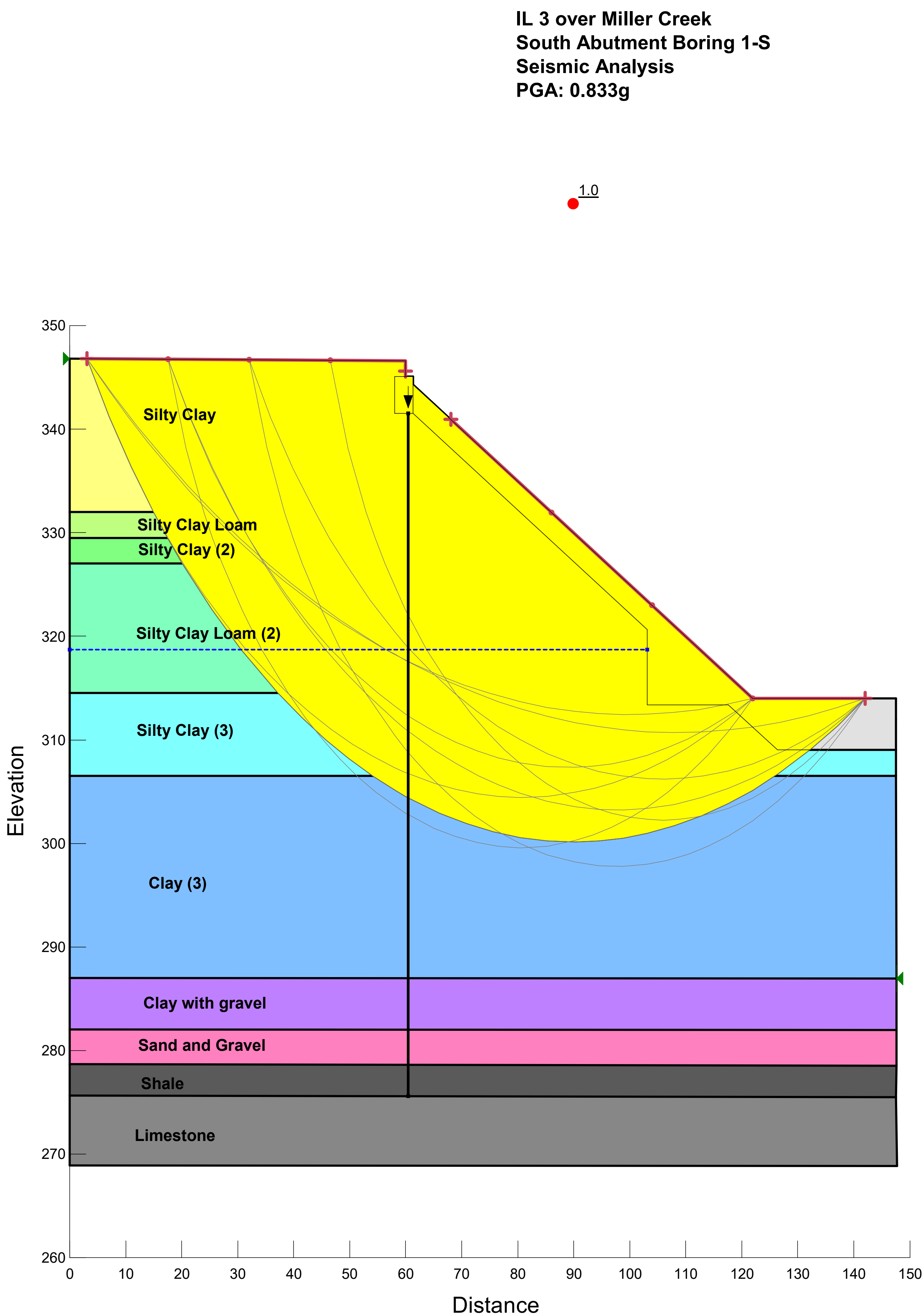
Name: Sand and gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 250 psf
Phi': 12 °
Piezometric Line: 1

Name: Limestone
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Rip Rap
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 42 °
Piezometric Line: 1



Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Clay (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Silty Clay Loam (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Silty Clay (3)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Clay with gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 28 °
Piezometric Line: 1

