STRUCTURE GEOTECHNICAL REPORT

US 67 over Henderson Creek

Existing S.N. 066-0004
Proposed S.N. 066-0020

F.A.P. RTE. 310
SECTION (102)BR-1
MERCER COUNTY, ILLINOIS
JOB NO. P-94-031-20
PTB 200-025, WO4
KEG NO. 21-1088.02

2/2/2024
Exp. 11/30/2025

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Kaskaskia
Engineering Group, LLC

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Exhibit H – Pile Length/Pile Type

1.0 PROJECT DESCRIPTION AND SCOPE

1.1 Introduction

The geotechnical study summarized in this report was performed by Kaskaskia Engineering Group, LLC (KEG) for a proposed bridge replacement carrying US 67 over Henderson Creek. The project is located in Mercer County, Illinois. The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of the removal and replacement of a two-span bridge (SN 066-0004) carrying US 67 over Henderson Creek. The existing structure was built in 1931. It has a total length of 103'-4" from back-to-back of abutments and a width of 33'. The general location of the proposed structure is shown on a Location Map, Exhibit A. The project is located around 13 miles northeast of Monmouth, IL. The site lies within the limits of the Galesburg Plain of the Till Plains section of the Central Lowland Province.

1.3 Proposed Structure Information

The proposed structure (SN 066-0020) will consist of a single-span bridge, which will be built on a 0°-degree skew over Henderson Creek. It will provide two 12 ft. wide driving lanes and two 4 ft. wide shoulders. The bridge will measure 110 ft. back-to-back of abutments. A Type, Size, and Location Plan (TS&L) is included in Exhibit C.

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

2.0 FIELD EXPLORATION

2.1 Subsurface Exploration and Testing

The site exploration plan was developed and completed by KEG. Three standard penetration test (SPT) borings designated SB-01, SB-02 and SB-03 were drilled on July 18 and July 19, 2022. The boring locations are shown on the Boring Plan, 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 D. The soil profile for the above-mentioned borings can be found in Subsurface Profile, Exhibit E.

2.2 Subsurface Conditions

The profiles at the three (3) boring locations exhibited layers of clay loam, clay, silty clay, sand, sandy clay, and sandy loam. The three borings were advanced to bedrock and proceeded to core 10 ft of rock. The bedrock consisted mostly of shale with limestone and coal zones. Table 2.2.1 shows a summary of the pavement structure(s) or topsoil thickness, depth of drilling, the top of rock and ground surface elevation (GSE) of the borings. A Summary of the general condition of the subsurface is described in Table 2.2.2.

Table 2.2.1 - Boring Information Summary

Designation	Asphalt	Concrete	Topsoil	Depth (ft)	Top of Rock (ft.)	GSE (ft.)
SB-01	9”	10”	-	55.0	42.5	670.91
SB-02	-	-	2”	38.0	27.0	657.62
SB-03	15”	-	-	45.0	34.5	665.44

Table 2.2.2 – Subsurface Profile Summary

Soil Type	N-Values (bpf)	Q_u (tsf)	WC (%)	Boring
Clay Loam	4 to 9	0.2 to 2.0	14 to 27	SB-01, SB-02, SB-03
Sand	4 to 11	-	17 to 35	SB-01, SB-02, SB-03
Sandy Clay	2 to 10	0.1 to 1.7	14 to 57	SB-01, SB-02, SB-03
Sandy Loam	3 to 10	-	14 to 37	SB-02
Silty Clay	2 to 9	0.1 to 1.2	21 to 34	SB-01, SB-02, SB-03
Clay Loam	4 to 9	0.2 to 2.0	14 to 27	SB-01, SB-02, SB-03

2.3 Groundwater

Groundwater was encountered at the time of drilling in Boring SB-01 at an elevation of 643.9 ft. (27 ft. below GSE), in Boring SB-02 at an elevation of 641.6 ft. (16 ft. below GSE) and in Boring SB-02 at an elevation of 638.4 ft. (27 ft. below GSE). It should be further noted that the groundwater level is subject to seasonal and climatic variations, including the level of adjacent affluents.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

Settlement is expected in the south abutment of the proposed structure, due to the approximate 12 feet fill necessary for its construction. Therefore, settlement calculations were performed. Boring SB-01 was used for the settlement analysis. No specific consolidation testing was completed, and empirical methods were used for estimation of the settlement. A 13.1 ft compressible layer was considered for the analysis and consisted of silty clay and clay layers. A settlement of about 7 in. was calculated. If a light-weight fill (30 pcf) is used, the total settlement goes down to about 2.7 inches.

The time for consolidation was calculated using empirical values, giving the time for 90 percent consolidation (t90) to be about 29 months, or over 2.4 years. Wick drains with 3-ft triangular spacing will decrease the t90 to about 127 days.

Due to the high estimated settlement amounts for the embankment, ground improvement will be required for support. Ground improvement could consist of surcharging the fill area before the bridge is constructed if the construction schedule would allow. If the layout of the site is such that the surcharge fill cannot be placed or if the construction schedule will not allow for an estimated 29-month surcharge without wick drains, or a 127-day surcharge with wick drains, then other methods will need to be considered, such as Removal and Replacement. Removing the top 5-feet of silty clay and replacing it with low-weight structural fill, as well as using low-weight material for the new fill, would eliminate settlement as the added weight of the replacement fill and new fill would be less than the removed soil. Settlement plates should be utilized during construction to monitor the settlement. Calculations are attached as Exhibit F - Settlement Calculations.

3.2 Slope Stability

Stability analysis using SLOPE/W was performed using the proposed structure geometry on the TS&L. Two conditions were modeled for each scenario: end-of-construction and long-term stability. A critical factor of safety (FOS) was calculated for each condition. According to the current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability.

To model the end-of-construction condition, full cohesion, and a friction angle of 0 degrees were assumed. Nominal values for cohesion were used with full friction angle to model the long-term condition to analyze the theoretical condition where pore water pressure has dissipated. Nominal values were between 50 and 100 psf for the cohesive soils, with friction angles between 26 and 30 degrees. Class A4 Stone Riprap and the abutment pile were also modeled into the analysis.

The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis is shown in Table 3.2. SLOPE/W program output from this analysis can be found in SLOPE/W Slope Stability Analysis, Exhibit G.

Table 3.2 – Slope Stability Critical FOS

Location (1V:2H Slope)	Critical FOS	
	End-of Construction	Long Term
North Abutment (SB-03)	1.8	3.4
South Abutment (SB-01)	2.9	1.5

The results of the analysis, as provided in Table 3.2, indicate an acceptable FOS will exist under all of the analyzed conditions at all locations.

3.3 Scour

The design scour elevations for the proposed structure are shown in Table 3.3. Class A4 stone riprap will be placed on the surface of the proposed abutment end slopes and streambed to reduce the potential for future scour.

