STRUCTURE GEOTECHNICAL REPORT

Westminster Drive over F.A.I Route 57 (I-57)

S.N. 100-0104

FAI ROUTE 57
SECTION (X1-6)HB-4
WILLIAMSON COUNTY, ILLINOIS
PTB 184/034
KEG NO. 17-1095.01

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08/26/2020
Exp 11/30/2021

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Springfield, Illinois 62703

February 21, 2020
Revised August 26, 2020

Kaskaskia
Engineering Group, LLC

EXECUTIVE SUMMARY

Westminster Drive over I-57
FAI Route 57
Section (X1-6)HB-4
Williamson County, Illinois
PTB 184/034
Existing Structure No. 100-0055
Proposed Structure No. 100-0104

The original structure (SN 100-0055) will be replaced by a two-span structure located at Westminster Drive over I-57 in Williamson County, Illinois. This report summarizes the analysis of the proposed structure replacement.

The proposed structure will result in reconstruction of endslopes at the abutments. The results of the analysis, as provided in Table 4.2, indicates an acceptable Factor of Safety (FOS) will exist under undrained and drained conditions for the endslopes at the 1 vertical to 2.4 horizontal (1V:2.4H), or 1V:2H conditions proposed.

TABLE OF CONTENTS

EXHIBITS

1.0 PROJECT DESCRIPTION AND PROPOSED STRUCTURE INFORMATION

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed bridge at Westminster Drive over I-57 located in Williamson County, Illinois. The bridge is located approximately 1.5 miles south of the IL 13 and I-57 Marion interchange. 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 100-0055) located at Westminster Drive over I-57. 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. 9S, R. 2E, Section 23) 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 2 degree 30 minute skew from the centerline of I-57. The Type, Size, and Location Plan (TS&L) is included in Exhibit B. The proposed structure will measure 200 feet 4 inches from back-to-back of abutments, with an out-to-out width of 43 feet 10 inches. The bridge spans from Station 11+31.99 to 13+32.33 along Westminster Drive. The bridge will carry two, 15-foot traffic lanes and a 10-foot pedestrian lane. The anticipated substructure units include integral abutments and one, solid wall pier. Further substructure details will be based on the findings of this SGR.

2.0 EXISTING BRIDGE INFORMATION

The original structure was built in 1959. The existing structure is a four-span haunched reinforced concrete deck girder bridge. The superstructure consists of a 6.75 foot reinforced concrete slab supported by 4 haunched concrete T-beams. The substructure consists of reinforced concrete pile bent abutments supported by steel piles and hammerhead piers on reinforced concrete spread footings.

3.0 SITE INVESTIGATION, SUBSURFACE EXPLORATION, AND GENERALIZED SUBSURFACE CONDITIONS

The site investigation plan was performed by IDOT District 9 Geotechnical personnel. A representative of Kaskaskia Engineering Group, LLC (KEG) did not conduct a site visit or observe the drilling operations.

Three (3) standard penetration test (SPT) borings, designated 1-S, 2-S and 3-S were drilled on September 13, 15 and 18, 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 3.0.1 - Boring Stations and Offsets

Designation	Stationing	Offset (ft.)	Surface Elevation (ft.)
1-S	11+19	8.0 LT	490.0
2-S	12+24	30.0 RT	471.1
3-S	13+41	8.0 RT	490.1

3.1 Subsurface Conditions

From the surface, approximate elevation 490, 1-S and 3-S encountered medium-stiff to stiff, clay to depths of approximately 7 to 12 feet below ground surface (bgs). N-values in the upper soils typically ranged from 3 to 7 blows per foot (bpf) with field Rimac (Qu) strength values ranging from 1.2 to 2.5 tons per square foot (tsf) and moisture contents of 17 to 20 percent. Below the clays, medium-stiff to stiff, silty clay and silty clay loams continued to depths of approximately 30 to 35 feet bgs. N-values of these soils ranged from 3 to 12 bpf, with field Qu values ranging from 0.4 to 3.1 tsf, and moisture contents of 17 to 24 percent. Below the silty clays were interbedded layers of medium-stiff to stiff layers of silty clay and clay materials. These interbedded layers were encountered to depths of approximately 44.5 to 48 feet bgs where a hard dense sandstone was encountered.

From the surface, approximate elevation 471, 2-S encountered a stiff clay to a depth of 4.5 feet bgs with an N-value of 7 bpf and a Qu value of 1.5 tsf. The moisture content was 22 percent. Below the clay, a medium-stiff to very-stiff silty clay to silty clay loam material was encountered to a depth of 19.5 feet bgs. N-values ranged from 6-9 bpf with Qu values between 0.7 to 2.3 tsf. The moisture contents ranged from 20 to 25 percent. A layer of very-stiff clay was encountered from 19.5 to 22 feet bgs with an N-value of 29 bpf and a Qu of 2.9 tsf. The moisture content was 14 percent. Below the very-stiff clay, a 1 foot thick layer of silty clay was encountered with an N-value of 17 bpf and a Qu of 1.1 tsf. The moisture content was 18 percent. Below the silty clay, the boring encountered a hard dense sandstone.

3.2 Groundwater

Groundwater was encountered in borings 1-S ands 3-S. Table 3.3 shows the elevation that groundwater was encountered during drilling.

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

Table 3.2.1 - Groundwater Elevations

Boring	Stationing	Offset (ft.)	Elevation (ft.)
1-S	11+19	8.0 LT	445.5
3-S	13+41	8.0 RT	455.6

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 2.4 Horizontal (1V:2.4H). The abutment endslopes were also modeled and evaluated with a 1 Vertical to 2 Horizontal (1V:2H) inclination.

Slope stability of the east and west endslopes were analyzed using SLOPE-W, the soil properties of the borings, and the endslope geometrics. Three conditions were modeled: end-of-construction, long-term, and seismic stability. 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.

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 27 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. Seismic stability was modeled using the end-of-construction parameters, with a PGA of 0.359g.

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 are shown in Table 4.2. SLOPE-W program output from this analysis can be found in SLOPE-W Stability Analysis, Exhibit E.

Table 4.2.1 - Slope Stability Critical FOS

Location	Reference Boring	Slope	End-of-Construction (Undrained)	Long-Term (Drained)	Seismic
East Abutment	3-S	1V:2.4H	3.2	1.7	1.3
West Abutment	1-S	1V:2.4H	3.7	1.6	1.4
East Abutment	3-S	1V:2H	3.2	1.5	1.3
West Abutment	1-S	1V:2H	3.6	1.5	1.4

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

4.3 Scour

The proposed structure will not cross a river or other tributary; therefore, scour is not considered.

4.4 Mining Activity

According to the Illinois State Geological Survey (ISGS) website, industrial mineral mining has occurred in Williamson County. According to the Williamson County Illinois Coal Mines and Underground Industrial Mines Map, dated August 8, 2019, obtained from the ISGS website (http://isgs.illinois.edu/ilmines), coal mining has occurred in Williamson County, however the project site has not been undermined. The closest mining activity to this site is directly north of the IL 13 and I-57 interchange.

KEG did not perform a specific site observation to detect any apparent depression(s) which could indicate mine subsidence or shafts beneath the project location. Refer to Illinois State Geological Survey Mine Map for Williamson County, Exhibit F, for additional information.

4.5 Seismic Considerations

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

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. Section 3.10.2 of the 2017 AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to determine the parameters for the project site location. The values, based on a 1000-Year Return Period, with a Probability of Exceedance (PE) of 7 percent in 75 years, and the Soil Site Class C are summarized below in Table 4.5.1.

Table 4.5.1 - Summary of Seismic Parameters

Parameter	Value
Soil Site Class	C
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.768 g
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.280 g
Seismic Performance Zone	2

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

4.6 Liquefaction

Per the Geotechnical Manual, due to the location of this structure and the seismic conditions resulting in an SPZ 2; a liquefaction analysis was performed using the liquefaction analysis worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis. The PGA and Mw pairs to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website for both

New Madrid Seismic Zone (NMSZ) and Central Eastern United States (CEUS) models. The deaggregation data indicated a NMSZ maximum Magnitude of 7.78, contributing 7.73% to the hazard for this site. The Peak Horizontal Ground Surface Acceleration coefficient was set to the NMSZ PGA (0.271g), calculated in the IDOT Liquefaction Analysis Spreadsheet.

The soil profiles for Borings 1-S and 3-S were analyzed for the west and east 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.

5.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

5.1 General Feasibility

ABD Memo 12.3 Integral Abutment Feasibility Analysis was used to review what pile types may be applicable for support of this structure using integral abutments. Based on that review, the IDOT Static Method of Estimating Pile Length, provided by IDOT BBS Foundations and Geotechnical Unit, was used to determine the design length of a range of piles as summarized below.

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 5.2.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
West Abutment	1437
Pier	2112
East Abutment	1437

The estimated pile lengths for applicable H pile types are shown in Tables 5.2.2 thru 5.2.7 below.

Table 5.2.2 - 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	41	481.34
Pier 1 2-S	335	184	19	461.5
East Abutment 3-S	335	184	36	481.78

Table 5.2.3 - 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	41	481.34
Pier 1 2-S	418	230	19	461.5
East Abutment 3-S	418	230	36	481.78

Table 5.2.4 - 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	42	481.34
Pier 1 2-S	497	273	20	461.5
East Abutment 3-S	497	273	37	481.78

Table 5.2.5 - 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	42	481.34
Pier 1 2-S	578	318	20	461.5
East Abutment 3-S	578	318	36	481.78

Table 5.2.6 - 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	42	481.34
Pier 1 2-S	705	388	21	461.5
East Abutment 3-S	705	388	37	481.78

Table 5.2.7 - Estimated Pile Lengths for HP 14x117 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment 1-S	929	511	44	481.34
Pier 1 2-S	929	511	22	461.5
East Abutment 3-S	929	511	39	481.78

As shown in the Tables above and in IDOT Static Method of Estimating Pile Length, Exhibit G, downdrag and liquefaction have not been considered at the substructure locations.

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

5.3 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 5.3.1 - 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	489	125	0	1500	26	250	8	80	500	0.007
	480.5	125	0	1700	26	100	5	80	500	0.007
	470.5	120	0	1300	28	50	7	65	500	0.007
	460.5	125	0	2500	26	100	9	80	1000	0.005
	442	125	0	1300	26	100	9	80	500	0.007
	430	150	45	--	45	--	100+	--	--	--
2-S	466.6	125	0	1500	26	100	7	80	500	0.007
	459.1	120	0	2300	28	100	9	65	1000	0.005
	454.1	120	0	700	28	50	6	65	100	0.010
	451.6	120	0	1200	26	100	7	80	500	0.007
	449.1	125	0	2900	27	100	29	65	1000	0.005
	448.1	120	0	1100	28	100	6	65	500	0.007
	439.1	150	45	--	45	--	100+	--	--	--
3-S	489.1	125	0	1500	26	250	8	80	500	0.007
	475.6	125	0	1900	26	100	7	80	500	0.007
	463.1	120	0	1700	26	100	9	80	500	0.007
	458.1	125	0	1400	26	50	7	80	500	0.007
	455.6	110	0	400	27	50	3	65	30	0.020
	453.1	125	0	1500	26	100	13	80	500	0.007
	450.6	120	0	2100	26	100	29	80	1000	0.005
	447.6	110	0	1000	27	50	21	65	100	0.007
	440.6	150	45	--	45	--	100+	--	--	--

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 Temporary Sheeting and Soil Retention

According to the TS&L, traffic will be maintained using road closure and detour; therefore, no Temporary Sheeting and Soil Retention is required. If during final design, stage construction is implementated, Temporary Sheeting will be required. The IDOT Temporary Sheet Piling Design Guide and Charts and Spreadsheet were used to review various retained heights ranging from 5 to 15 feet below existing grades. Based on these resources, Temporary Sheet Piling Systems are feasible for retained heights of 15 feet or less.

Temporary Soil Retention Systems may be required versus Temporary Sheet Piling, 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.

6.3 Site and Soil Conditions

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

6.4 Foundation Construction

Conventional pile driving equipment and methodologies should be assumed.