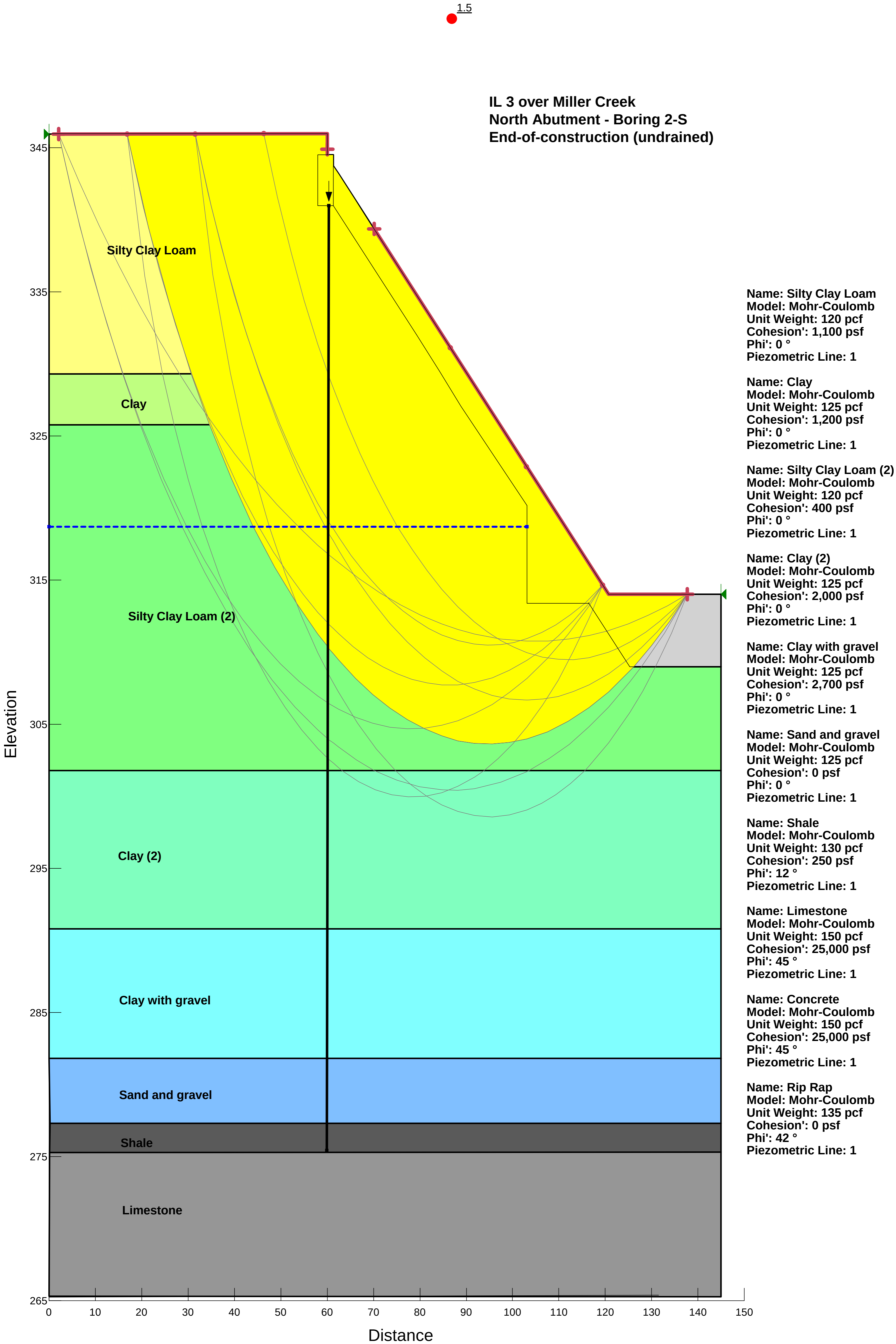
Name: Sand and gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 250 psf
Phi': 12 °
Piezometric Line: 1

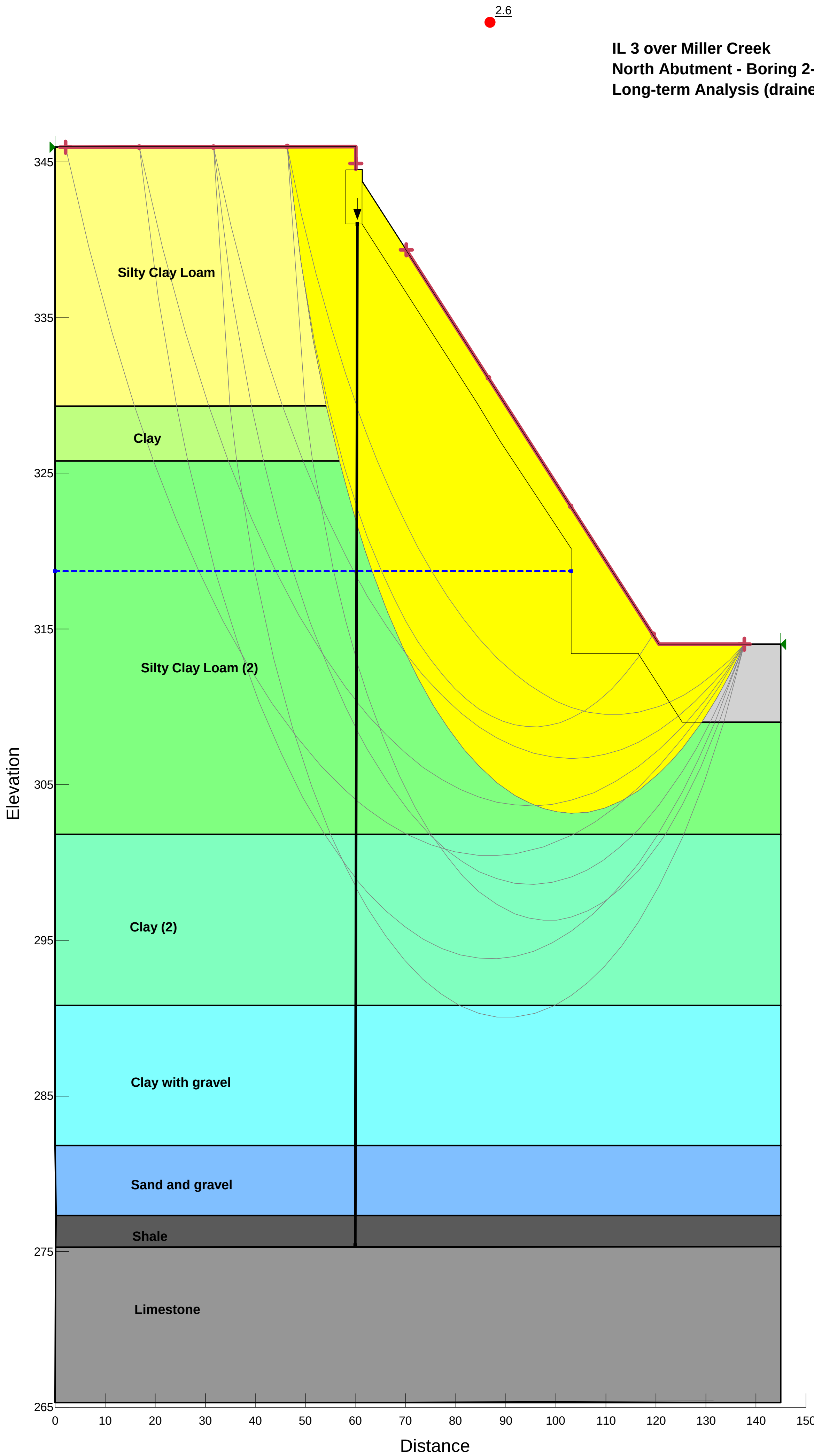
Name: Limestone
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Rip Rap
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 42 °
Piezometric Line: 1