Table 3.3 - Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)		Item 113
	North Abutment	South Abutment	
Q_{100}	659.19	662.79	8
Q_{200}	659.19	662.79	
Design	659.19	662.79	
Check	659.19	662.79	

3.4 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 C.

Additional seismic parameters were calculated for use in the design of the structure. Published information and mapping from the USGS, including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to develop the parameters for the bridge location. The values, based on Soil Site Class C, are summarized below.

Table 3.4 - Summary of Seismic Parameters

Parameter	Value
Soil Site Class	D
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.138 g (Site Class C)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.094 g (Site Class C)
Seismic Performance Zone	1

As indicated in the table above, the Seismic Performance Zone is 1, 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.

4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

4.1 Driven Piles

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

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

Table 4.1.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
North Abutment	1539
South Abutment	1539

The estimated pile lengths for applicable Metal-Shell and H-pile types are shown in Tables 4.1.2 through 4.1.7 below. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

Table 4.1.2 - Estimated Pile Lengths for Metal Shell 12"Φ w/.25" walls

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 (SB-03)	392	216	30	661.19
South Abutment (SB-01)	392	216 (*148 with DD)	29	664.79

Table 4.1.3 - Estimated Pile Lengths for Metal Shell 14"Φ w/.25" walls

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 (SB-03)	459	252	28	661.19
South Abutment (SB-01)	459	252 (*173 with DD)	29	664.79

Table 4.1.4 - Estimated Pile Lengths for Metal Shell 14" Φ w/.312" walls

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 (SB-03)	570	313	30	661.19
South Abutment (SB-01)	570	313 (*234 with DD)	34	664.79

Table 4.1.5 - 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 (SB-03)	335	184	34	661.19
South Abutment (SB-01)	335	184 (*139 with DD)	39	664.79

Table 4.1.6 - 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 (SB-03)	418	230	34	661.19
South Abutment (SB-01)	418	230 (*176 with DD)	39	664.79

Table 4.1.7 - 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 (SB-03)	497	273	36	661.19
South Abutment (SB-01)	497	273 (*218 with DD)	41	664.79

Table 4.1.8 - Estimated Pile Lengths for HP 14x73 Steel H-Piles

Substructure Unit	R_n Nominal Required Bearing (318kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (SB-03)	578	318	35	661.19
South Abutment (SB-01)	578	318 (*253 with DD)	40	664.79

Table 4.1.9 – 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 (SB-03)	705	388	37	661.19
South Abutment (SB-01)	705	388 (*323 with DD)	42	664.79

Table 4.1.10 - 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 (SB-03)	929	511	40	661.19
South Abutment (SB-01)	929	511 (*444 with DD)	46	664.79

As shown in the Tables above and in Pile Length/Pile Type, Exhibit H, scour has been included in the pile estimates. Downdrag due to the estimated 7" of settlement was also included for the South Abutment. Liquefaction was not included in this pile analysis.

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

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

4.3 Lateral Pile Response

Generally, the geotechnical engineer provides soil parameters to the structural engineer so that an L-Pile program, or other approved software, can be used for the lateral or displacement analysis of the foundations. Table 4.3.1 and Table 4.3.2 are included for the structural engineer's use in determining lateral pile response.

Table 4.3.1 - Soil Parameters for Lateral Pile Load Analysis

Boring	Depth at Bottom of Layer (Feet)	γ (pcf)	Short Term		Long Term		N Value (Average)	Assumed % Fines < #200	K (pci)	ε50
			c (psf)	Φ (deg)	c (psf)	Φ (deg)				
SB-01	667.9	120	1700	0	100	30	10	45	500	0.007
	657.4	120	1400	0	100	26	6	65	500	0.007
	647.9	120	2400	0	100	26	7	65	1000	0.005
	645.4	120	800	0	100	26	8	85	100	0.01

Boring	Depth at Bottom of Layer (Feet)	γ (pcf)	Short Term		Long Term		N Value (Average)	Assumed % Fines < #200	K (pci)	ε50
			c (psf)	Φ (deg)	c (psf)	Φ (deg)				
	643.9	120	400	0	100	30	4	45	30	0.02
	628.4	115	-	34	-	34	20	3	25	-
SB-02	652.1	120	350	0	100	26	8	65	30	0.02
	644.6	120	430	0	50	26	3	65	30	0.02
	641.6	120	100	0	50	30	2	45	30	0.004
	633.4	120	-	30	-	30	6	20	25	-
	632.1	120	800	0	100	26	5	65	100	0.01
	630.6	115	-	34	-	34	58	3	225	-
SB-03	658.4	120	1050	0	100	26	4	65	500	0.007
	649.9	120	730	0	100	26	6	65	100	0.01
	638.4	120	300	0	50	30	3	45	30	0.02
	630.9	115	-	34	-	34	7	3	25	-

Table 4.3.2 - Rock Parameters for Lateral Pile Load Analysis

Rock Type	Weak Rock			Strong Rock	
	y (psf)	RQD	Qu (tsf)	y (psf)	Qu (tsf)
Shale	144	0	4.5	149	40.0

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Construction Activities

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

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

5.2 Temporary Sheeting and Soil Retention

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

Temporary Soil Retention Systems may be required versus Temporary Shoring, depending upon the surcharge loading, and retained heights required to be supported during construction. The soils at the site indicate temporary shoring is possible with a retained height of 5 ft, but embedment may not be feasible if the retained heights required are greater than 5 ft. An Illinois-licensed Structural Engineer is required to seal the design of Temporary Soil Retention Systems, if deemed necessary.