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

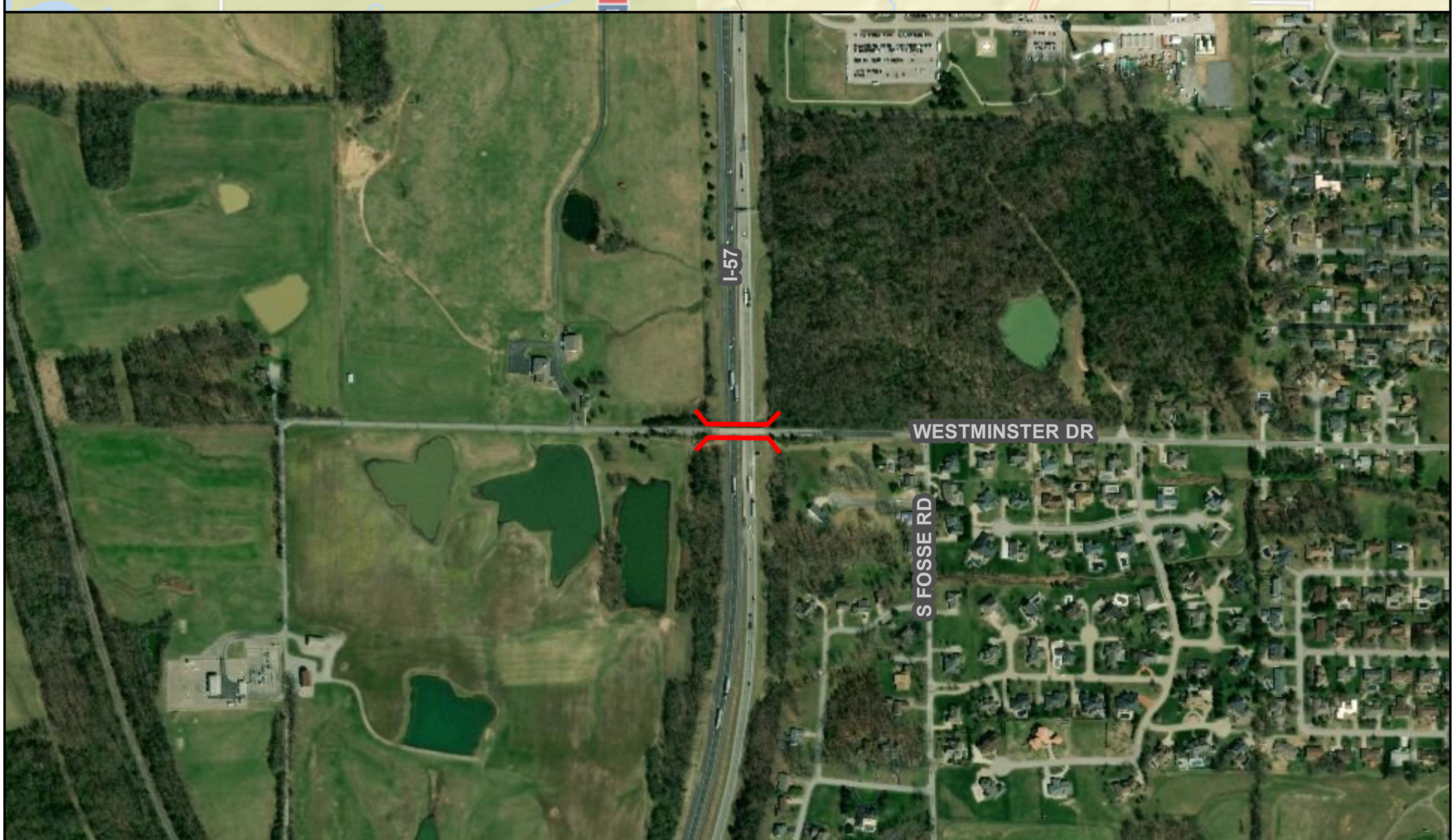
Soil boring logs can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

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 three 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

Westminster Drive over I-57 (FAI-57)
Structure No. 100-0104
Williamson County, Illinois

Exhibit No.

A

KEG JOB #17-1095.01

EXHIBIT B

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

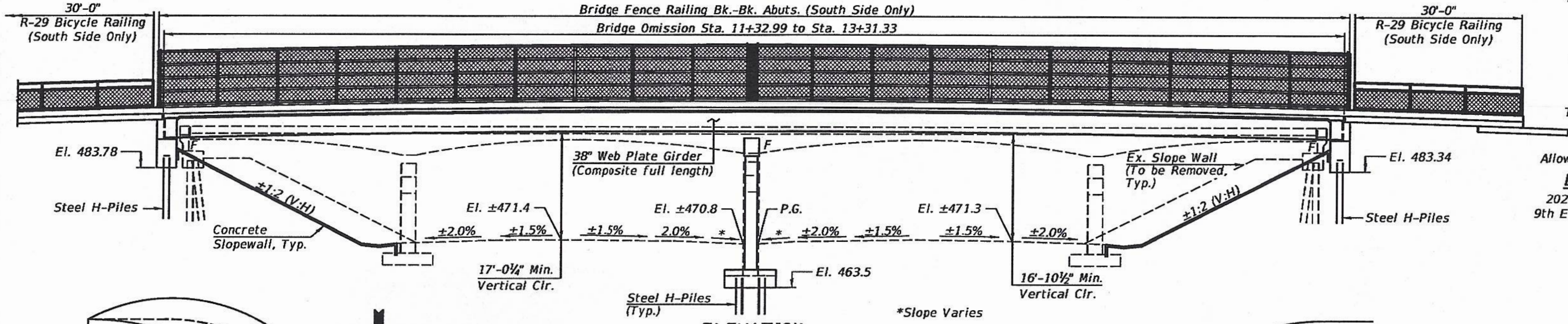
APPROVED

AUG 18 2020

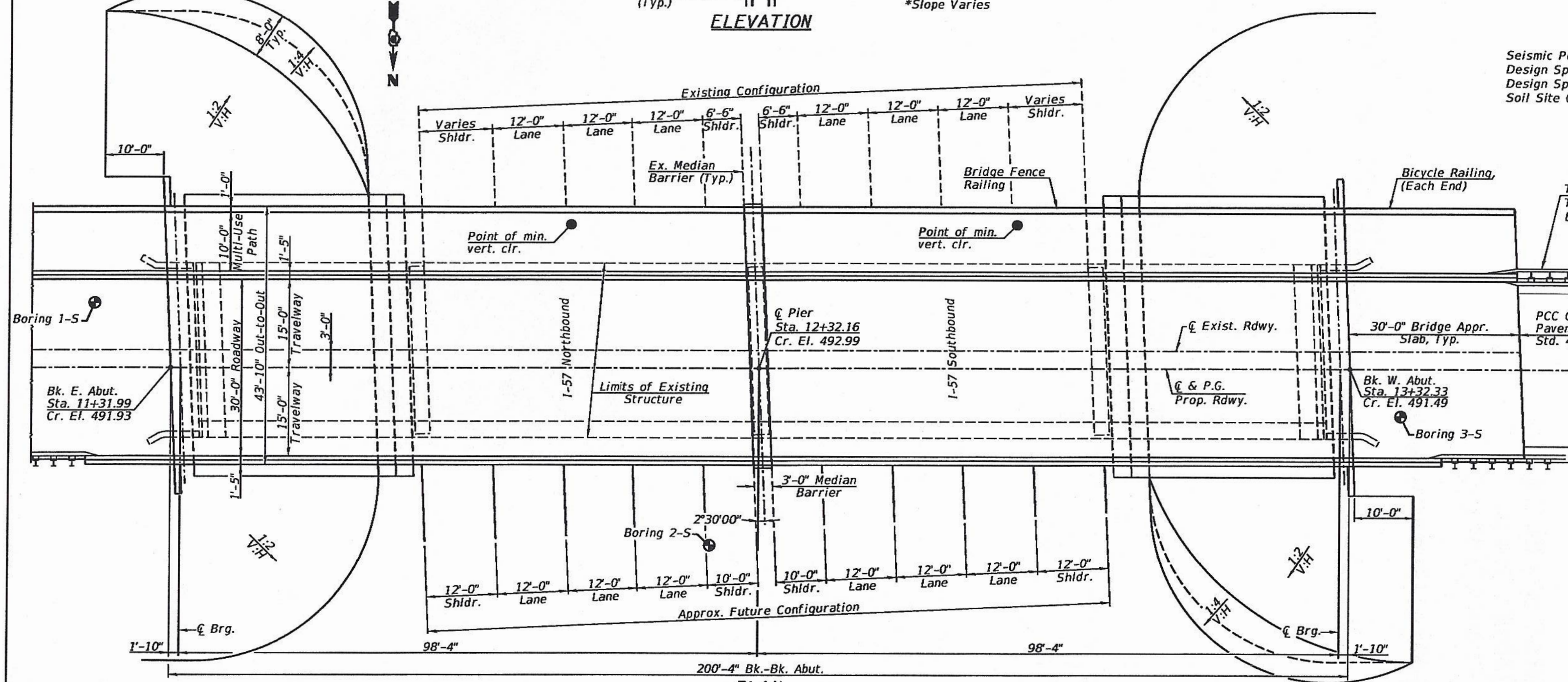
AS A BASIS FOR
PREPARATION OF DETAILED PLANS

Bench Mark: BM 11B - Chiseled "☐" on top of southeast wingwall of Structure 100-0055.
Station 11+29.8, 15' Lt. Elevation - 492.453

Existing Structure: SN 100-0055 was constructed in 1959 under Section X1-6HB-3 at Sta. 12+32.03.
The existing structure is a 4-span, haunched reinforced concrete deck girder bridge having a back-to-back abutment length of 191'-6" and a 24'-0" face-to-face of curb and 29'-8" out-to-out of deck at a 2°30' right forward skew. The superstructure consists of a reinforced concrete slab supported by four haunched concrete T-beams. The substructure consists of reinforced concrete pile bent abutments supported by steel piles and hammerhead piers on reinforced concrete spread footings. The structure will be replaced under road closure.
No salvage.



ELEVATION



PLAN

HIGHWAY CLASSIFICATION

Westminster Drive
Functional Class: Local Street (Urban)
ADT: 1900 (2020); 2320 (2040)
ADTT: 230 (2020); 280 (2040)
DHV: 170 (2019); 210 (2040)
Design Speed: 35 m.p.h.
Posted Speed: 35 m.p.h.
Two-way Traffic Directional Dist. 50:50

F.A.I. Rte. 57 - I-57
Functional Class: Interstate
ADT: 33500 (2018); 32347 (2032)
ADTT: 13375 (2018); 12915 (2032)
DHV: 3350 (2018); 3235 (2032)
Design Speed: 70 m.p.h.
Posted Speed: 70 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.

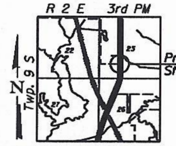
DESIGN STRESSES

FIELD UNITS

f'_c = 3,500 psi
f'_c = 4,000 psi (Superstructure Concrete)
f_y = 60,000 psi (Reinforcement)
f_y = 50,000 psi (M270 Grade 50)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.280 g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.768 g
Soil Site Class = C

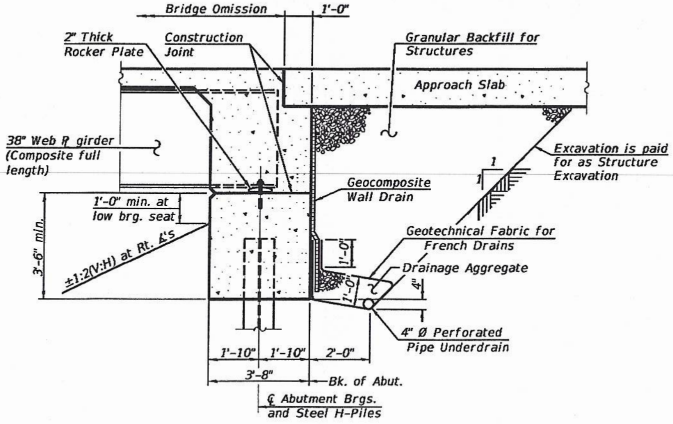


LOCATION SKETCH

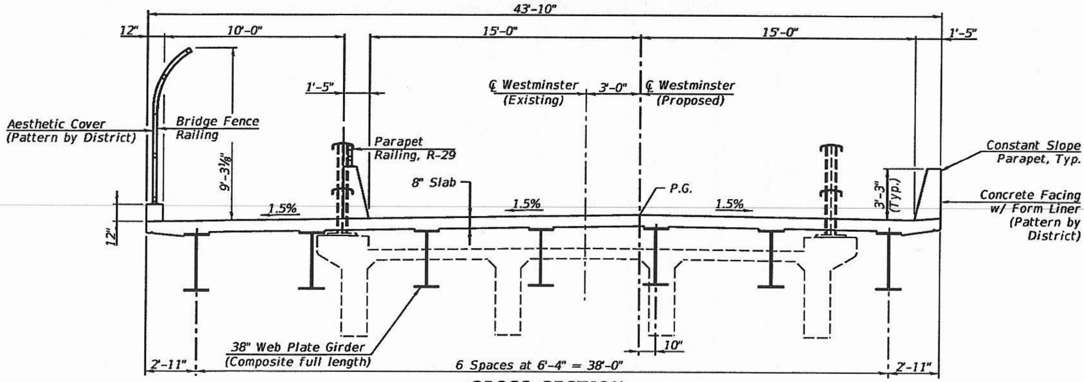
GENERAL PLAN & ELEVATION
WESTMINSTER DRIVE
OVER INTERSTATE 57
SECTION (X1-6)HB-4
WILLIAMSON COUNTY
STATION 12+32.16
STRUCTURE NO. 100-0104