1.5
IL 3 over Miller Creek
North Abutment - Boring 2-S
End-of-construction (undrained)
Silty Clay Loam
Clay
Silty Clay Loam (2)
Clay (2)
Clay with gravel
Sand and gravel
Shale
Limestone
Elevation
345
335
325
315
305
295
285
275
265
Distance
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,100 psf
Phi': 0 °
Piezometric Line: 1
Name: Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': 0 °
Piezometric Line: 1
Name: Silty Clay Loam (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 400 psf
Phi': 0 °
Piezometric Line: 1
Name: Clay (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Piezometric Line: 1
Name: Clay with gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,700 psf
Phi': 0 °
Piezometric Line: 1
Name: Sand and gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 0 °
Piezometric Line: 1
Name: Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 250 psf
Phi': 12 °
Piezometric Line: 1
Name: Limestone
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1
Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1
Name: Rip Rap
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 42 °
Piezometric Line: 1

IL 3 over Miller Creek
North Abutment - Boring 2-S
Long-term Analysis (drained)



Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 28 °
Piezometric Line: 1

Name: Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Silty Clay Loam (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Clay (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Clay with gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 26 °
Piezometric Line: 1

Name: Sand and gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 250 psf
Phi': 12 °
Piezometric Line: 1

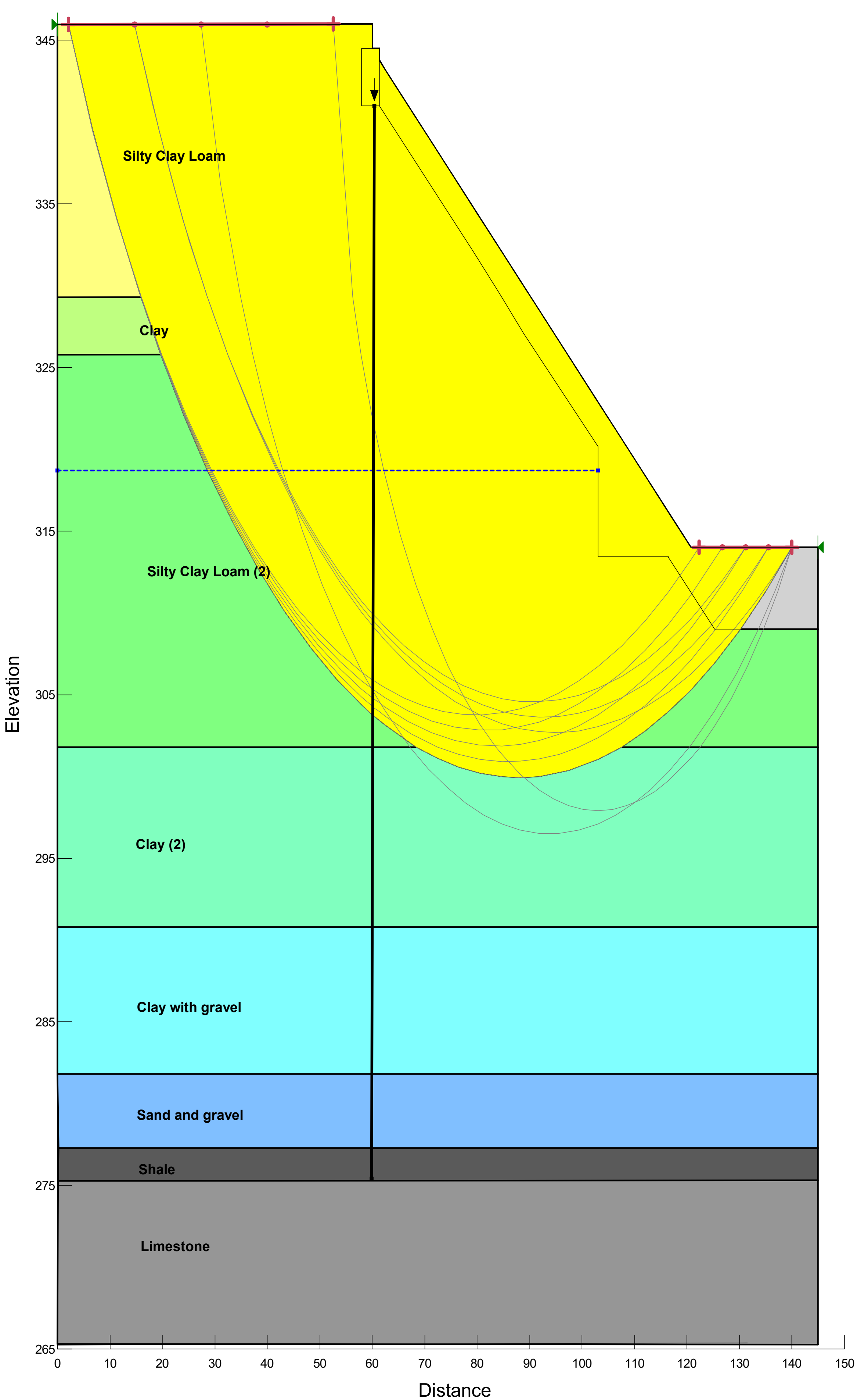
Name: Limestone
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Rip Rap
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 42 °
Piezometric Line: 1