5.3 Site and Soil Conditions

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

6.0 COMPUTATIONS

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

7.0 GEOTECHNICAL DATA

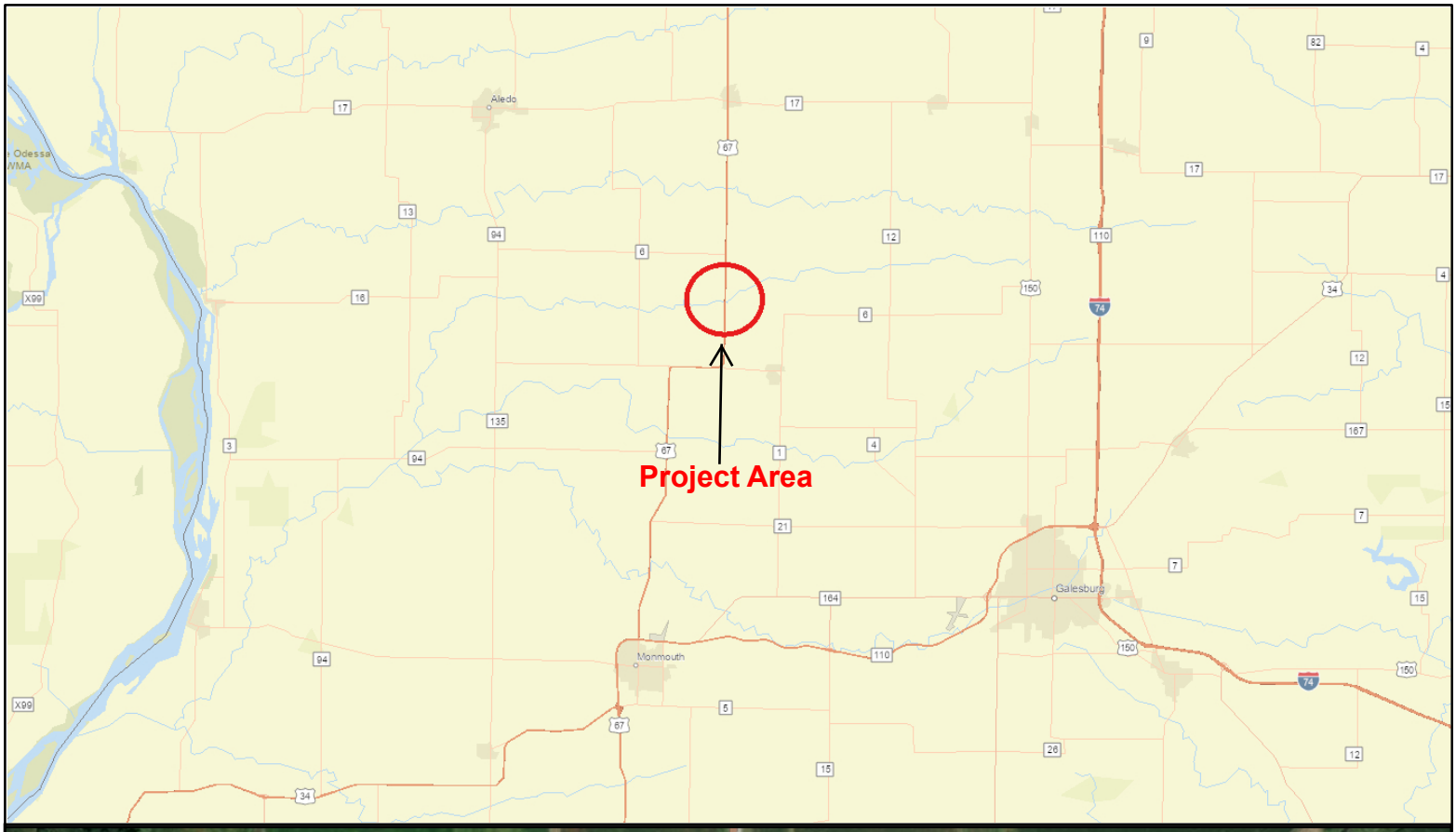
Soil boring logs can be found in Exhibit D. The Subsurface Profile can be found in Exhibit E**.** Pile Design Tables can be found in Exhibit G.

8.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of Horner & Shifrin and the Illinois Department of Transportation (IDOT) District 4. They are specific only to the project described and are based on the subsurface information obtained by KEG at two boring locations within the structure areas, KEG's understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. KEG should be contacted if conditions encountered during construction are not consistent with those described.

EXHIBIT A

LOCATION MAP



Kaskaskia Engineering Group, LLC

LOCATION MAP

US 67 over Henderson Creek
Mercer County, IL

Exhibit No.

A

KEG JOB #21-1088.02

EXHIBIT B

BORING PLAN

Kaskaskia Engineering Group, LLC

BORING LOCATION MAP

US 67 over Henderson Creek

Mercer County, IL

Exhibit No.

B

KEG JOB #21-1088.02

EXHBIT C

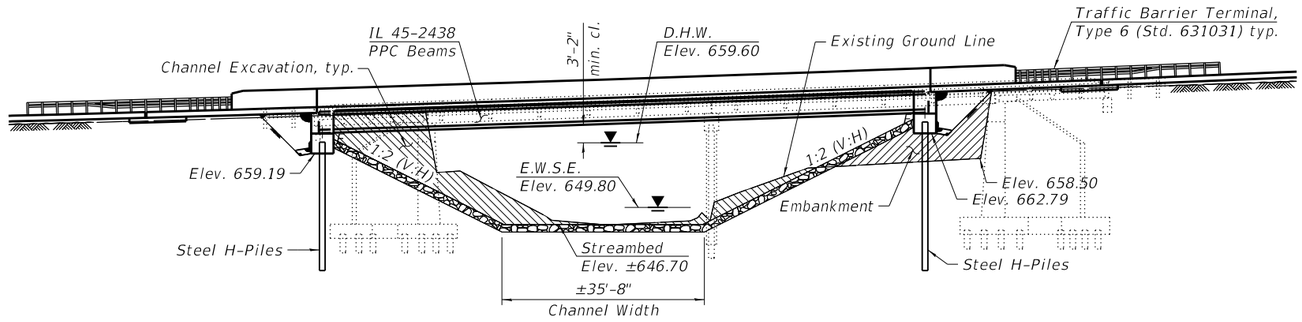
TYPE, SIZE, AND LOCATION PLAN (TS&L)

Bench Mark: Chisled "□" on southeast corner of bridge deck of bridge over Henderson Creek. Elev. 670.09