V&K Veenstra & Kimm, Inc. Springfield, IL. Phone: (217)544-8033	USER NAME = ___ / PLOT SCALE = ___ / PLOT DATE = 8-4-2020	DESIGNED - ___ / CHECKED - ___ / DRAWN - ___ / CHECKED - ___	REVISED - ___ / REVISED - ___ / REVISED - ___ / REVISED - ___	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	GENERAL PLAN & ELEVATION S.N. 100-0104 / SHEET NO. 1 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
	(X1-6)HB-4	WILLIAMSON	___	___
		CONTRACT NO. 78619		
	ILLINOIS FED. AID PROJECT			



SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. ∠'s)

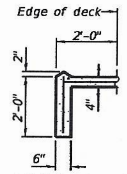


CROSS SECTION
(Looking West)

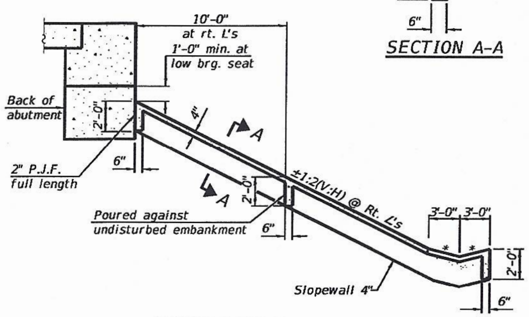
APPROVED

AUG 18 2020

AS A BASIS FOR
PREPARATION OF DETAILED PLANS

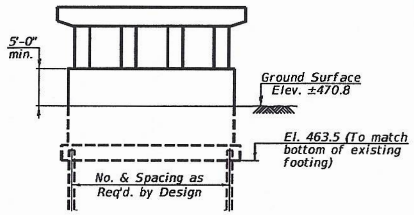


SECTION A-A

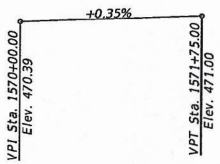


SECTION THRU CONCRETE SLOPEWALL

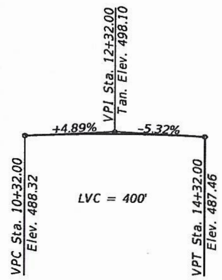
*1:6 (V:H)



PIER SKETCH



PROFILE GRADE
(Along NB & SB I-57)
(Edge of Median Barrier Wall)
(Stations increase North to South)



PROFILE GRADE
(Along ℄ Westminster Drive)

DETAILS
WESTMINSTER DRIVE
OVER INTERSTATE 57
SECTION (X1-6)HB-4
WILLIAMSON COUNTY
STATION 12+32.16
STRUCTURE NO. 100-0104

V&K Veenstra & Kimm, Inc. Springfield, IL. Phone: (217)544-8033	USER NAME = ___ PLOT SCALE = ___ PLOT DATE = 8-4-2020	DESIGNED - ___ CHECKED - ___ DRAWN - ___ CHECKED - ___	REVISED - ___ REVISED - ___ REVISED - ___ REVISED - ___	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	DETAILS S.N. 100-0104 SHEET NO. 2 OF 2 SHEETS	F.A.I. RTE.	SECTION (X1-6)HB-4	COUNTY WILLIAMSON	TOTAL SHEETS	SHEET NO.
								CONTRACT NO. 78619		
						ILLINOIS FED. AID PROJECT				

EXHIBIT C

BORING LOGS

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

Westminster Drive Over FAI 57

Route: FAI 57 Structure Number: 100-0055 Date: 9/18/2017

Section X1-6HB-3 Bored By: R Moberly

County: Williamson Location: 0.25 mi E of WCL Marion Checked By: A Hayes

Boring No 1-S (2017)
Station 11+19
Offset 8' Lt CL
Ground Surface 490.0 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 445.5
At Completion
At: Hrs:

Description	DEPTH	BLOWS	Qu tsf	W%
Oil and chip with crushed gravel				
489.0				
Stiff, moist, brown and grey, Clay A7-6				
		1		
		3	1.6B	20
		3		
	5.0	WH		
		1	1.2B	19
		2		
483.0				
Very stiff, moist, grey and brown, Clay to Silty Clay A7-6		1		
		3	2.3B	18
		4		
480.5				
Stiff, moist, grey and brown, Silty Clay A-6	10.0	1		
		3	1.2S	19
		3		
		1		
		3	1.5B	18
		4		
	15.0	1		
		3	1.4B	19
		3		
473.0				
Stiff, moist to very moist, grey, Silty Clay to Silty Clay Loam A-6		1		
		3	1.1B	20
		5		
470.5				
Very stiff, moist, grey mottled brown, Clay A7-6	20.0	1		
		4	2.7B	18
		7		
468.0				
Stiff, moist to very moist, brown, Clay A7-6		2		
		3	1.1B	24
		3		
465.5				
	25.0	1		

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, brown mottled grey, Clay to Silty Clay A7-6		3	3.1B	21
		5		
		1		
		4	2.9B	19
		6		
460.5				
Stiff, moist, brown mottled grey, Clay A7-6	30.0	2		
		4	1.6S	24
		6		
		2		
		3	1.2B	21
		4		
	35.0	1		
		4	1.1B	21
		5		
453.0				
Stiff, moist, brown, Clay A7-6 with some broken Sandstone gravel		2		
		6	1.6B	17
		8		
	40.0	2		
		4	1.7B	19
		5		
445.5				
Medium, very moist, grey, Clay A7-6	45.0	1		
		3	0.8B	18
		3		
442.0				
Very dense, dry, brown, Sand to Sandstone				
	50.0	100/1.5"		

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

Route: FAI 57

Date: 9/18/2017

Section: X1-6HB-3

County: Williamson

Boring No: 1-S (2017)
Station: 11+19
Offset: 8' Lt CL
Ground Surface: 490.0 Ft

Description	DEPTH	BLOWS	Qu tsf	W%	Description	DEPTH	BLOWS	Qu tsf	W%
Very dense, dry, brown, Sand to Sandstone Cored 49.6 to 54.6 feet 90% Recovery; 37% RQD 435.5									
Cored 54.6 to 59.6 feet but the barrel and 55' rods were lost while retrieving. The 5' drilled easily and likely would have poor strength similar to the first 5' cored. 430.5	55.0					80.0			
Bottom of hole = 59.6 feet Free water observed at 44.5 feet	60.0					85.0			
Elevation referenced to BM at SE wingwall: BM= 492.5 feet Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.) To convert "N" values to "N60" multiply by 1.25	65.0					90.0			
	70.0					95.0			
	75.0					100.0			

Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

FAI 57
Structure 100-0055 (Boring 1-S)
Williamson County

Boring #	Specimen#	Depth	Unconfined Compression
1-S	1	50'10"	2,793 psi
1-S	2	53'0"	2,581 psi
1-S	3	53'8"	3,158 psi

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

Westminster Drive Over FAI 57 — Sheet 1 of 1

Route: FAI 57 | Structure Number: 100-0055 | Date: 9/13/2017

Section X1-6HB-3 | Bored By: R Moberly

County: Williamson | Location: 0.25 mi E of WCL Marion | Checked By: A Hayes

Boring No 2-S (2017)
Station 12+24
Offset 30' Rt CL
Ground Surface 471.1 Ft

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

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Asphalt (17")	469.6				
Crushed aggregate			5		
	468.1		4		
Stiff, moist, grey and brown, Clay A7-6			3	1.5P	22
	466.6				
Very stiff, moist, grey and brown, Clay to Silty Clay A7-6		5.0	2		
			4	2.3B	21
			5		
	464.1				
Very stiff, moist, grey and brown, Clay to Silty Clay A7-6			1		
			4	2.3S	20
			4		
		10.0	1		
			4	2.3S	21
			5		
	459.1				
Medium, very moist, brown, Silty Clay A-6			1		
			3	0.7B	25
			3		
	456.6				
Medium, very moist, brown and grey, Silty Clay to Clay A-6		15.0	1		
			3	0.7B	20
			4		
	454.1				
Stiff, moist, brown and grey, Clay to Silty Clay A7-6			WH		
			3	1.2B	20
			4		
	451.6				
Very stiff, moist, brown, Clay to Clay Loam A-6		20.0	2		
			16	2.9S	14
			13		
	449.1				
Stiff, moist, grey, Silty Clay A-6			1		
	448.1		5	1.1B	18
Medium dense to very dense, moist to damp, brown, Sand with Sandstone layers			12		
		25.0	100/6"		10

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
	445.1				
Very dense, damp, brown, Sandstone	444.1		100/3"		
Note: Cored 5' from 26.8 to 31.8 feet; A broken piece of Sandstone became lodged in the bottom tip of the barrel and prevented any recovery. The Sandstone cored easily and likely has poor strength similar to other cores obtained at this structure.		30.0			
	439.1				
Bottom of hole = 26.8 feet					
No free water was encountered		35.0			
Elevation referenced to BM at SE wingwall; Elevation = 492.5 ft					
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)					
To convert "N" values to "N60" multiply by 1.25					
		40.0			
		45.0			
		50.0			

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

Westminster Drive Over FAI 57

Sheet 1 of 2

Route: FAI 57 Structure Number: 100-0055 Date: 9/15/2017

Section X1-6HB-3 Bored By: R Moberly

County: Williamson Location: 0.25 mi E of WCL Marion Checked By: A Hayes

Boring No 3-S (2017)
Station 13+41
Offset 8' Rt CL
Ground Surface 490.1 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 455.6
At Completion
At: Hrs:

Description	DEPTH	BLOWS	Qu tsf	W%
Oil and chip				
489.1				
Stiff, moist, brown, Clay A7-6				
		1		
		2	1.2B	20
		2		
485.6				
Very stiff, moist, brown and grey, Clay A7-6	5.0	1		
		3	2.5B	18
		4		
483.1				
Stiff, moist, brown and grey, Clay A7-6		1		
		2	1.9B	17
		4		
	10.0	1		
		3	1.4B	19
		4		
478.1				
Very stiff, moist, grey and brown, Clay to Silty Clay A7-6		1		
		4	2.3B	17
		5		
475.6				
Stiff, moist, grey, Silty Clay A-6	15.0	1		
		4	1.6B	18
		5		
		1		
		4	1.9B	17
		6		
	20.0	2		
		3	1.8B	24
		4		
		2		
		5	1.9B	21
		7		
465.1	25.0	2		

Description	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey and brown, Clay to Silty Clay A-6		3	1.5B	20
		5		
463.1				
Stiff, moist, grey mottled brown, Clay A7-6		1		
		4	1.6B	20
		4		
460.6				
Stiff, moist, brown, Clay A7-6	30.0	1		
		2	1.2B	22
		4		
458.1				
Soft, very moist, brown, Silty Clay Loam A-6 with Sand seams		WH		
		1	0.4S	23
		2		
455.6				
Stiff, moist, brown, Clay A7-6 with some gravel	35.0	2		
		5	1.5B	18
		8		
453.1				
Very stiff, moist, brown, Silty Clay A-6 with Coal pieces		3		
		9	2.1B	13
		20		
450.6				
Medium to stiff, moist, brown, Silty Clay Loam A-6 with Sand layers	40.0	3		
		8	1.0B	18
		13		
447.6				
Very dense, damp, brown, Sandstone				
445.6				
	45.0	100/1"		
Cored 44.5 to 49.5 feet				
82% Recovery				
30% RQD				
440.6				
	50.0			