1.1

IL 3 over Miller Creek
North Abutment - Boring 2-S
Seismic Analysis
PGA: 0.833g



Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 28 °
Piezometric Line: 1

Name: Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °
Piezometric Line: 1

Name: Silty Clay Loam (2)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 28 °
Piezometric Line: 1

Name: Clay (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Piezometric Line: 1

Name: Clay with gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 150 psf
Phi': 26 °
Piezometric Line: 1

Name: Sand and gravel
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °
Piezometric Line: 1

Name: Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 250 psf
Phi': 12 °
Piezometric Line: 1

Name: Limestone
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Piezometric Line: 1

Name: Rip Rap
Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion': 0 psf
Phi': 42 °
Piezometric Line: 1

EXHIBIT F

LIQUEFACTION ANALYSES RESULTS

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER	1-S S. Abut
ELEVATION OF BORING GROUND SURFACE	346.50 FT.
DEPTH TO GROUNDWATER - DURING DRILLING	64.40 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE	50.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As)	0.523
EARTHQUAKE MOMENT MAGNITUDE	7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE	0.00 FT.
HAMMER EFFICIENCY	73 %
BOREHOLE DIAMETER	8 IN.
SAMPLING METHOD	Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.999**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **245** FT./SEC.

PGA CALCULATOR

Earthquake Moment Magnitude =	7.52
Source-To-Site Distance, R (km) =	31.06
Ground Motion Prediction Equations =	NMSZ
PGA =	**0.523**

	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	3.5	6	1.7					0.128	0.448	10.796	10.796	0.120	0.128	0.448	0.448	1.444	**0.173**	0.885	**0.301**	**N.L. (1)**
340.5	6	4	1.6					0.127	0.766	6.507	6.507	0.084	0.127	0.766	0.766	1.238	**0.104**	0.804	**0.273**	**N.L. (1)**
338	8.5	5	1.2					0.124	1.076	7.744	7.744	0.094	0.124	1.076	1.076	1.159	**0.109**	0.728	**0.248**	**N.L. (1)**
335.5	11	4	0.8					0.119	1.373	6.118	6.118	0.081	0.119	1.373	1.373	1.094	**0.088**	0.658	**0.224**	**N.L. (1)**
333	13.5	3	0.8					0.119	1.671	4.468	4.468	0.068	0.119	1.671	1.671	1.049	**0.071**	0.596	**0.202**	**N.L. (1)**
330.5	16	2	0.3					0.108	1.941	2.893	2.893	0.058	0.108	1.941	1.941	1.018	**0.059**	0.541	**0.184**	**N.L. (1)**
328	18.5	5	0.9					0.120	2.241	6.938	6.938	0.087	0.120	2.241	2.241	0.988	**0.086**	0.495	**0.168**	**N.L. (1)**
325.5	21	4	0.7					0.117	2.533	5.317	5.317	0.074	0.117	2.533	2.533	0.965	**0.072**	0.457	**0.155**	**N.L. (1)**
323	23.5	1	0.1					0.098	2.778	1.283	1.283	0.050	0.098	2.778	2.778	0.947	**0.047**	0.425	**0.144**	**N.L. (1)**
320.5	26	1	0.3					0.108	3.048	1.231	1.231	0.050	0.108	3.048	3.048	0.930	**0.046**	0.399	**0.136**	**N.L. (1)**
318	28.5	3	0.8					0.119	3.346	3.527	3.527	0.062	0.119	3.346	3.346	0.913	**0.056**	0.379	**0.129**	**N.L. (1)**
315.5	31	1	0.4					0.111	3.623	1.128	1.128	0.050	0.111	3.623	3.623	0.898	**0.044**	0.362	**0.123**	**N.L. (1)**
313	33.5	1	0.6					0.116	3.913	1.082	1.082	0.049	0.116	3.913	3.913	0.885	**0.044**	0.349	**0.119**	**N.L. (1)**
310.5	36	1	0.4					0.111	4.191	1.041	1.041	0.049	0.111	4.191	4.191	0.873	**0.043**	0.339	**0.115**	**N.L. (1)**
308	38.5	1	0.7					0.117	4.483	1.000	1.000	0.049	0.117	4.483	4.483	0.861	**0.042**	0.331	**0.113**	**N.L. (1)**
305.5	41	4	1.6					0.127	4.801	3.840	3.840	0.064	0.127	4.801	4.801	0.849	**0.054**	0.325	**0.110**	**N.L. (1)**
300.5	46	10	2.3					0.132	5.461	8.858	8.858	0.103	0.132	5.461	5.461	0.809	**0.083**	0.316	**0.108**	**N.L. (1)**
295.5	51	8	1.9		25	50	26	0.129	6.106	6.587	6.587	0.084	0.067	5.796	5.858	0.809	**0.068**	0.311	**0.107**	**N.L. (2)**
290.5	56	9	1.5		25	50	36	0.126	6.736	6.929	6.929	0.087	0.064	6.116	6.490	0.799	**0.070**	0.308	**0.111**	**N.L. (2)**
285.5	61	20	2.9		25	50	25	0.134	7.406	14.385	14.385	0.154	0.072	6.476	7.162	0.749	**0.115**	0.306	**0.115**	**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