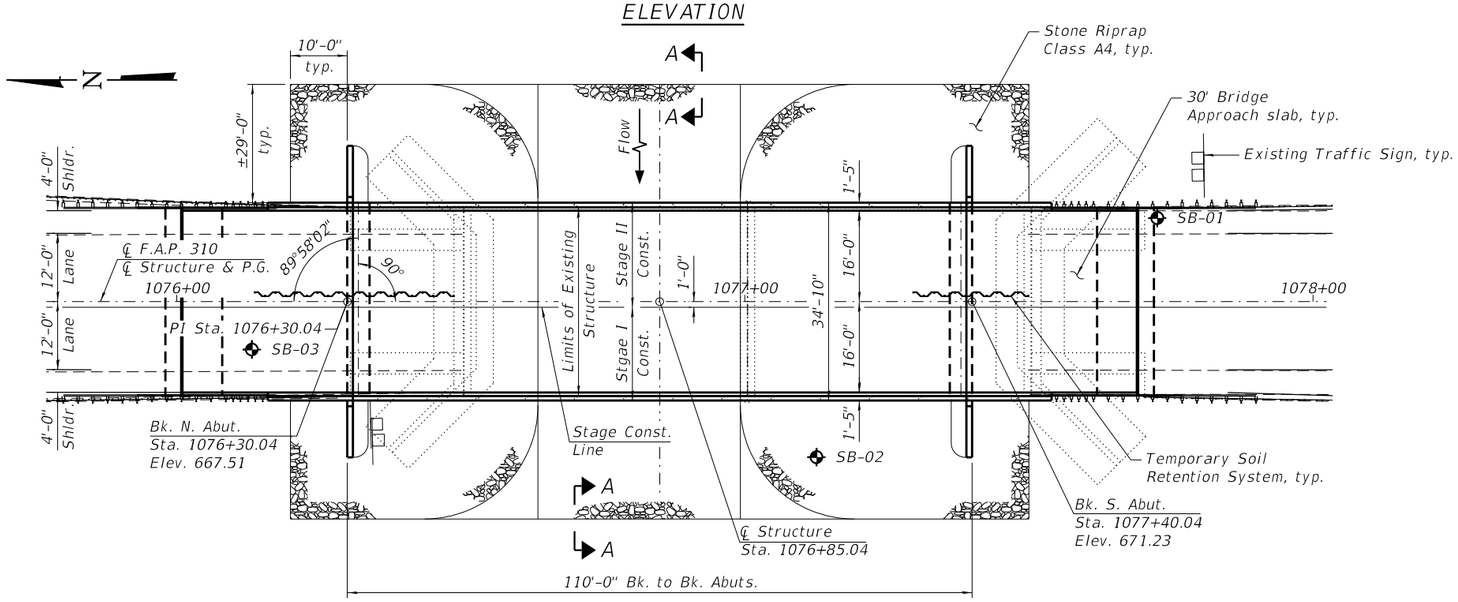
Existing Structure: S.N. 066-0004 was built in 1931, under construction Route FAP 310, US Rt. 67, Sec. 102B. The structure is a two span precast prestressed concrete structure that replaced the original steel truss. The total length of the structure is 103'-4" from back to back of abutments, and it has a width of 33'-0". In 1971, the original truss was replaced with a two-span PPC deck beam structure, the abutments were modified and a center pier was added to support the PPC deck beams. In 2001, the deck beams and substructures were repaired and 6½" reinforced concrete overlay was placed over the deck beams. In 2008, temporary support beams were installed in both spans. Existing structure to be removed.

Traffic to be maintained using staged construction.

Salvage: Existing temporary steel beams and supports to be delivered to the E. Peoria Yard.



ELEVATION



PLAN

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

PRECAST PRESTRESSED UNITS

f'c = 8,500 psi
f'ci = 6,500 psi
fpu = 270,000 psi (0.6"Ø Lowlax strands)
fpbt = 202,300 psi (0.6"Ø Lowlax strands)

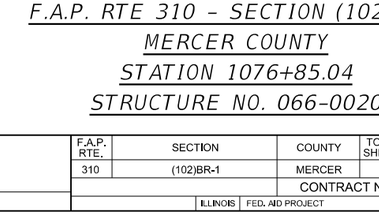
SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.067g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.104g
Soil Site Class = C

Note: The condition of the existing PPC deck beams shall be verified during final design. If required, the sequence of staging shall be modified, or beam supports added to the final contract plans.

HIGHWAY CLASSIFICATION

F.A.P. Rte. 310 - US 67
Functional Class: Other Principal Arterial NHS
ADT: 2400 (2021); 2928 (2041)
ADTT: 310 (2021)
DHV: 293 (2041)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two Way Traffic Directional Dist. 48:52



PROFILE GRADE

Along ℄ FAP 310 (US 67)

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)		
	N. Abut.	S. Abut.	Item 113
Q100	659.19	662.79	8
Q200	659.19	662.79	
Design	659.19	662.79	
Check	659.19	662.79	

WATERWAY INFORMATION

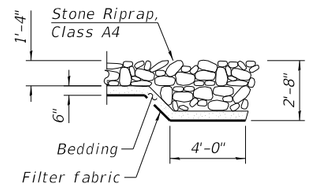
Drainage Area = 33.2 Sq. Mi.
Existing Overtopping Elev. 661.5 @ Sta. 1072+00
Proposed Overtopping Elev. 661.5 @ Sta. 1072+00

Flood Event	Freq. Yr.	Discharge (cfs)	Opening Ft²		Nat. H.W.E.	Head - Ft.		Headwater El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
Ten-Year	10	3,040	542	578	658.6	2.0	1.8	660.6	660.4
Design	50	4,650	633	678	659.6	3.1	2.5	662.7	662.1
Base	100	5,370	671	718	660.0	3.7	2.9	663.7	662.9
Scour Check	200	5,800	681	738	660.2	4.0	3.1	664.2	663.3
Overtop Existing	38	4,167	605	-	659.3	2.8	-	662.1	-
Overtop Proposed	51	4,700	-	678	659.6	-	2.5	-	662.1

10 year velocity through existing bridge = 5.6 ft/s
10 year velocity through proposed bridge = 5.3 ft/s

LEGEND

Channel Excavation
Channel Embankment

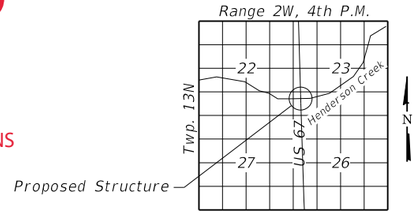


SECTION A-A

APPROVED

SEPTEMBER 27, 2023

AS A BASIS FOR
PREPARATION OF DETAILED PLANS



LOCATION SKETCH

GENERAL PLAN & ELEVATION
US 67 OVER HENDERSON CREEK
F.A.P. RTE 310 - SECTION (102)BR-1
MERCER COUNTY
STATION 1076+85.04
STRUCTURE NO. 066-0020

GRAEF
8501 W. Higgins Road; Suite 280
Chicago, Illinois 60631; (773) 399-0112

USER NAME =	DESIGNED - J.T.B.	REVISED -	
	CHECKED - H.A.	REVISED -	
PLOT SCALE =	DRAWN - D.C.P.	REVISED -	
PLOT DATE =	CHECKED - K.G.W.	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
310	(102)BR-1	MERCER		
		CONTRACT NO. 68801		
	ILLINOIS FED. AID PROJECT			