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

Route: FAI 57

Date: 9/15/2017

Section: X1-6HB-3

County: Williamson

Boring No: 3-S (2017)
Station: 13+41
Offset: 8' Rt CL
Ground Surface: 490.1 Ft

	DEPTH	BLOWS	Qu tsf	W%		DEPTH	BLOWS	Qu tsf	W%
Bottom of hole = 49.5 feet Free water observed at 34.5 feet Elevation referenced to BM at SE wingwall; Elevation=492.5 ft Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)	55.0					80.0			
To convert "N" values to "N60" multiply by 1.25	60.0					85.0			
	65.0					90.0			
	70.0					95.0			
	75.0					100.0			

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

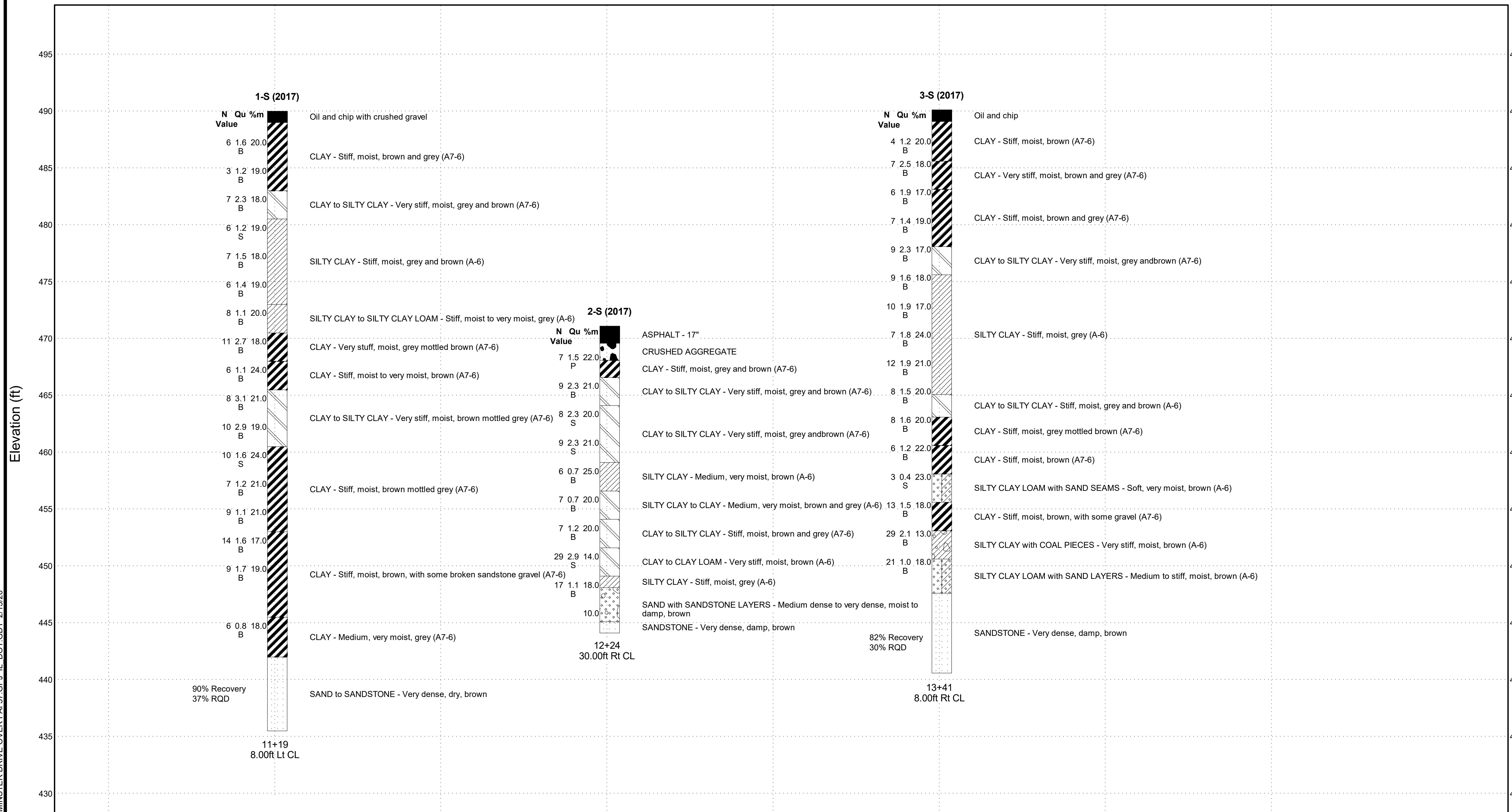
Illinois Department of Transportation
District Nine Materials
Unconfined Compressive Strength

FAI 57
Structure 100-0055 (Boring 3-S)
Williamson County

Boring #	Specimen#	Depth	Unconfined Compression
3-S	1	45'5"	2,129 psi
3-S	2	47'3"	2,288 psi

EXHIBIT D

SUBSURFACE PROFILE



PRINTERMOD 11X17 17-1095.01 WESTMINSTER DRIVE OVER FAI 57.GPJ IL_DOT.GDT 2/13/20

Illinois Department of Transportation
Division of Highways

NOT TO HORIZONTAL SCALE

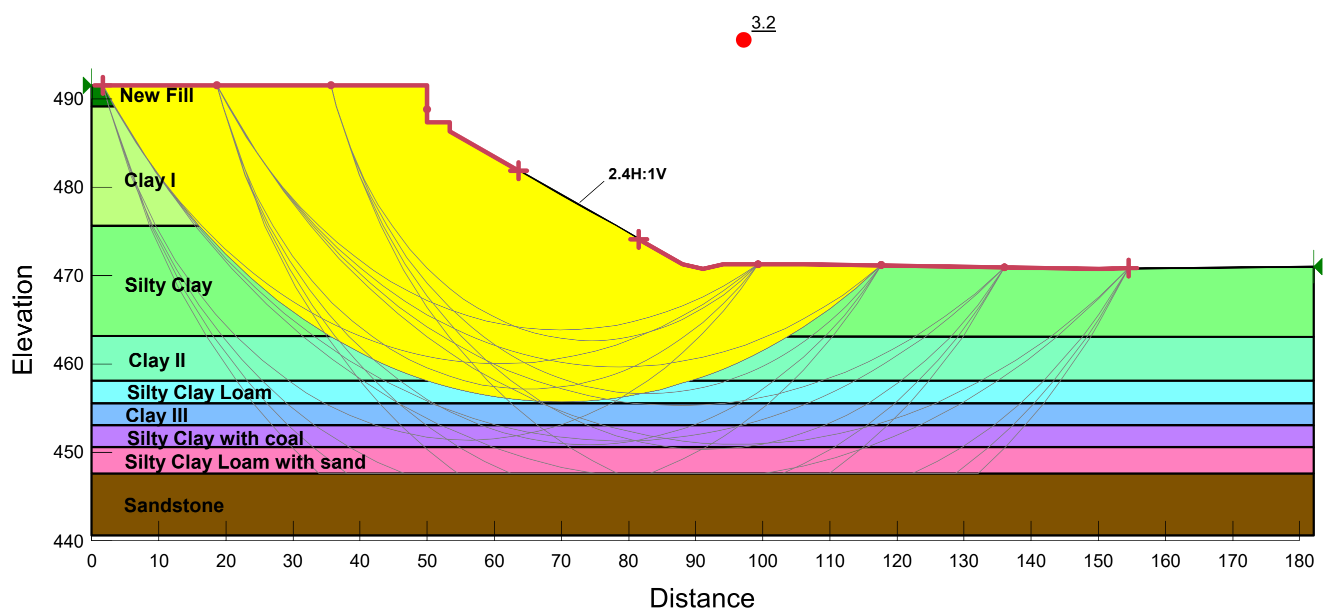
SUBSURFACE DATA PROFILE

Route: Westminster Drive Over FAI 57
Section: (X1-6)HB-4
County: Williamson

EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS

Westminster Drive WO-2
East Abutment - Boring 3-S - 2.4H:1V Slope
End-of-construction (Undrained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,900 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

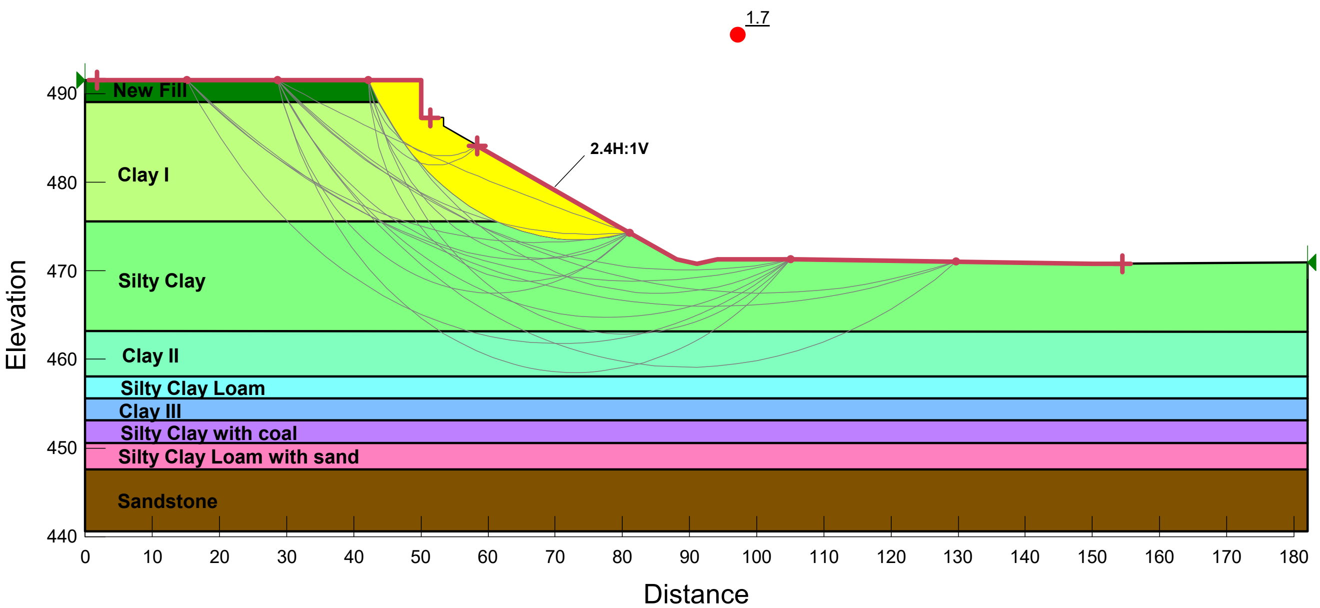
Name: Silty Clay with coal
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,100 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam with sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
East Abutment - Boring 3-S - 2.4H:1V Slope
Long Term Analysis (Drained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 27 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

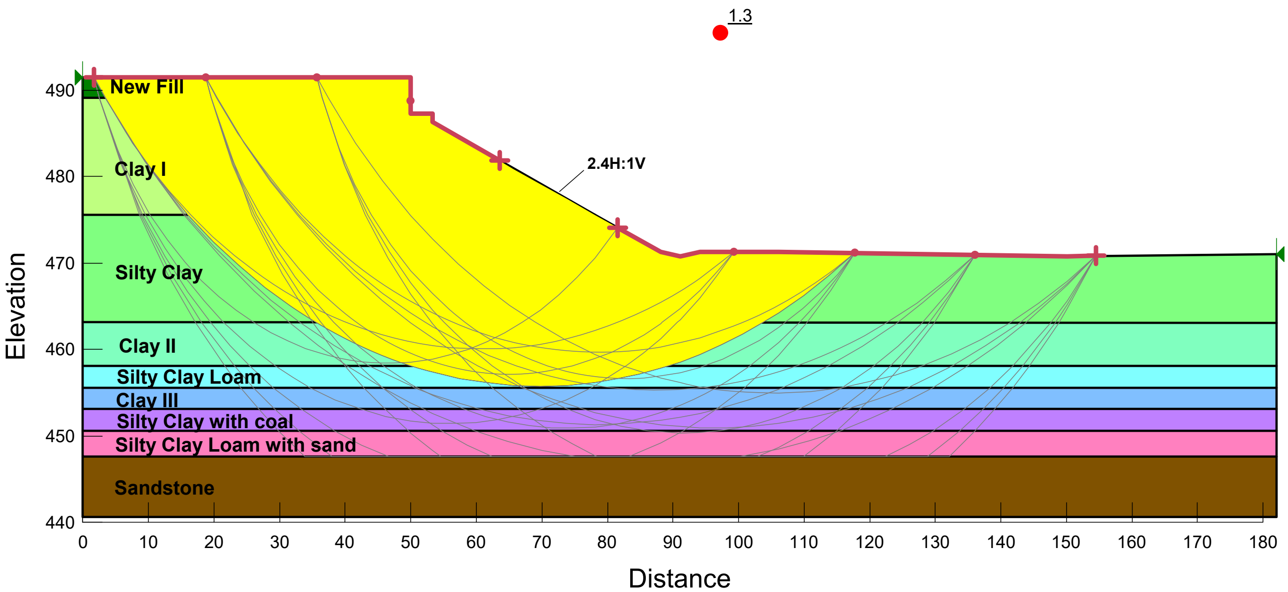
Name: Silty Clay with coal
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam with sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 27 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
East Abutment - Boring 3-S - 2.4H:1V Slope
End-of-construction (Undrained Condition)
Seismic PGA 0.359g