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ==================================== 2-S N. Abut
ELEVATION OF BORING GROUND SURFACE ========================= 346.30 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 55.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ================== 50.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.523
EARTHQUAKE MOMENT MAGNITUDE ================================ 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== 0.00 FT.
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 8 IN.
SAMPLING METHOD== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.999**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **253** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.52
Source-To-Site Distance, R (km) = 31.06
Ground Motion Prediction Equations = NMSZ
PGA = **0.523**

ELEV. OF SAMPLE (FT.)	BORING DATA: 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 (%)	CONDITIONS DURING DRILLING: 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 $CRR_{7.5}$	CONDITIONS DURING EARTHQUAKE: 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
342.8	3.5	8	1.1					0.123	0.431	14.815	14.815	0.158	0.123	0.431	0.431	1.500	**0.237**	0.889	**0.302**	**N.L. (1)**
340.3	6	6	1.1					0.123	0.738	9.842	9.842	0.112	0.123	0.738	0.738	1.275	**0.142**	0.811	**0.276**	**N.L. (1)**
337.8	8.5	4	0.8					0.119	1.036	6.265	6.265	0.082	0.119	1.036	1.036	1.161	**0.095**	0.736	**0.250**	**N.L. (1)**
335.3	11	4	0.8					0.119	1.333	6.181	6.181	0.081	0.119	1.333	1.333	1.101	**0.089**	0.666	**0.227**	**N.L. (1)**
332.8	13.5	6	0.9					0.120	1.633	9.017	9.017	0.105	0.120	1.633	1.633	1.061	**0.111**	0.604	**0.205**	**N.L. (1)**
330.3	16	8	1.8					0.128	1.953	11.540	11.540	0.127	0.128	1.953	1.953	1.020	**0.129**	0.550	**0.187**	**N.L. (1)**
327.8	18.5	4	1.2					0.124	2.263	5.524	5.524	0.076	0.124	2.263	2.263	0.987	**0.075**	0.503	**0.171**	**N.L. (1)**
325.3	21	5	0.3					0.108	2.533	6.646	6.646	0.085	0.108	2.533	2.533	0.963	**0.082**	0.464	**0.158**	**N.L. (1)**
322.8	23.5	1	0.3					0.108	2.803	1.277	1.277	0.050	0.108	2.803	2.803	0.946	**0.047**	0.432	**0.147**	**N.L. (1)**
320.3	26	1	0.2					0.104	3.063	1.228	1.228	0.050	0.104	3.063	3.063	0.929	**0.046**	0.406	**0.138**	**N.L. (1)**
317.8	28.5	1	0.2					0.104	3.323	1.180	1.180	0.050	0.104	3.323	3.323	0.914	**0.045**	0.385	**0.131**	**N.L. (1)**
315.3	31	3	0.8					0.119	3.621	3.386	3.386	0.061	0.119	3.621	3.621	0.898	**0.055**	0.368	**0.125**	**N.L. (1)**
312.8	33.5	1	0.4					0.111	3.898	1.084	1.084	0.049	0.111	3.898	3.898	0.885	**0.044**	0.355	**0.121**	**N.L. (1)**
310.3	36	1	0.3					0.108	4.168	1.044	1.044	0.049	0.108	4.168	4.168	0.874	**0.043**	0.344	**0.117**	**N.L. (1)**
307.8	38.5	1	0.2					0.104	4.428	1.008	1.008	0.049	0.104	4.428	4.428	0.863	**0.042**	0.336	**0.114**	**N.L. (1)**
305.3	41	1	0.4					0.111	4.706	0.973	0.973	0.049	0.111	4.706	4.706	0.853	**0.042**	0.330	**0.112**	**N.L. (1)**
300.3	46	9	2.5					0.133	5.371	8.062	8.062	0.096	0.133	5.371	5.371	0.816	**0.079**	0.321	**0.109**	**N.L. (1)**
295.3	51	8	1.5		25	50	35	0.126	6.001	6.668	6.668	0.085	0.064	5.691	5.753	0.812	**0.069**	0.316	**0.108**	**N.L. (2)**
290.3	56	19	1.9		25	50	28	0.067	6.336	15.288	15.288	0.163	0.067	6.026	6.400	0.759	**0.124**	0.312	**0.113**	**N.L. (2)**
285.3	61	22	3.5		25	50	24	0.074	6.706	17.190	17.190	0.183	0.074	6.396	7.082	0.737	**0.135**	0.311	**0.117**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI ≥ 12 OR w_c/LL ≤ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

EXHIBIT G

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

Illinois Department of Transportation

SUBSTRUCTURE=================================== North Abutment
REFERENCE BORING ================================ 2-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================ 340.60 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 338.60 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ============== 338.60 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 750 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 28.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts =========== 214.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts =========== 80.36 KIPS