MODEL: $MODELNAMES
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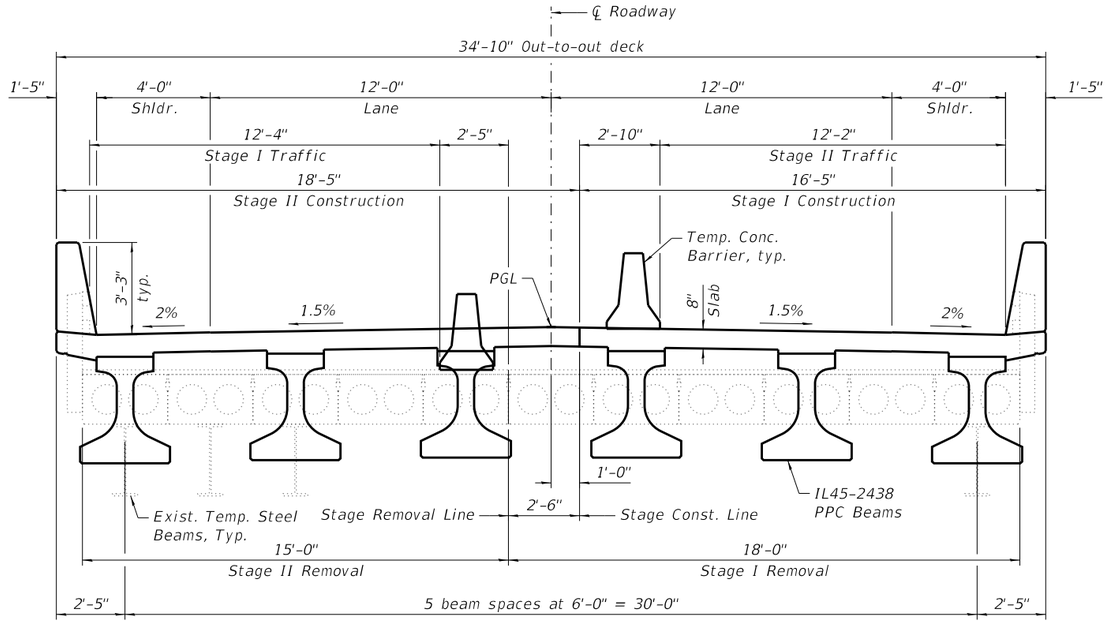
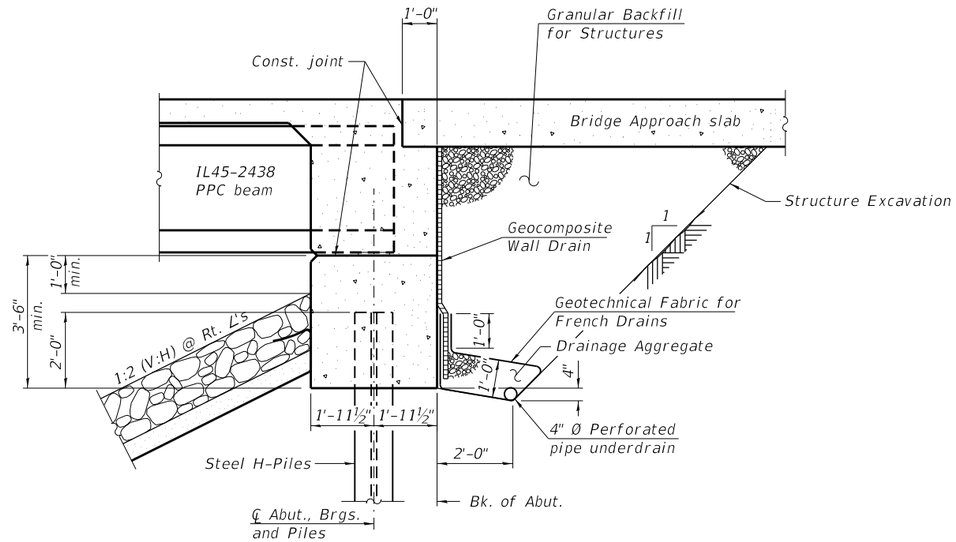


CROSS SECTION
(Looking South)



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

APPROVED

SEPTEMBER 27, 2023

AS A BASIS FOR
PREPARATION OF DETAILED PLANS

DETAILS
US 67 OVER HENDERSON CREEK
F.A.P. RTE 310 - SECTION (102)BR-1
MERCER COUNTY
STATION 1076+85.04
STRUCTURE NO. 066-0020

GRÄEF
8501 W. Higgins Road; Suite 280
Chicago, Illinois 60631; (773) 399-0112

USER NAME =		DESIGNED -	J.T.B.	REVISED -
		CHECKED -	H.A.	REVISED -
PLOT SCALE =		DRAWN -	D.C.P.	REVISED -
PLOT DATE =		CHECKED -	K.G.W.	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
310	(102)BR-1	MERCER		
		CONTRACT NO. 68801		
	ILLINOIS	FED. AID PROJECT		

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EXHIBIT D

BORING LOGS

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 7/18/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.0994° N, -90.5889° W

COUNTY Mercer **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 066-0020
Station 1007+85.04

BORING NO. SB-01
Station 1077+72.60
Offset 14.7 ft LT
Ground Surface Elev. 670.91 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 643.9 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
670.2				ASPHALT PAVEMENT - 9"
669.3				CONCRETE PAVEMENT - 10"
	4			
	5	1.7	14	SANDY CLAY - Brown and gray,
	5	B		med-stiff, with some gravel
667.9				LL = 36%, PL= 10%, PI = 26%
	3			CLAY LOAM - Brown, med-stiff
	2	1.5	14	
-5	3	B		
	2			becomes brown and gray, moist
	2	1.1	20	
	5	B		
	2			no more sand
	2	1.0	20	
-10	4	P		
				Shelby Tube Pushed 11'-13'
		2.0		1.3% Gravel, 26.6% Sand, 42.2%
		P		Silt, 29.8% Clay
657.4				
	2			SILTY CLAY - Dark gray, med-stiff,
	3	0.5	29	w/ some sand and organics, moist
-15	4	B		
	2			
	3	0.6	23	
	5	B		
	1			becomes gray, w/ sand seams,
	3	0.6	33	gravel and organics
-20	3	B		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
	1			SILTY CLAY - Dark gray, med-stiff, w/ some sand and organics, moist *(continued)*
	3	0.8	31	becomes dark gray
	4	B		
647.9				
	3			CLAY - Dark gray, med-stiff, w/ some sand, moist
	4	0.8	27	
-25	4	B		
645.4				
	2			SANDY CLAY - Dark gray, med-stiff, w/ organics
643.9 ▼				
	2	0.4	35	SAND - Gray, med-dense,
	2	B		med-coarse grained, wet
				GWT Encountered at 27'
	1			w/ some organics, well graded, w/
	2	-	25	some clay
-30	2			
	1			becomes dark gray, w/ organics
	2	-	32	(wood fragment - 5")
-35	4			
	50/4"			w/ weathered shale fragments
		-	17	
-40				

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

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 7/18/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.0994° N, -90.5889° W

COUNTY Mercer **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 066-0020
Station 1007+85.04

BORING NO. SB-01
Station 1077+72.60
Offset 14.7 ft LT
Ground Surface Elev. 670.91 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 643.9 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
SAND - Gray, med-dense, med-coarse grained, wet GWT Encountered at 27' *(continued)*				
628.4				
SHALE - Gray, mod. hard, wet	20			
	41	-	11	
625.9 -45	50/5"			
Borehole continued with rock coring.				
-50				
-55				
-60				

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

Illinois Department of Transportation
Division of Highways

ROCK CORE LOG

Date 7/18/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.0994° N, -90.5889° W

COUNTY Mercer **CORING METHOD**

STRUCT. NO. 066-0020
Station 1007+85.04

BORING NO. SB-01
Station 1077+72.60
Offset 14.73 LT
Ground Surface Elev. 670.91 ft