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,900 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

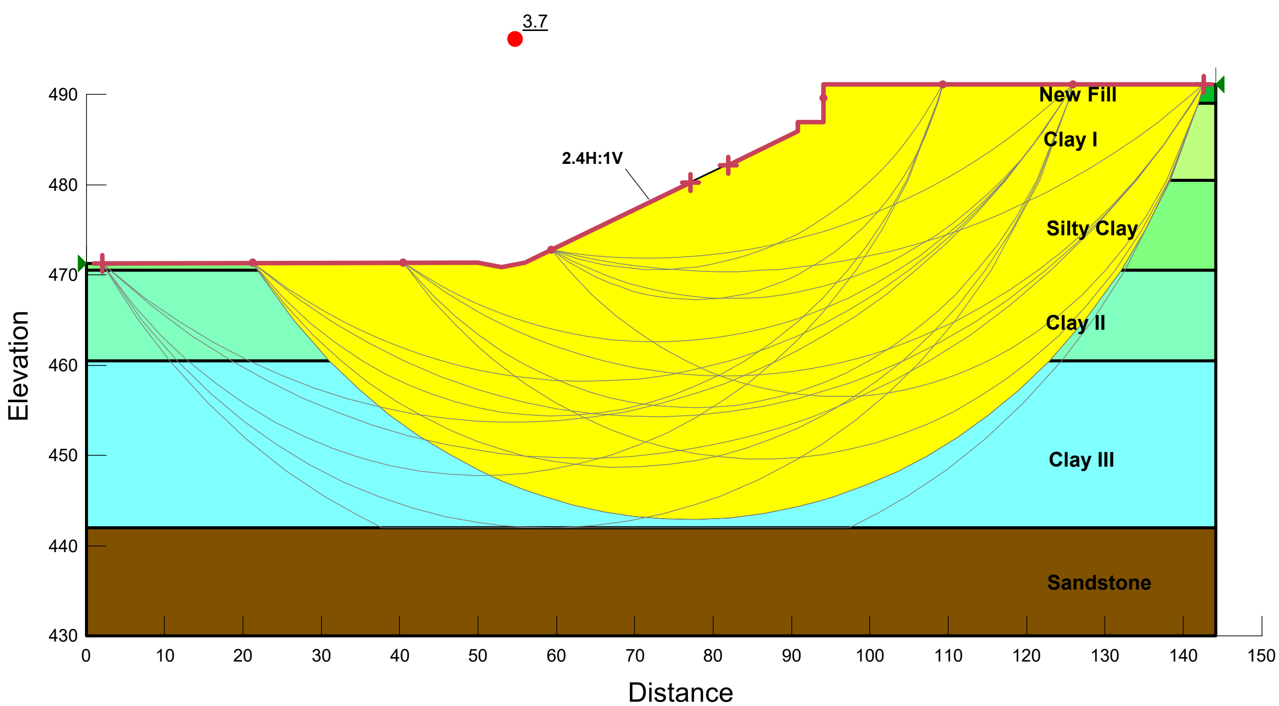
Name: Silty Clay with coal
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,100 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam with sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
West Abutment - Boring 1-S - 2.4H:1V Slope
End-of-construction (Undrained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

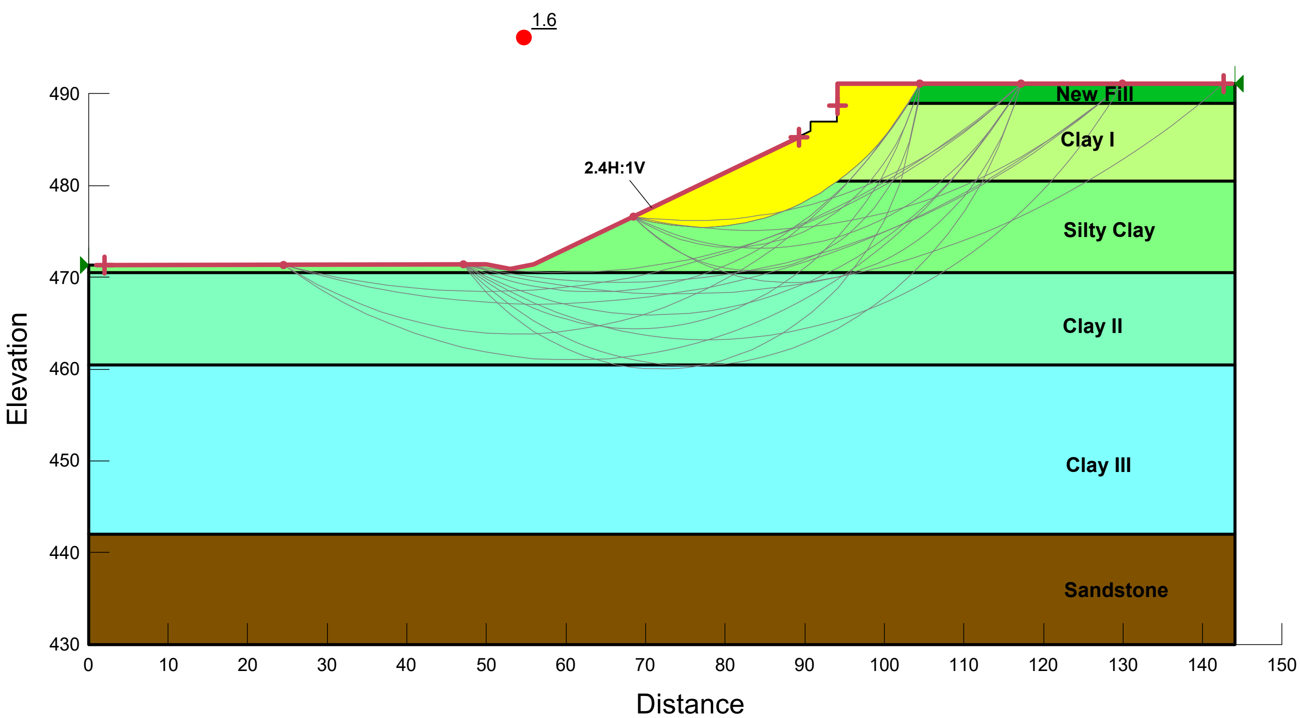
Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
West Abutment - Boring 1-S - 2.4H:1V Slope
Long Term Analysis (Drained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

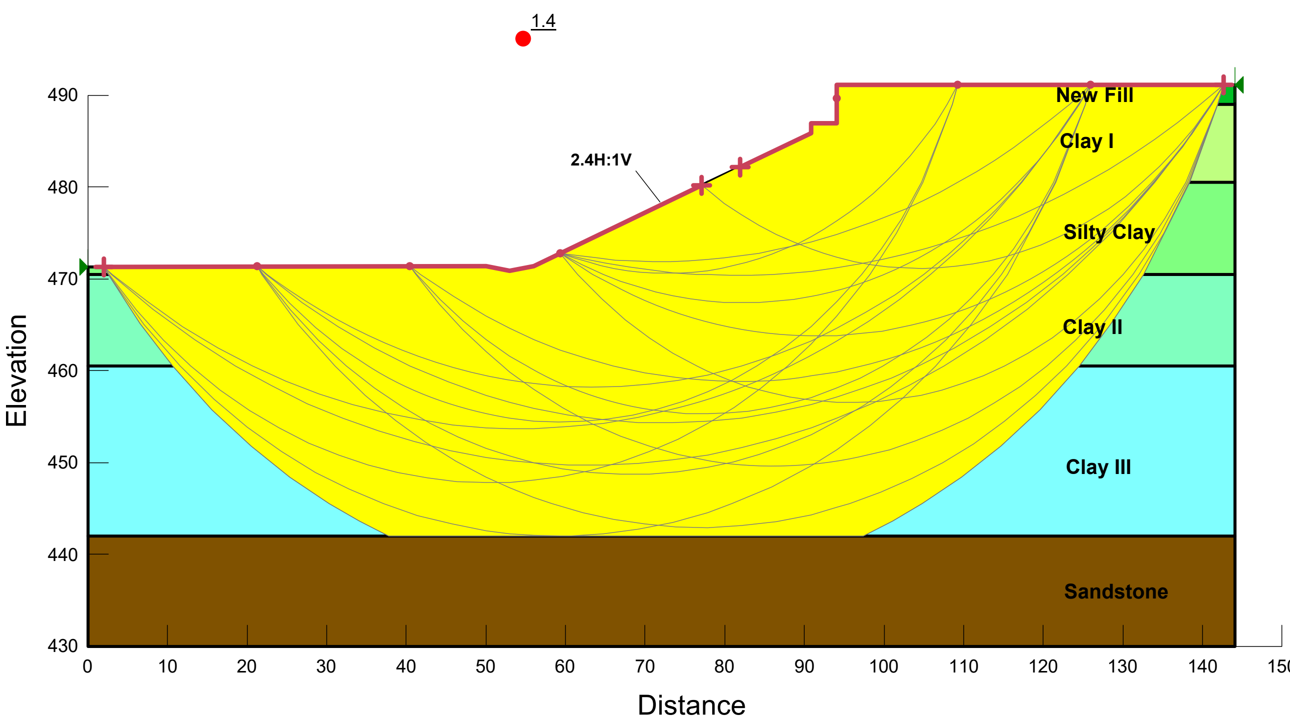
Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
West Abutment - Boring 1-S - 2.4H:1V Slope
End-of-construction (Undrained Condition)
Seismic PGA 0.359g



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

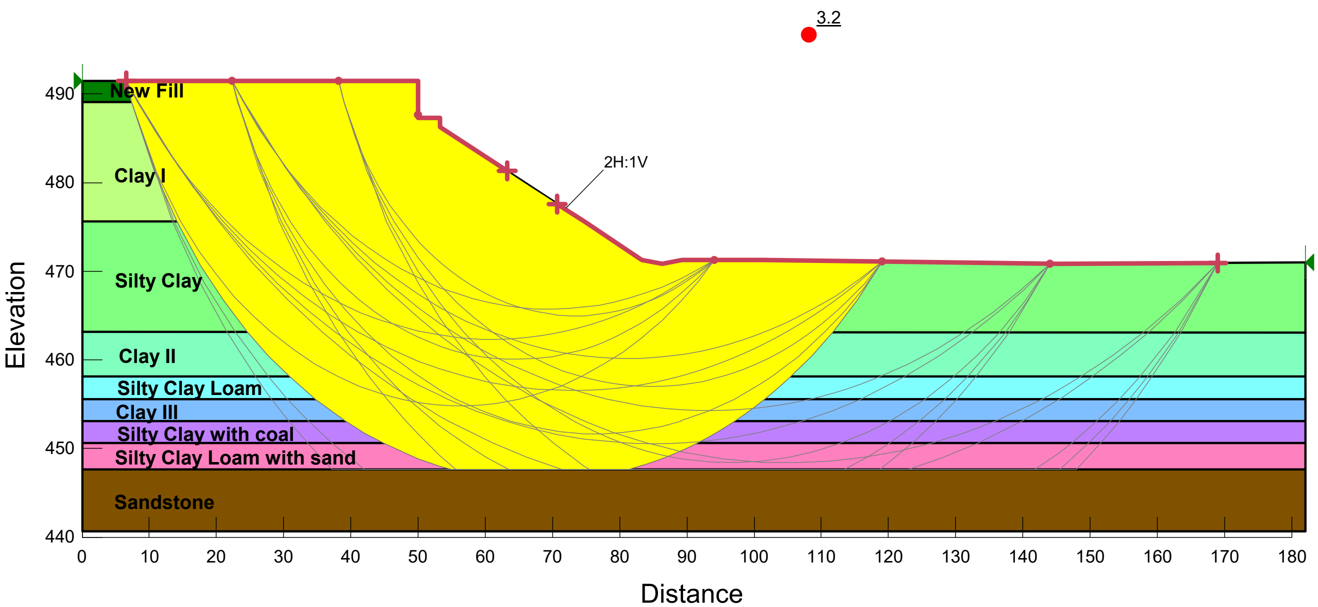
Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
East Abutment - Boring 3-S - 2H:1V Slope
End-of-construction (Undrained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,900 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