PILE TYPE AND SIZE ============ Steel HP 10 X 42
Plugged Pile Perimeter========================= 3.300 FT.
Plugged Pile End Bearing Area=================== 0.680 SQFT.
Unplugged Pile Perimeter============= 4.858 FT.
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	**64** 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.)
337.80	0.80	0.80			1.6		9.2	2.3		***3.3***	3	0	0	2	3
335.30	2.50	0.80			4.9	7.6	15.0	7.2	1.0	***10.6***	11	0	0	6	5
332.80	2.50	0.90			5.4	8.6	29.0	7.9	1.1	***19.6***	20	0	0	11	8
330.30	2.50	1.80			9.0	17.2	32.2	13.2	2.2	***32.0***	32	0	0	18	10
327.80	2.50	1.20			6.8	11.4	***30.4***	10.0	1.4	40.9	30	0	0	17	13
325.30	2.50	0.30			2.0	2.9	***32.4***	2.9	0.4	43.9	32	0	0	18	15
322.80	2.50	0.30			2.0	2.9	***33.4***	2.9	0.4	46.7	33	0	0	18	18
320.30	2.50	0.20			1.4	1.9	***34.8***	2.0	0.2	48.7	35	0	0	19	20
317.80	2.50	0.20			1.4	1.9	***41.9***	2.0	0.2	51.4	42	0	0	23	23
315.30	2.50	0.80			4.9	7.6	***42.9***	7.2	1.0	58.1	43	0	0	24	25
312.80	2.50	0.40			2.6	3.8	***44.6***	3.9	0.5	61.8	45	0	0	25	28
310.30	2.50	0.30			2.0	2.9	***45.6***	2.9	0.4	64.6	46	0	0	25	30
307.80	2.50	0.20			1.4	1.9	***48.9***	2.0	0.2	66.9	49	0	0	27	33
302.80	5.00	0.40			5.2	3.8	***74.2***	7.7	0.5	77.1	74	0	0	41	38
297.80	5.00	2.50			22.2	23.8	***86.9***	32.7	3.0	108.6	87	0	0	48	43
292.80	5.00	1.50			15.9	14.3	***106.5***	23.4	1.8	132.5	107	0	0	59	48
287.80	5.00	1.90			18.6	18.1	***140.4***	27.4	2.3	161.8	140	0	0	77	53
282.80	5.00	3.50	22		28.3	33.4	214.1	41.6	4.2	***209.1***	209	0	0	115	58
278.30	4.50		62	Hard Till	13.4	78.8	233.5	19.8	10.0	***229.6***	230	0	0	126	62
277.30	1.00			Shale	41.1	84.8	***274.6***	60.5	10.7	290.2	275	0	0	151	63.3
276.30	1.00			Shale	41.1	84.8	400.4	60.5	10.7	***361.4***	~~361~~	~~0~~	~~0~~	~~199~~	~~64.3~~
275.30	1.00			Limestone	82.2	169.5	482.6	121.0	21.5	***482.5***	~~482~~	~~0~~	~~0~~	~~265~~	~~65.3~~
274.30	1.00			Limestone	82.2	169.5	***564.9***	121.0	21.5	603.5	~~565~~	~~0~~	~~0~~	~~311~~	~~66.3~~
273.30	1.00			Limestone	82.2	169.5	***647.1***	121.0	21.5	724.5	~~647~~	~~0~~	~~0~~	~~356~~	~~67.3~~
272.30	1.00			Limestone	82.2	169.5	***729.3***	121.0	21.5	845.6	~~729~~	~~0~~	~~0~~	~~401~~	~~68.3~~
271.30	1.00			Limestone	82.2	169.5	***811.5***	121.0	21.5	966.6	~~812~~	~~0~~	~~0~~	~~446~~	~~69.3~~
270.30	1.00			Limestone	82.2	169.5	***893.7***	121.0	21.5	1087.7	~~894~~	~~0~~	~~0~~	~~492~~	~~70.3~~
269.30	1.00			Limestone	82.2	169.5	***975.9***	121.0	21.5	1208.7	~~976~~	~~0~~	~~0~~	~~537~~	~~71.3~~
268.30	1.00			Limestone	82.2	169.5	***1058.2***	121.0	21.5	1329.8	~~1058~~	~~0~~	~~0~~	~~582~~	~~72.3~~
267.30	1.00			Limestone	82.2	169.5	***1140.4***	121.0	21.5	1450.8	~~1140~~	~~0~~	~~0~~	~~627~~	~~73.3~~
266.30	1.00			Limestone	82.2	169.5	***1222.6***	121.0	21.5	1571.8	~~1223~~	~~0~~	~~0~~	~~672~~	~~74.3~~
265.30	1.00			Limestone	82.2	169.5	***1304.8***	121.0	21.5	1692.9	~~1305~~	~~0~~	~~0~~	~~718~~	~~75.3~~
264.30	1.00			Limestone	82.2	169.5	***1387.0***	121.0	21.5	1813.9	~~1387~~	~~0~~	~~0~~	~~763~~	~~76.3~~
263.30	1.00			Limestone	82.2	169.5	***1469.2***	121.0	21.5	1935.0	~~1469~~	~~0~~	~~0~~	~~808~~	~~77.3~~
262.30	1.00			Limestone	82.2	169.5	***1551.5***	121.0	21.5	2056.0	~~1551~~	~~0~~	~~0~~	~~853~~	~~78.3~~
261.30	1.00			Limestone	82.2	169.5	***1633.7***	121.0	21.5	2177.0	~~1634~~	~~0~~	~~0~~	~~899~~	~~79.3~~
260.30	1.00			Limestone		169.5			21.5						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== Pier 1
REFERENCE BORING ================================ 1-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================= 312.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 310.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ============== 302.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1560 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 28.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 222.86 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 83.57 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	**273** KIPS	**138** KIPS	**36** 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.)