CORING BARREL TYPE & SIZE
Core Diameter in
Top of Rock Elev. 625.91 ft
Begin Core Elev. 625.91 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE - Gray, Highly weathered, Mod. hard, w/ pebbles	625.91		1	73	25	2.2	
	624.41						
LIMESTONE - Gray, Hard, Mod. weathered	623.81						
SHALE - Black, hard, Slightly weathered becomes highly fractured		-50					
w/ limestone seams			2	100	60	1.2	
	618.91						
COAL - mod. hard	617.58						
SHALE - Gray, hard, slightly weathered		-55					40.8
	615.91						
End of Boring		-60					
		-65					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 7/19/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.099610° N, -90.589091° W

COUNTY Mercer **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 066-0020
Station 1007+85.04

BORING NO. SB-02
Station 1077+12.60
Offset 27.4 ft RT
Ground Surface Elev. 657.62 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 641.6 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
657.5				TOPSOIL - 2"
	10			CLAY LOAM - Brown, med-stiff, w/ some gravel and organics
	6 3	0.2 B	24	
	4			Poor Recovery no more gravel
	4 3	0.5 P	21	
-5				
652.1				SILTY CLAY - Dark gray, soft, w/ organics and sand, moist
	1			
	1 1	0.1 B	34	
	1			becomes med-stiff
	2 2	0.4 B	33	
-10				
		0.8 P		Shelby Tube Pushed 11'-13' LL = 34%, PL = 14%, PI = 20%
644.6				SANDY CLAY - Gray, soft, w/ organics, moist
	1			
	1 1	0.1 B	27	
-15				
641.6 ▼				SANDY LOAM - Gray, loose, w/ some clay, well graded, wet GWT encountered at 16'
	WH			
	1 2	-	37	
	1			becomes med-dense, w/ pebbles
	4 3	-	19	
-20				
	6			SANDY LOAM - Gray, loose, w/ some clay, well graded, wet GWT encountered at 16' *(continued)*
	5 5	-	14	w/ gravel and pebbles
	2			7.0% Gravel, 54.9% Sand, 24.1% Silt, 14.0% Clay
633.4				
	2 3	0.8 B	21	SILTY CLAY - Gray, med-stiff, w/ some sand, moist
-25				
632.1				SAND - Gray, poorly graded, med-coarse grained, med-dense, w/ pebbles
	6			
630.6	19 39	-	13	SHALE - gray, weathered, mix w/ sand
629.6				Borehole continued with rock coring.
-30				
-35				
-40				

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

Illinois Department of Transportation
Division of Highways

ROCK CORE LOG

Date 7/19/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.099610° N, -90.589091° W

COUNTY Mercer **CORING METHOD**

STRUCT. NO. 066-0020
Station 1007+85.04

CORING BARREL TYPE & SIZE
Core Diameter in
Top of Rock Elev. 629.62 ft
Begin Core Elev. 629.62 ft

BORING NO. SB-02
Station 1077+12.60
Offset 27.37 LT
Ground Surface Elev. 657.62 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE - Black, Mod. Hard, Highly Weathered	629.62		2	100	0	2.5	
		-30					
becomes gray							
becomes black	624.62						
COAL	624.12						
SHALE - Grayish Brown, Mod-Hard, Mod-Weathered							4.0
		-35					
	621.79						
LIMESTONE - Gray, Mod-Hard, weathered	621.52		1	85	54	1.75	
COAL							
	619.62						
End of Boring							
		-40					
		-45					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 7/19/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.099892° N, -90.589012° W

COUNTY Mercer **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 066-0020
Station 1007+85.04

BORING NO. SB-03
Station 1076+13.20
Offset 8.4 ft RT
Ground Surface Elev. 665.44 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 638.4 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
0				ASPHALT PAVEMENT - 15" 665.0
	3			CLAY LOAM - Brown, med-stiff, w/ some gravel
	2 3	1.0 B	21	LL = 37%, PL = 12%, PI = 25%
	2			
	2 2	0.7 B	18	
-5				
	2			
	2 3	1.5 P	25	658.4
	1			SILTY CLAY - Gray, med-stiff
	2 2	0.2 B	28	becomes moist, soft, w/ some sand
-10				
	2			becomes black, med-stiff
	4 5	1.2 B	25	
	1			no more sand
	3 4	0.8 B	31	
-15				649.9
	1			SANDY CLAY - Black, soft, moist
	2 1	0.4 B	57	becomes gray
				Shelby Tube Pushed 18'-20'
-20		0.5 P		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
				SANDY CLAY - Black, soft, moist *(continued)*
	1			
	2 1	0.2 B	30	
	1			w/ organics (wood pieces)
	1 2	0.1 B	29	
-25				
	1			
	2 2	0.3 B	24	638.4 ▼
	4			SAND - Gray, med-coarse grained, poorly graded, loose, wet
	6 5	-	21	90.4% Sand, 5.5% Silt, 4.2% Clay
-30				
	14			becomes med-dense, moist
	40 50/4"	3.5 S	12	630.9
-35				SHALE - Black, hard 630.4
				Borehole continued with rock coring.
-40				

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

Illinois Department of Transportation
Division of Highways

ROCK CORE LOG

Date 7/19/22

ROUTE F.A.P 310 (US 67) **DESCRIPTION** US 67 over Henderson Creek **LOGGED BY** KEG

SECTION (102)BR-1 **LOCATION** 41.099892° N, -90.589012° W

COUNTY Mercer **CORING METHOD**

STRUCT. NO. 066-0020
Station 1007+85.04

BORING NO. SB-03
Station 1076+13.20
Offset 8.42 RT
Ground Surface Elev. 665.44 ft

CORING BARREL TYPE & SIZE
Core Diameter in
Top of Rock Elev. 630.44 ft
Begin Core Elev. 630.44 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE - Black, Mod. Hard, Mod. Fracture, Mod. Weathered	630.44		1	60	12	3.4	
	626.19						
LIMESTONE - Gray, Mod. Hard, Mod. Weathered, Slightly Fracture	625.44	-40					
COAL - Highly Fractured, Mod. Hard			2	48	30	1	
	620.44	-45					
End of Boring		-50					
		-55					

Color pictures of the cores
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

EXHIBIT E

SUBSURFACE PROFILE

Elevation (ft)