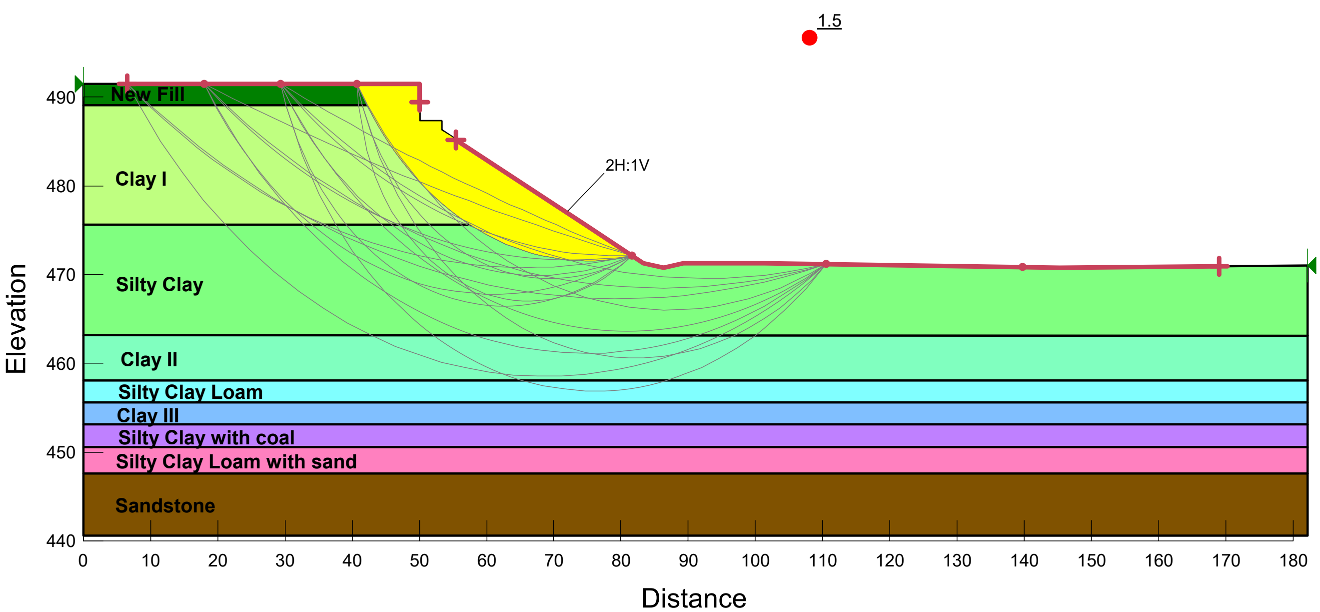
Name: Silty Clay with coal
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,100 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam with sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
East Abutment - Boring 3-S - 2H:1V Slope
Long Term Analysis (Drained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 27 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

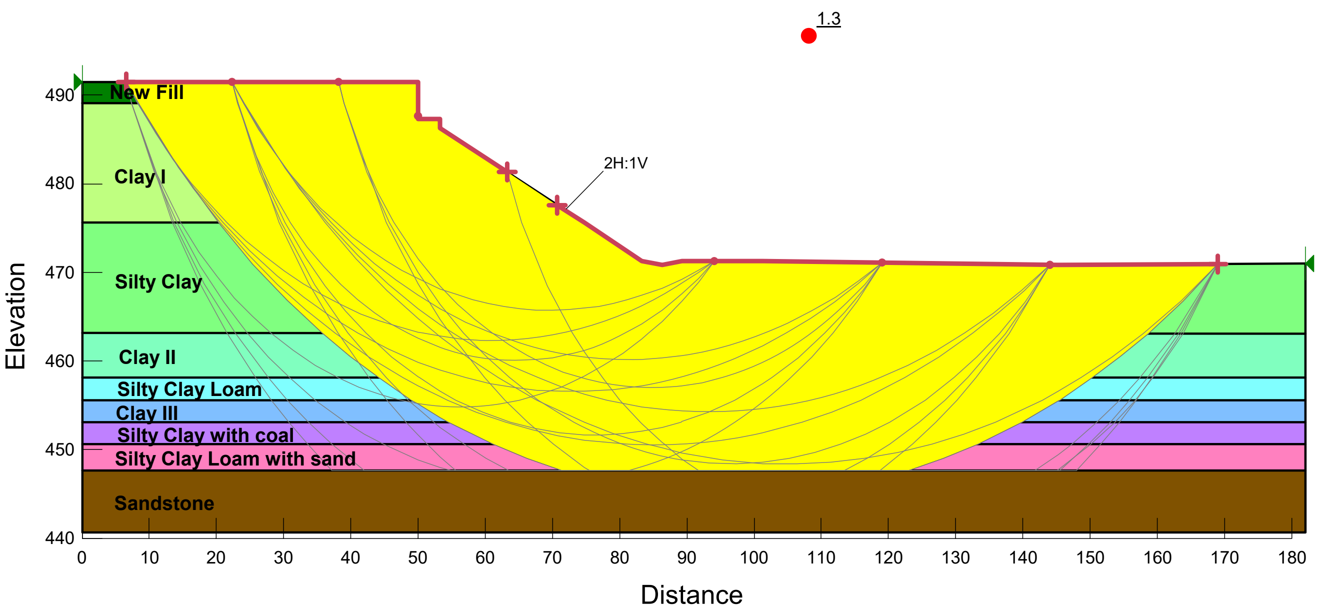
Name: Silty Clay with coal
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam with sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 50 psf
Phi': 27 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
East Abutment - Boring 3-S - 2H:1V Slope
End-of-construction (Undrained Condition)
Seismic PGA 0.359g



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,900 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

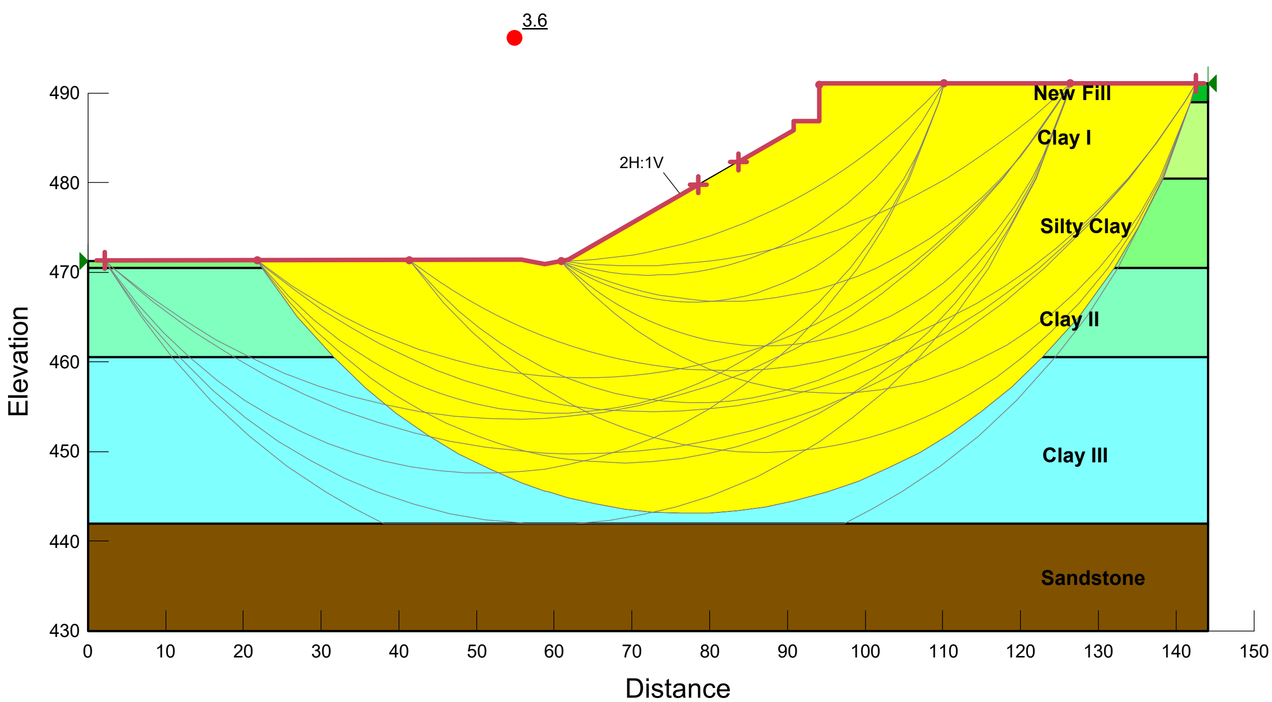
Name: Silty Clay with coal
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,100 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay Loam with sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
West Abutment - Boring 1-S - 2H:1V Slope
End-of-construction (Undrained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

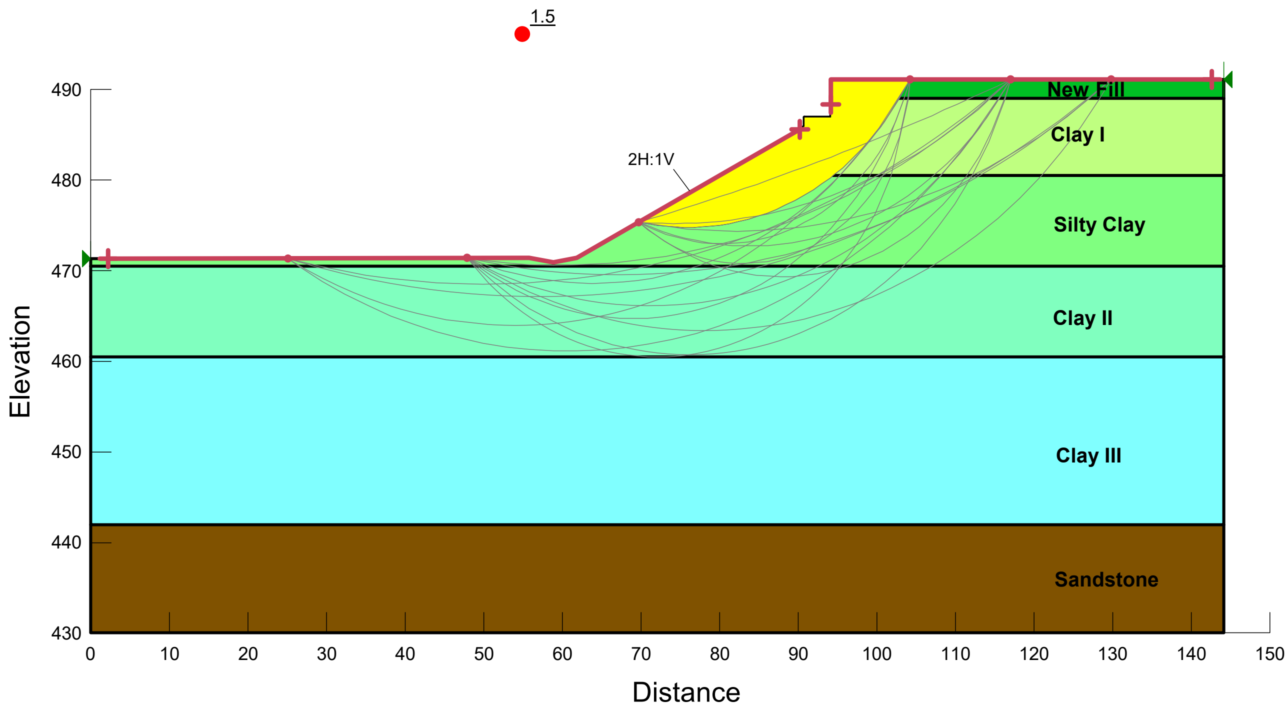
Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
West Abutment - Boring 1-S - 2H:1V Slope
Long Term Analysis (Drained Condition)



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 250 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