309.50	0.50	0.40			0.5		7.2	0.8		**1.6**	2	0	0	1	3
307.00	2.50	0.70			4.3	6.7	20.1	6.4	0.8	**9.1**	9	3	0	2	5
302.00	5.00	1.60			16.6	15.3	43.4	24.4	1.9	**34.4**	34	12	0	7	10
297.00	5.00	2.30			21.0	21.9	**60.6**	30.9	2.8	64.8	61	12	0	22	15
292.00	5.00	1.90			18.6	18.1	**75.4**	27.4	2.3	91.7	75	12	0	30	20
287.00	5.00	1.50			15.9	14.3	**104.6**	23.4	1.8	116.8	105	12	0	46	25
282.00	5.00	2.90			24.6	27.7	**147.3**	36.3	3.5	155.3	147	12	0	69	30
278.50	3.50		36	Hard Till	4.6	45.8	190.9	6.8	5.8	**167.1**	167	12	0	80	34
277.50	1.00			Shale	41.1	84.8	232.1	60.5	10.7	**227.6**	228	12	0	113	34.5
276.50	1.00			Shale	41.1	84.8	**273.2**	60.5	10.7	288.1	273	12	0	138	35.5
275.50	1.00			Shale	41.1	84.8	399.0	60.5	10.7	**359.4**	~~359~~	~~12~~	~~0~~	~~186~~	~~36.5~~
274.50	1.00			Limestone	82.2	169.5	481.2	121.0	21.5	**480.4**	~~480~~	~~12~~	~~0~~	~~252~~	~~37.5~~
273.50	1.00			Limestone	82.2	169.5	**563.5**	121.0	21.5	601.4	~~563~~	~~12~~	~~0~~	~~298~~	~~38.5~~
272.50	1.00			Limestone	82.2	169.5	**645.7**	121.0	21.5	722.5	~~646~~	~~12~~	~~0~~	~~343~~	~~39.5~~
271.50	1.00			Limestone	82.2	169.5	**727.9**	121.0	21.5	843.5	~~728~~	~~12~~	~~0~~	~~389~~	~~40.5~~
270.50	1.00			Limestone	82.2	169.5	**810.1**	121.0	21.5	964.6	~~810~~	~~12~~	~~0~~	~~434~~	~~41.5~~
269.50	1.00			Limestone	82.2	169.5	**892.3**	121.0	21.5	1085.6	~~892~~	~~12~~	~~0~~	~~479~~	~~42.5~~
268.50	1.00			Limestone	82.2	169.5	**974.5**	121.0	21.5	1206.7	~~975~~	~~12~~	~~0~~	~~524~~	~~43.5~~
267.50	1.00			Limestone	82.2	169.5	**1056.8**	121.0	21.5	1327.7	~~1057~~	~~12~~	~~0~~	~~569~~	~~44.5~~
266.50	1.00			Limestone	82.2	169.5	**1139.0**	121.0	21.5	1448.7	~~1139~~	~~12~~	~~0~~	~~615~~	~~45.5~~
265.50	1.00			Limestone	82.2	169.5	**1221.2**	121.0	21.5	1569.8	~~1221~~	~~12~~	~~0~~	~~660~~	~~46.5~~
264.50	1.00			Limestone	82.2	169.5	**1303.4**	121.0	21.5	1690.8	~~1303~~	~~12~~	~~0~~	~~705~~	~~47.5~~
263.50	1.00			Limestone	82.2	169.5	**1385.6**	121.0	21.5	1811.9	~~1386~~	~~12~~	~~0~~	~~750~~	~~48.5~~
262.50	1.00			Limestone	82.2	169.5	**1467.9**	121.0	21.5	1932.9	~~1468~~	~~12~~	~~0~~	~~796~~	~~49.5~~
261.50	1.00			Limestone	82.2	169.5	**1550.1**	121.0	21.5	2053.9	~~1550~~	~~12~~	~~0~~	~~841~~	~~50.5~~
260.50	1.00			Limestone	82.2	169.5	**1632.3**	121.0	21.5	2175.0	~~1632~~	~~12~~	~~0~~	~~886~~	~~51.5~~
259.50	1.00			Limestone	82.2	169.5	**1714.5**	121.0	21.5	2296.0	~~1715~~	~~12~~	~~0~~	~~931~~	~~52.5~~
258.50	1.00			Limestone	82.2	169.5	**1796.7**	121.0	21.5	2417.1	~~1797~~	~~12~~	~~0~~	~~976~~	~~53.5~~
257.50	1.00			Limestone	82.2	169.5	**1878.9**	121.0	21.5	2538.1	~~1879~~	~~12~~	~~0~~	~~1022~~	~~54.5~~
256.50	1.00			Limestone	82.2	169.5	**1961.2**	121.0	21.5	2659.2	~~1961~~	~~12~~	~~0~~	~~1067~~	~~55.5~~
255.50	1.00			Limestone	82.2	169.5	**2043.4**	121.0	21.5	2780.2	~~2043~~	~~12~~	~~0~~	~~1112~~	~~56.5~~
254.50	1.00			Limestone	82.2	169.5	**2125.6**	121.0	21.5	2901.2	~~2126~~	~~12~~	~~0~~	~~1157~~	~~57.5~~
253.50	1.00			Limestone	82.2	169.5	**2207.8**	121.0	21.5	3022.3	~~2208~~	~~12~~	~~0~~	~~1202~~	~~58.5~~
252.50	1.00			Limestone	82.2	169.5	**2290.0**	121.0	21.5	3143.3	~~2290~~	~~12~~	~~0~~	~~1248~~	~~59.5~~
251.50	1.00			Limestone	82.2	169.5	**2372.2**	121.0	21.5	3264.4	~~2372~~	~~12~~	~~0~~	~~1293~~	~~60.5~~
250.50	1.00			Limestone	82.2	169.5	**2454.5**	121.0	21.5	3385.4	~~2454~~	~~12~~	~~0~~	~~1338~~	~~61.5~~
249.50	1.00			Limestone	82.2	169.5	**2536.7**	121.0	21.5	3506.5	~~2537~~	~~12~~	~~0~~	~~1383~~	~~62.5~~
248.50	1.00			Limestone		169.5			21.5						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