675 670 665 660 655 650 645 640 635 630 625 620 615

SB-01

N	Qu	w%	
			670.91 ASPHALT PAVEMENT - 9"
			CONCRETE PAVEMENT - 10"
10	1.7	14	SANDY CLAY - Brown and gray, med-stiff, with some gravel
B			LL = 36%, PL= 10%, PI = 26%
5	1.5	14	
B			
7	1.1	20	CLAY LOAM - Brown, med-stiff
B			
6	1.0	20	
P			
	2.0		
P			
7	0.5	29	
B			
8	0.6	23	SILTY CLAY - Dark gray, med-stiff, w/ some sand and organics, moist
B			
6	0.6	33	
B			
7	0.8	31	
B			
8	0.8	27	CLAY - Dark gray, med-stiff, w/ some sand, moist
B			
4	0.4	35	SANDY CLAY - Dark gray, med-stiff, w/ organics
B			
4	-	25	
6	-	32	SAND - Gray, med-dense, med-coarse grained, wet
50/4"		17	
50/5"	-	17	SHALE - Gray, mod. hard, wet
			SHALE - Gray, H. weathered, Mod. hard, w/ pebbles
			LIMESTONE - Gray, Hard, Mod. weathered
-		11	SHALE - Balck, hard, Slightly weathered
			COAL - mod. hard
			SHALE - Gray, hard, slightly weathered
			615.9

SB-02

N	Qu	w%	
			657.62 TOPSOIL - 2"
9	0.2	24	CLAY LOAM - Brown, med-stiff, w/ some gravel and organics
B			
7	0.5	21	
P			
2	0.1	34	SILTY CLAY - Dark gray, soft, w/ organics and sand, moist
B			
4	0.4	33	
B			
	0.8		
P			
2	0.1	27	SANDY CLAY - Gray, soft, w/ organics, moist
B			
3	-	37	
7	-	19	SANDY LOAM - Gray, loose, w/ some clay, well graded, wet
10	-	14	
5	0.8	21	SILTY CLAY - Gray, med-stiff, w/ some sand, moist
B			
58	-	13	SAND - Gray, poorly graded, med-coarse grained, med-dense, w/ pebbles
			SHALE - gray, weathered, mix w/ sand
			SHALE - Black, Mod. Hard, H. Weathered
			COAL
			SHALE - Grayish Brown, Mod-Hard, Mod-Weathered
			LIMESTONE - Gray, Mod-Hard, weathered
			COAL
			619.6

SB-03

N	Qu	w%	
			665.44 ASPHALT PAVEMENT - 15"
5	1.0	21	
B			
4	0.7	18	CLAY LOAM - Brown, med-stiff, w/ some gravel
B			
5	1.5	25	
P			
4	0.2	28	
B			
9	1.2	25	SILTY CLAY - Gray, med-stiff
B			
7	0.8	31	
B			
3	0.4	57	
B			
	0.5		
P			
3	0.2	30	SANDY CLAY - Black, soft, moist
B			
3	0.1	29	
B			
4	0.3	24	
B			
11	-	21	SAND - Gray, med-coarse grained, poorly graded, loose, wet
50/4"	3.5	12	SHALE - Black, hard
S			
			SHALE - Balck, Mod. Hard, Mod. Fracture, Mod. Weathered
			LIMESTONE - Gray, Mod. Hard, Mod. Weathered, Slightly Fracture
			COAL - H. Fracture, Mod. Hard
			620.4

NOT TO HORIZONTAL SCALE

Illinois Department of Transportation
Division of Highways

SUBSURFACE PROFILE

Route: F.A.P 310 (US 67)
Section: (102)BR-1
County: Mercer

PRINTERMOD2 11X17 21-1088.02 US 67 OVER HENDRESON CREEK.GPJ IL_DOT.GDT 3/7/23

EXHIBIT F

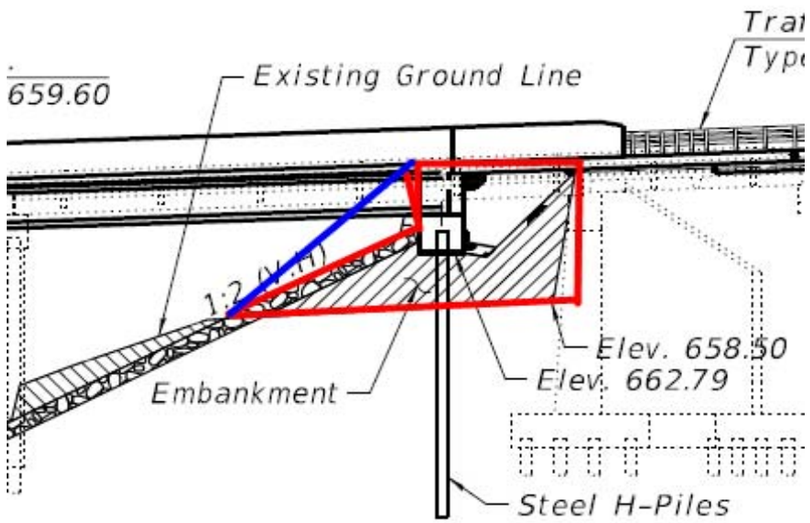
SETTLEMENT ANALYSIS

US 67 over Henderson Creek **Settlement Calculations (Original)**

Boring SB-01													
Layer	H (ft)	Soil Type	zcl (ft)	γ (pcf)	LL	PI	p'o (psf)	ΔP' (psf)	p'o + ΔP' (psf)	Cv (in²/min)=	eo	Cc	Δi (in)
1	2.5	Silty Clay	1.25	120	34	20	150	999.81	1149.81	6.64E-03	0.918	0.216	2.988
2	2.5	Silty Clay	3.75	120	34	20	450	864.13	1314.13	6.64E-03	0.918	0.216	1.572
3	2.5	Silty Clay	6.25	120	34	20	750	754.35	1504.35	6.64E-03	0.918	0.216	1.021
4	3.1	Silty Clay	9.05	120	34	20	1086	654.55	1740.55	6.64E-03	0.918	0.216	0.858
5	2.5	Clay	11.85	120	40	35	1422	573.35	1995.35	1.17E-03	1.08	0.27	0.573
												Σ=	7.01

Equicvalent H from silty clay Cv			
	H (ft)	Cv (in2/min)	equivalent H
Clay	2.5	1.17E-03	5.96
silty Clay	10.6	6.64E-03	10.60
			16.56

Time Rate of consolidation			
Without wick drains			
Cv (in²/min)=	6.64E-03		
H (in)=	99.33	double drain	
	days	months	years
t50	203.37	6.78	0.56
t90	875.41	29.18	2.40
With Wick Drains			
Cv hor. (in²/min)=	1.33E-02		
Triangular spacing(ft)=	3.0		
de(ft)=	3.2		
	days	months	years
t50	29.5	0.98	0.08
t90	126.8	4.23	0.35



US 67 over Henderson Creek **Settlement Calculations (Light-Weight Fill)**

Boring SB-01													
Layer	H (ft)	Soil Type	zcl (ft)	γ (pcf)	LL	PI	p'o (psf)	ΔP' (psf)	p'o + ΔP' (psf)	Cv (in²/min)=	eo	Cc	Δi (in)
1	2.5	Silty Clay	1.25	120	34	20	150	239.95	389.95	6.64E-03	0.918	0.216	1.402
2	2.5	Silty Clay	3.75	120	34	20	450	207.39	657.39	6.64E-03	0.918	0.216	0.556
3	2.5	Silty Clay	6.25	120	34	20	750	181.04	931.04	6.64E-03	0.918	0.216	0.317
4	3.1	Silty Clay	9.05	120	34	20	1086	157.09	1243.09	6.64E-03	0.918	0.216	0.246
5	2.5	Clay	11.85	120	40	35	1422	137.60	1559.60	1.17E-03	1.08	0.27	0.156
												Σ=	2.68