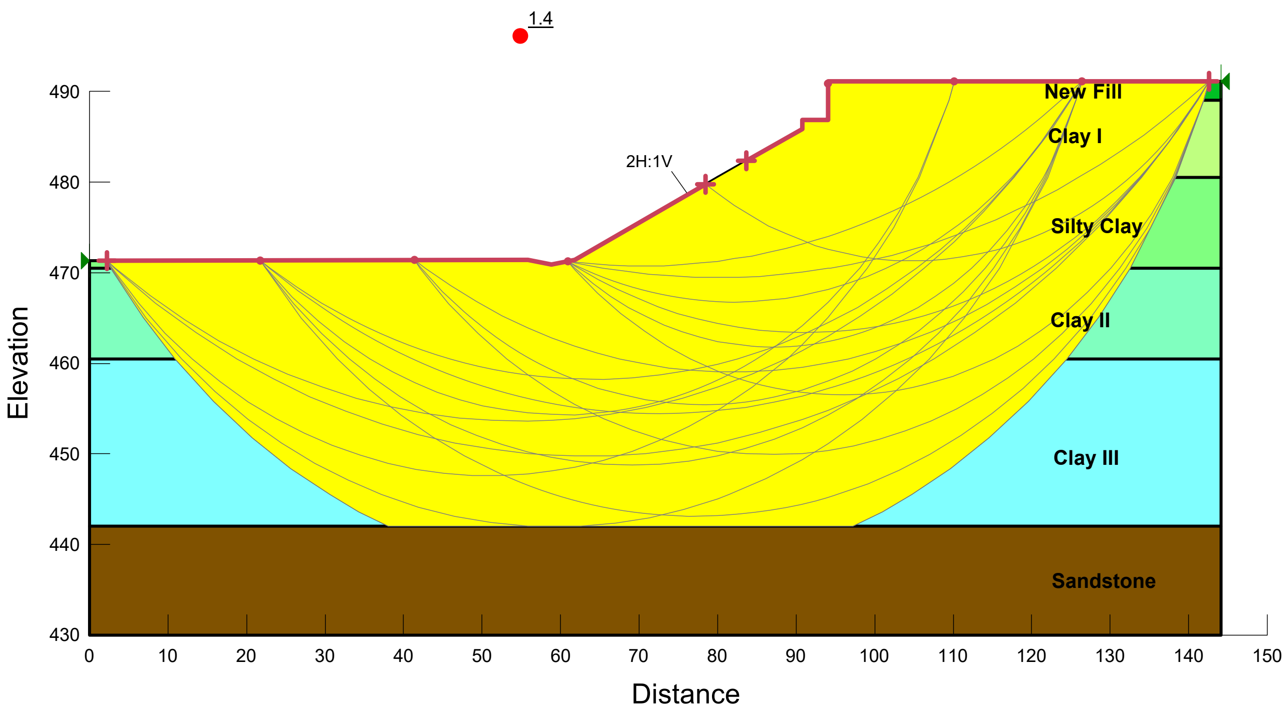
Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Westminster Drive WO-2
West Abutment - Boring 1-S - 2H:1V Slope
End-of-construction (Undrained Condition)
Seismic PGA 0.359g



Name: New Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay I
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,700 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Clay
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay II
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,500 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay III
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,300 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

EXHIBIT F

ILLINOIS STATE

GEOLOGICALSURVEY MINE MAP

ILLINOIS
Illinois State Geological Survey
PRAIRIE RESEARCH INSTITUTE

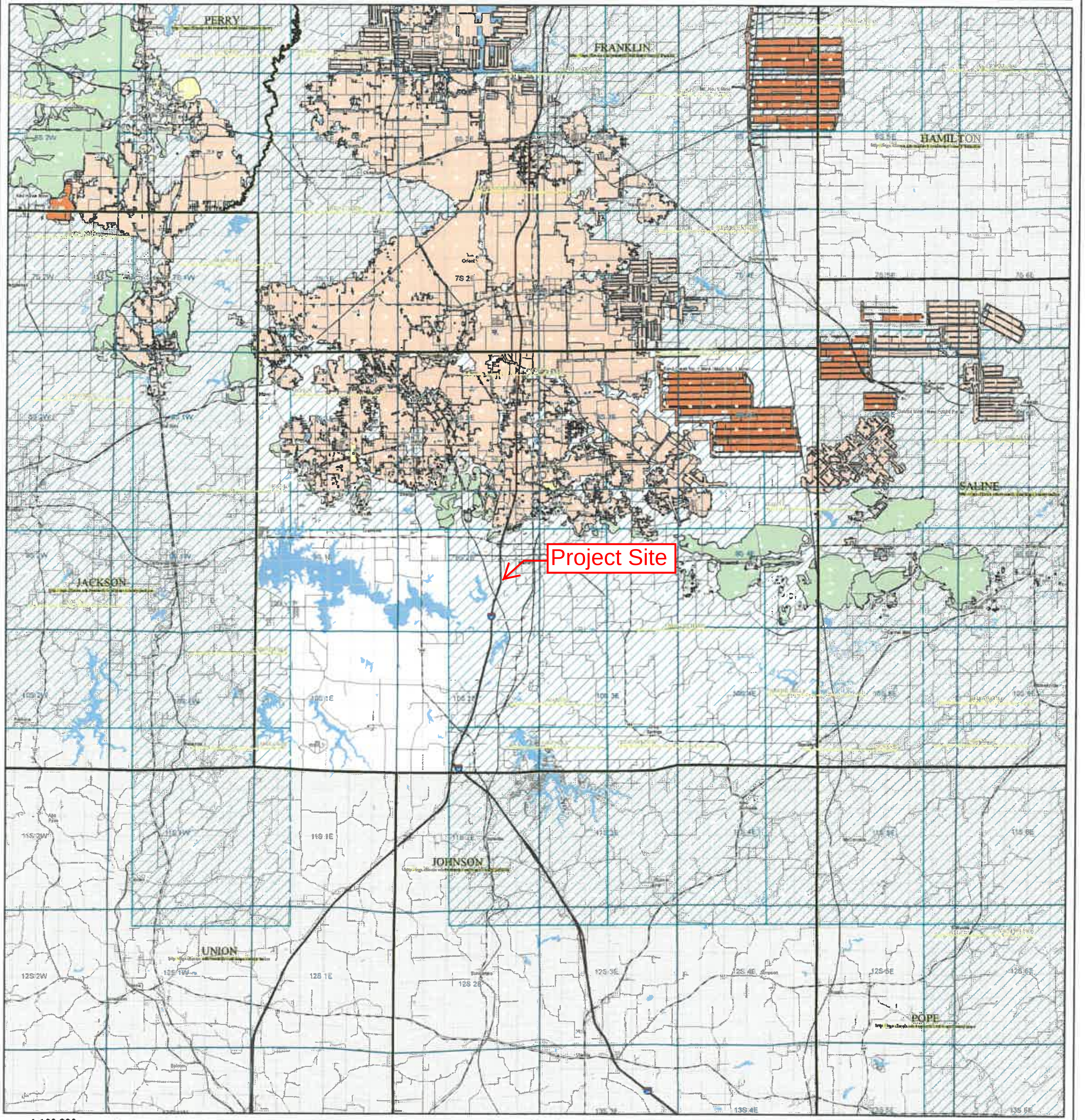
For further information contact:
Prairie Research Institute
Illinois State Geological Survey
University of Illinois at Urbana-Champaign
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 333-4747
http://www.isgs.illinois.edu

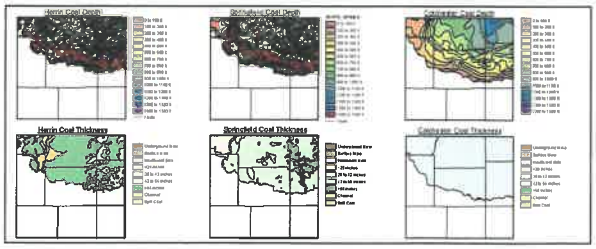
Coal Mines - Herrin Coal
WILLIAMSON
County

County Coal Map Series
ISGS Coal Section
Map construction: August 08, 2019

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

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





	County		Opening type unknown
	Township		Uncertain location
	Section		Active surface tipple
	Quadrangle study (Available on Website)		Abandoned surface tipple
	Lake or river		Active shaft
	Coal mine - active		Abandoned shaft
	Underground coal mine - abandoned		Active slope
	Surface coal mine - abandoned		Abandoned slope
	Indefinite underground coal mine boundary - abandoned		Active drift
	Underground industrial mineral mine and surrounding buffer region		Abandoned drift
			Underground industrial mineral mine entrance or general location
561, 951	Coal mine index number (polygon label, point label)		