Illinois Department of Transportation

SUBSTRUCTURE================================== South Abutment
REFERENCE BORING ================================ 1-S
LRFD or ASD or SEISMIC ============================= LRFD
PILE CUTOFF ELEV. ================================= 340.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 338.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ============== 338.80 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 615 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 28.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts =========== 175.71 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts =========== 65.89 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	**65** 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.)
337.00	1.80	1.20			4.9		12.5	7.2		***8.1***	8	0	0	4	4
334.50	2.50	0.80			4.9	7.6	17.4	7.2	1.0	***15.3***	15	0	0	8	6
332.00	2.50	0.80			4.9	7.6	***17.5***	7.2	1.0	21.9	17	0	0	10	9
329.50	2.50	0.30			2.0	2.9	***25.2***	2.9	0.4	25.5	25	0	0	14	11
327.00	2.50	0.90			5.4	8.6	***28.7***	7.9	1.1	33.2	29	0	0	16	14
324.50	2.50	0.70			4.3	6.7	***27.3***	6.4	0.8	38.9	27	0	0	15	16
322.00	2.50	0.10			0.7	1.0	***29.9***	1.0	0.1	40.1	30	0	0	16	19
319.50	2.50	0.30			2.0	2.9	***36.6***	2.9	0.4	43.7	37	0	0	20	21
317.00	2.50	0.80			4.9	7.6	***37.7***	7.2	1.0	50.4	38	0	0	21	24
314.50	2.50	0.40			2.6	3.8	***42.2***	3.9	0.5	54.5	42	0	0	23	26
312.00	2.50	0.60			3.8	5.7	***44.1***	5.6	0.7	59.8	44	0	0	24	29
309.50	2.50	0.40			2.6	3.8	***49.6***	3.9	0.5	64.0	50	0	0	27	31
307.00	2.50	0.70			4.3	6.7	***62.5***	6.4	0.8	71.5	63	0	0	34	34
302.00	5.00	1.60			16.6	15.3	***85.8***	24.4	1.9	96.8	86	0	0	47	39
297.00	5.00	2.30			21.0	21.9	***103.0***	30.9	2.8	127.2	103	0	0	57	44
292.00	5.00	1.90			18.6	18.1	***117.8***	27.4	2.3	154.1	118	0	0	65	49
287.00	5.00	1.50			15.9	14.3	***147.0***	23.4	1.8	179.2	147	0	0	81	54
282.00	5.00	2.90			24.6	27.7	***189.7***	36.3	3.5	217.7	190	0	0	104	59
278.50	3.50		36	Hard Till	4.6	45.8	233.3	6.8	5.8	***229.5***	229	0	0	126	62
277.50	1.00			Shale	41.1	84.8	***274.5***	60.5	10.7	290.0	274	0	0	151	63.3
276.50	1.00			Shale	41.1	84.8	***315.6***	60.5	10.7	350.5	316	0	0	174	64.3
275.50	1.00			Shale	41.1	84.8	441.4	60.5	10.7	***421.8***	~~422~~	~~0~~	~~0~~	~~232~~	~~65.3~~
275.25	0.25			Limestone	20.6	169.5	462.0	30.3	21.5	***452.0***	~~452~~	~~0~~	~~0~~	~~249~~	~~65.6~~
275.00	0.25			Limestone	20.6	169.5	482.5	30.3	21.5	***482.3***	~~482~~	~~0~~	~~0~~	~~265~~	~~65.8~~
274.75	0.25			Limestone	20.6	169.5	***503.1***	30.3	21.5	512.6	~~503~~	~~0~~	~~0~~	~~277~~	~~66.1~~
274.50	0.25			Limestone	20.6	169.5	***523.6***	30.3	21.5	542.8	~~524~~	~~0~~	~~0~~	~~288~~	~~66.3~~
274.25	0.25			Limestone	20.6	169.5	***544.2***	30.3	21.5	573.1	~~544~~	~~0~~	~~0~~	~~299~~	~~66.6~~
274.00	0.25			Limestone	20.6	169.5	***564.7***	30.3	21.5	603.3	~~565~~	~~0~~	~~0~~	~~311~~	~~66.8~~
273.75	0.25			Limestone	20.6	169.5	***585.3***	30.3	21.5	633.6	~~585~~	~~0~~	~~0~~	~~322~~	~~67.1~~
272.75	1.00			Limestone	82.2	169.5	***667.5***	121.0	21.5	754.6	~~668~~	~~0~~	~~0~~	~~367~~	~~68.1~~
271.75	1.00			Limestone	82.2	169.5	***749.7***	121.0	21.5	875.7	~~750~~	~~0~~	~~0~~	~~412~~	~~69.1~~
270.75	1.00			Limestone	82.2	169.5	***832.0***	121.0	21.5	996.7	~~832~~	~~0~~	~~0~~	~~458~~	~~70.1~~
269.75	1.00			Limestone	82.2	169.5	***914.2***	121.0	21.5	1117.8	~~914~~	~~0~~	~~0~~	~~503~~	~~71.1~~
268.75	1.00			Limestone	82.2	169.5	***996.4***	121.0	21.5	1238.8	~~996~~	~~0~~	~~0~~	~~548~~	~~72.1~~
267.75	1.00			Limestone	82.2	169.5	***1078.6***	121.0	21.5	1359.8	~~1079~~	~~0~~	~~0~~	~~593~~	~~73.1~~
266.75	1.00			Limestone	82.2	169.5	***1160.8***	121.0	21.5	1480.9	~~1161~~	~~0~~	~~0~~	~~638~~	~~74.1~~
265.75	1.00			Limestone		169.5			21.5						