Map Explanation

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

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

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

Disclaimer

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

EXHIBIT G

IDOT STATIC METHOD OF

ESTIMATING PILE LENGTH

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== East Abutment
REFERENCE BORING ================================ 3-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. =================================== 481.78 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 480.78 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1437 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 43.88 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts =========== 261.99 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts =========== 98.25 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	**323** KIPS	**178** 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.)
480.60	0.18	1.90			0.7		14.0	1.0		**2.7**	3	0	0	1	1
478.10	2.50	1.40			7.6	13.3	30.2	11.1	1.7	**14.9**	15	0	0	8	4
475.60	2.50	2.30			10.5	21.9	34.0	15.5	2.8	**29.5**	30	0	0	16	6
473.10	2.50	1.60			8.3	15.3	45.2	12.2	1.9	**42.1**	42	0	0	23	9
470.60	2.50	1.90			9.3	18.1	**53.5**	13.7	2.3	55.7	53	0	0	29	11
468.10	2.50	1.80			9.0	17.2	**63.4**	13.2	2.2	69.0	63	0	0	35	14
465.60	2.50	1.90			9.3	18.1	**68.9**	13.7	2.3	82.2	69	0	0	38	16
463.10	2.50	1.50			7.9	14.3	**77.8**	11.7	1.8	94.0	78	0	0	43	19
460.60	2.50	1.60			8.3	15.3	**82.3**	12.2	1.9	105.7	82	0	0	45	21
458.10	2.50	1.20			6.8	11.4	**81.4**	10.0	1.4	114.7	81	0	0	45	24
455.60	2.50	0.40			2.6	3.8	**94.5**	3.9	0.5	119.9	95	0	0	52	26
453.10	2.50	1.50			7.9	14.3	**108.2**	11.7	1.8	132.3	108	0	0	59	29
450.60	2.50	2.10			9.9	20.0	**107.6**	14.6	2.5	145.6	108	0	0	59	31
447.60	3.00	1.00			7.0	9.5	242.8	10.4	1.2	**172.1**	172	0	0	95	34
447.35	0.25			Sandstone	17.1	137.7	259.9	25.2	17.4	**197.3**	197	0	0	109	34.4
447.10	0.25			Sandstone	17.1	137.7	277.1	25.2	17.4	**222.6**	223	0	0	122	34.7
446.85	0.25			Sandstone	17.1	137.7	294.2	25.2	17.4	**247.8**	248	0	0	136	34.9
446.60	0.25			Sandstone	17.1	137.7	311.3	25.2	17.4	**273.0**	273	0	0	150	35.2
446.35	0.25			Sandstone	17.1	137.7	328.4	25.2	17.4	**298.2**	298	0	0	164	35.4
446.10	0.25			Sandstone	17.1	137.7	345.6	25.2	17.4	**323.4**	323	0	0	178	35.7
445.85	0.25			Sandstone	17.1	137.7	362.7	25.2	17.4	**348.7**	~~349~~	~~0~~	~~0~~	~~192~~	~~35.9~~
445.60	0.25			Sandstone	17.1	137.7	379.8	25.2	17.4	**373.9**	~~374~~	~~0~~	~~0~~	~~206~~	~~36.2~~
445.35	0.25			Sandstone	17.1	137.7	**397.0**	25.2	17.4	399.1	~~397~~	~~0~~	~~0~~	~~218~~	~~36.4~~
445.10	0.25			Sandstone	17.1	137.7	**414.1**	25.2	17.4	424.3	~~414~~	~~0~~	~~0~~	~~228~~	~~36.7~~
444.85	0.25			Sandstone	17.1	137.7	**431.2**	25.2	17.4	449.5	~~431~~	~~0~~	~~0~~	~~237~~	~~36.9~~
444.60	0.25			Sandstone	17.1	137.7	**448.3**	25.2	17.4	474.7	~~448~~	~~0~~	~~0~~	~~247~~	~~37.2~~
444.35	0.25			Sandstone	17.1	137.7	**465.5**	25.2	17.4	500.0	~~465~~	~~0~~	~~0~~	~~256~~	~~37.4~~
444.10	0.25			Sandstone	17.1	137.7	**482.6**	25.2	17.4	525.2	~~483~~	~~0~~	~~0~~	~~265~~	~~37.7~~
443.85	0.25			Sandstone	17.1	137.7	**499.7**	25.2	17.4	550.4	~~500~~	~~0~~	~~0~~	~~275~~	~~37.9~~
443.60	0.25			Sandstone	17.1	137.7	**516.9**	25.2	17.4	575.6	~~517~~	~~0~~	~~0~~	~~284~~	~~38.2~~
443.35	0.25			Sandstone	17.1	137.7	**534.0**	25.2	17.4	600.8	~~534~~	~~0~~	~~0~~	~~294~~	~~38.4~~
443.10	0.25			Sandstone	17.1	137.7	**551.1**	25.2	17.4	626.0	~~551~~	~~0~~	~~0~~	~~303~~	~~38.7~~
442.85	0.25			Sandstone	17.1	137.7	**568.2**	25.2	17.4	651.3	~~568~~	~~0~~	~~0~~	~~313~~	~~38.9~~
442.60	0.25			Sandstone	17.1	137.7	**585.4**	25.2	17.4	676.5	~~585~~	~~0~~	~~0~~	~~322~~	~~39.2~~
442.35	0.25			Sandstone	17.1	137.7	**602.5**	25.2	17.4	701.7	~~603~~	~~0~~	~~0~~	~~331~~	~~39.4~~
442.10	0.25			Sandstone	17.1	137.7	**619.6**	25.2	17.4	726.9	~~620~~	~~0~~	~~0~~	~~341~~	~~39.7~~
441.85	0.25			Sandstone	17.1	137.7	**636.8**	25.2	17.4	752.1	~~637~~	~~0~~	~~0~~	~~350~~	~~39.9~~
441.60	0.25			Sandstone		137.7			17.4						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== Pier
REFERENCE BORING ================================ 2-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 461.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 460.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 2112 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 43.88 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 192.53 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.20 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	**326** KIPS	**179** KIPS	**19** 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.)
460.25	0.25	2.30			1.1		23.0	1.5		**4.3**	4	0	0	2	1
460.00	0.25	2.30			1.1	21.9	24.0	1.5	2.8	**5.9**	6	0	0	3	2
459.75	0.25	2.30			1.1	21.9	25.1	1.5	2.8	**7.4**	7	0	0	4	2
459.10	0.65	2.30			2.7	21.9	12.6	4.0	2.8	**9.5**	10	0	0	5	2
456.60	2.50	0.70			4.3	6.7	16.9	6.4	0.8	**15.9**	16	0	0	9	5
454.10	2.50	0.70			4.3	6.7	26.0	6.4	0.8	**22.9**	23	0	0	13	7
451.60	2.50	1.20			6.8	11.4	49.0	10.0	1.4	**34.9**	35	0	0	19	10
449.10	2.50	2.90			12.3	27.7	**44.1**	18.1	3.5	50.9	44	0	0	24	12
448.10	1.00	1.10			2.5	10.5	56.5	3.7	1.3	**55.8**	56	0	0	31	13
445.10	3.00		12	Medium Sand	2.2	20.3	176.1	3.2	2.6	**73.9**	74	0	0	41	16
444.85	0.25			Sandstone	17.1	137.7	193.2	25.2	17.4	**99.1**	99	0	0	55	16.7
444.60	0.25			Sandstone	17.1	137.7	210.3	25.2	17.4	**124.3**	124	0	0	68	16.9
444.35	0.25			Sandstone	17.1	137.7	227.5	25.2	17.4	**149.5**	150	0	0	82	17.2
444.10	0.25			Sandstone	17.1	137.7	244.6	25.2	17.4	**174.7**	175	0	0	96	17.4
443.85	0.25			Sandstone	17.1	137.7	261.7	25.2	17.4	**200.0**	200	0	0	110	17.7
443.60	0.25			Sandstone	17.1	137.7	278.8	25.2	17.4	**225.2**	225	0	0	124	17.9
443.35	0.25			Sandstone	17.1	137.7	296.0	25.2	17.4	**250.4**	250	0	0	138	18.2
443.10	0.25			Sandstone	17.1	137.7	313.1	25.2	17.4	**275.6**	276	0	0	152	18.4
442.85	0.25			Sandstone	17.1	137.7	330.2	25.2	17.4	**300.8**	301	0	0	165	18.7
442.60	0.25			Sandstone	17.1	137.7	347.4	25.2	17.4	**326.1**	326	0	0	179	18.9
442.35	0.25			Sandstone	17.1	137.7	364.5	25.2	17.4	**351.3**	~~351~~	~~0~~	~~0~~	~~193~~	~~19.2~~
442.10	0.25			Sandstone	17.1	137.7	381.6	25.2	17.4	**376.5**	~~376~~	~~0~~	~~0~~	~~207~~	~~19.4~~
441.85	0.25			Sandstone	17.1	137.7	**398.7**	25.2	17.4	401.7	~~399~~	~~0~~	~~0~~	~~219~~	~~19.7~~
441.60	0.25			Sandstone	17.1	137.7	**415.9**	25.2	17.4	426.9	~~416~~	~~0~~	~~0~~	~~229~~	~~19.9~~
441.35	0.25			Sandstone	17.1	137.7	**433.0**	25.2	17.4	452.1	~~433~~	~~0~~	~~0~~	~~238~~	~~20.2~~
441.10	0.25			Sandstone	17.1	137.7	**450.1**	25.2	17.4	477.4	~~450~~	~~0~~	~~0~~	~~248~~	~~20.4~~
440.85	0.25			Sandstone	17.1	137.7	**467.3**	25.2	17.4	502.6	~~467~~	~~0~~	~~0~~	~~257~~	~~20.7~~
440.60	0.25			Sandstone	17.1	137.7	**484.4**	25.2	17.4	527.8	~~484~~	~~0~~	~~0~~	~~266~~	~~20.9~~
440.35	0.25			Sandstone	17.1	137.7	**501.5**	25.2	17.4	553.0	~~502~~	~~0~~	~~0~~	~~276~~	~~21.2~~
440.10	0.25			Sandstone	17.1	137.7	**518.6**	25.2	17.4	578.2	~~519~~	~~0~~	~~0~~	~~285~~	~~21.4~~
439.85	0.25			Sandstone	17.1	137.7	**535.8**	25.2	17.4	603.4	~~536~~	~~0~~	~~0~~	~~295~~	~~21.7~~
439.60	0.25			Sandstone	17.1	137.7	**552.9**	25.2	17.4	628.7	~~553~~	~~0~~	~~0~~	~~304~~	~~21.9~~
439.35	0.25			Sandstone	17.1	137.7	**570.0**	25.2	17.4	653.9	~~570~~	~~0~~	~~0~~	~~314~~	~~22.2~~
439.10	0.25			Sandstone	17.1	137.7	**587.2**	25.2	17.4	679.1	~~587~~	~~0~~	~~0~~	~~323~~	~~22.4~~
438.85	0.25			Sandstone	17.1	137.7	**604.3**	25.2	17.4	704.3	~~604~~	~~0~~	~~0~~	~~332~~	~~22.7~~
438.60	0.25			Sandstone		137.7			17.4						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== West Abutment
REFERENCE BORING ================================ 1-S
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 481.34 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 480.34 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1437 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 43.88 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 261.99 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 98.25 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	**41** 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.)
480.00	0.34	1.20			0.9		12.4	1.4		***2.8***	3	0	0	2	1
479.00	1.00	1.20			2.7	11.4	15.1	4.0	1.4	***6.8***	7	0	0	4	2
478.00	1.00	1.20			2.7	11.4	20.6	4.0	1.4	***11.1***	11	0	0	6	3
475.50	2.50	1.50			7.9	14.3	27.6	11.7	1.8	***22.7***	23	0	0	12	6
473.00	2.50	1.40			7.6	13.3	***32.3***	11.1	1.7	33.5	32	0	0	18	8
470.50	2.50	1.10			6.3	10.5	53.9	9.3	1.3	***44.7***	45	0	0	25	11
468.00	2.50	2.70			11.7	25.7	***50.4***	17.2	3.3	60.0	50	0	0	28	13
465.50	2.50	1.10			6.3	10.5	***56.4***	9.3	1.3	69.3	56	0	0	31	16
463.00	2.50		8	Hard Till	0.7	10.2	74.6	1.1	1.3	***72.6***	73	0	0	40	18
460.50	2.50	2.90			12.3	27.7	***74.5***	18.1	3.5	89.1	74	0	0	41	21
458.00	2.50	1.60			8.3	15.3	***79.0***	12.2	1.9	100.9	79	0	0	43	23
455.50	2.50	1.20			6.8	11.4	***84.8***	10.0	1.4	110.7	85	0	0	47	26
453.00	2.50	1.10			6.3	10.5	***95.9***	9.3	1.3	120.6	96	0	0	53	28
450.50	2.50	1.60			8.3	15.3	***105.1***	12.2	1.9	132.9	105	0	0	58	31
445.50	5.00	1.70			17.3	16.2	***113.8***	25.4	2.1	157.3	114	0	0	63	36
442.00	3.50	0.80			6.8	7.6	250.7	10.0	1.0	***183.8***	184	0	0	101	39
441.75	0.25			Sandstone	17.1	137.7	267.8	25.2	17.4	***209.0***	209	0	0	115	39.6
441.50	0.25			Sandstone	17.1	137.7	285.0	25.2	17.4	***234.2***	234	0	0	129	39.8
441.25	0.25			Sandstone	17.1	137.7	302.1	25.2	17.4	***259.4***	259	0	0	143	40.1
441.00	0.25			Sandstone	17.1	137.7	319.2	25.2	17.4	***284.7***	285	0	0	157	40.3
440.75	0.25			Sandstone	17.1	137.7	336.4	25.2	17.4	***309.9***	310	0	0	170	40.6
440.50	0.25			Sandstone	17.1	137.7	353.5	25.2	17.4	***335.1***	~~335~~	~~0~~	~~0~~	~~184~~	~~40.8~~
440.25	0.25			Sandstone	17.1	137.7	370.6	25.2	17.4	***360.3***	~~360~~	~~0~~	~~0~~	~~198~~	~~41.1~~
440.00	0.25			Sandstone	17.1	137.7	387.7	25.2	17.4	***385.5***	~~386~~	~~0~~	~~0~~	~~212~~	~~41.3~~
439.75	0.25			Sandstone	17.1	137.7	***404.9***	25.2	17.4	410.7	~~405~~	~~0~~	~~0~~	~~223~~	~~41.6~~
439.50	0.25			Sandstone	17.1	137.7	***422.0***	25.2	17.4	436.0	~~422~~	~~0~~	~~0~~	~~232~~	~~41.8~~
439.25	0.25			Sandstone	17.1	137.7	***439.1***	25.2	17.4	461.2	~~439~~	~~0~~	~~0~~	~~242~~	~~42.1~~
439.00	0.25			Sandstone	17.1	137.7	***456.3***	25.2	17.4	486.4	~~456~~	~~0~~	~~0~~	~~251~~	~~42.3~~
438.75	0.25			Sandstone	17.1	137.7	***473.4***	25.2	17.4	511.6	~~473~~	~~0~~	~~0~~	~~260~~	~~42.6~~
438.50	0.25			Sandstone	17.1	137.7	***490.5***	25.2	17.4	536.8	~~491~~	~~0~~	~~0~~	~~270~~	~~42.8~~
438.25	0.25			Sandstone	17.1	137.7	***507.6***	25.2	17.4	562.0	~~508~~	~~0~~	~~0~~	~~279~~	~~43.1~~
438.00	0.25			Sandstone	17.1	137.7	***524.8***	25.2	17.4	587.3	~~525~~	~~0~~	~~0~~	~~289~~	~~43.3~~
437.75	0.25			Sandstone	17.1	137.7	***541.9***	25.2	17.4	612.5	~~542~~	~~0~~	~~0~~	~~298~~	~~43.6~~
437.50	0.25			Sandstone	17.1	137.7	***559.0***	25.2	17.4	637.7	~~559~~	~~0~~	~~0~~	~~307~~	~~43.8~~
437.25	0.25			Sandstone	17.1	137.7	***576.2***	25.2	17.4	662.9	~~576~~	~~0~~	~~0~~	~~317~~	~~44.1~~
437.00	0.25			Sandstone	17.1	137.7	***593.3***	25.2	17.4	688.1	~~593~~	~~0~~	~~0~~	~~326~~	~~44.3~~
436.75	0.25			Sandstone	17.1	137.7	***610.4***	25.2	17.4	713.3	~~610~~	~~0~~	~~0~~	~~336~~	~~44.6~~
436.50	0.25			Sandstone		137.7			17.4						