Equicvalent H from silty clay Cv			
	H (ft)	Cv (in2/min)	equivalent H
Clay	2.5	1.17E-03	5.96
silty Clay	10.6	6.64E-03	10.60
			16.56

Time Rate of consolidation			
Without wick drains			
Cv (in²/min)=	6.64E-03		
H (in)=	99.33	double drain	
	days	months	years
t50	203.37	6.78	0.56
t90	875.41	29.18	2.40
With Wick Drains			
Cv hor. (in²/min)=	1.33E-02		
Triangular spacing(ft)=	3.0		
de(ft)=	3.2		
	days	months	years
t50	29.5	0.98	0.08
t90	126.8	4.23	0.35

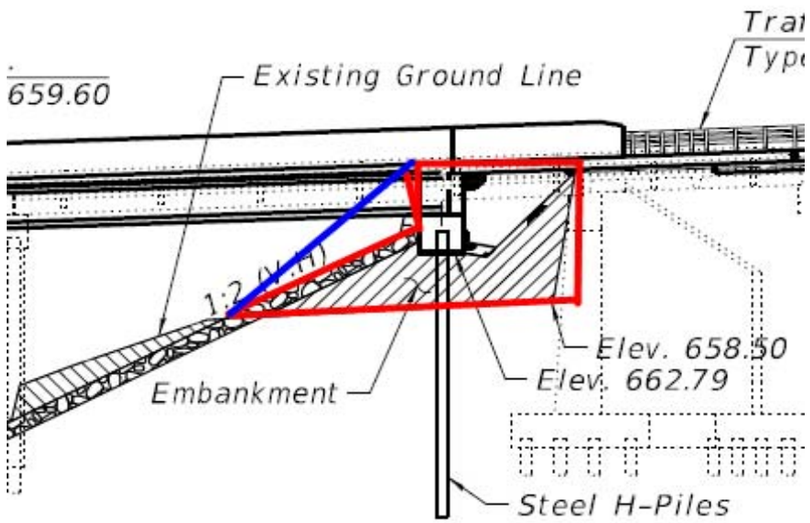
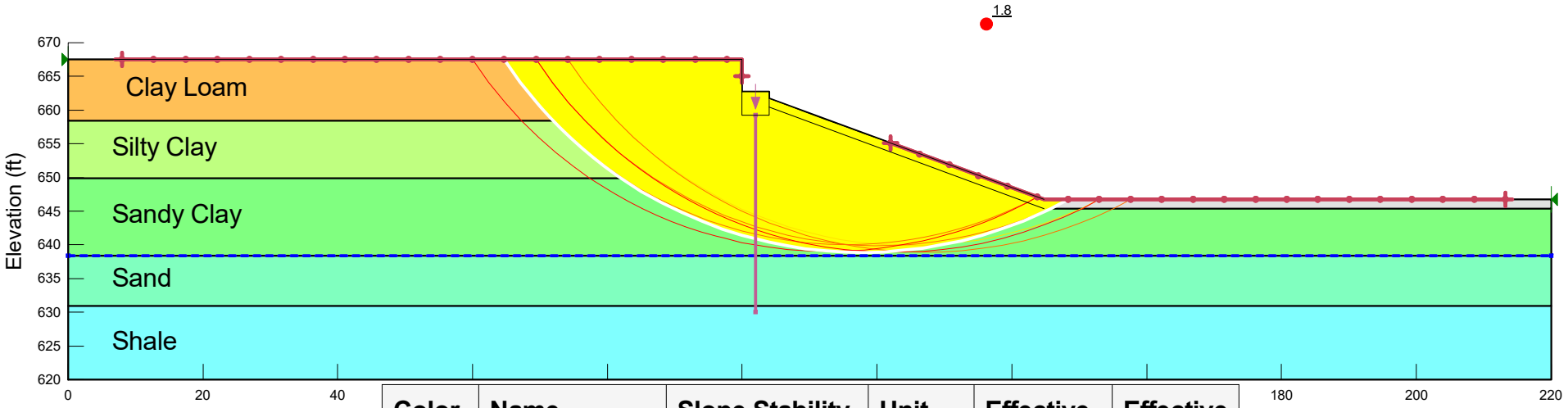


EXHIBIT G

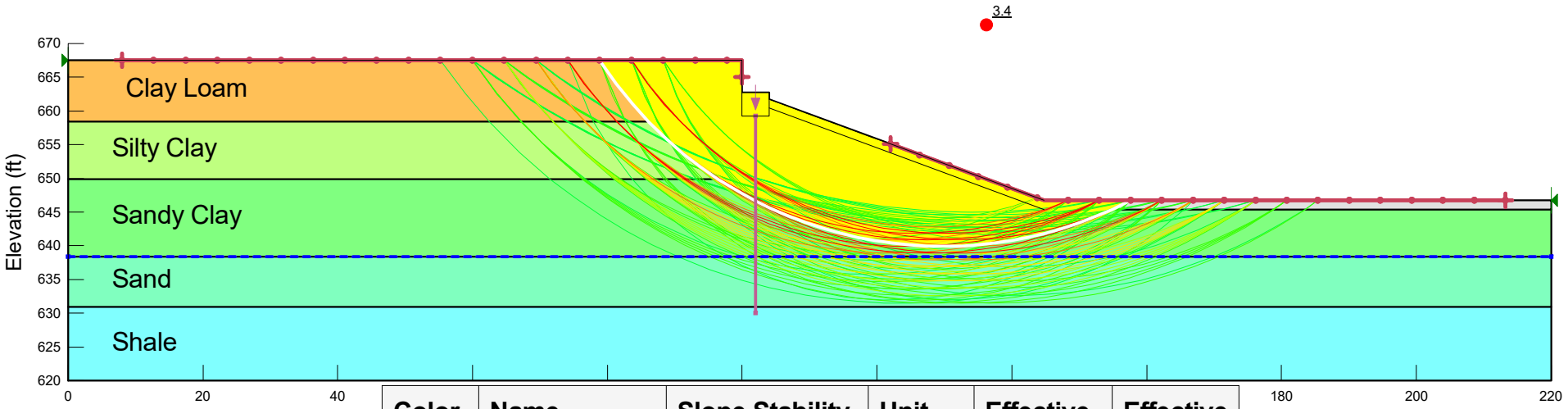
SLOPE W SLOPE STABILITY ANALYSIS

US 67 over Henderson Creek
North Abutment (Boring SB-03)
End-of-Construction (Undrained Condition)



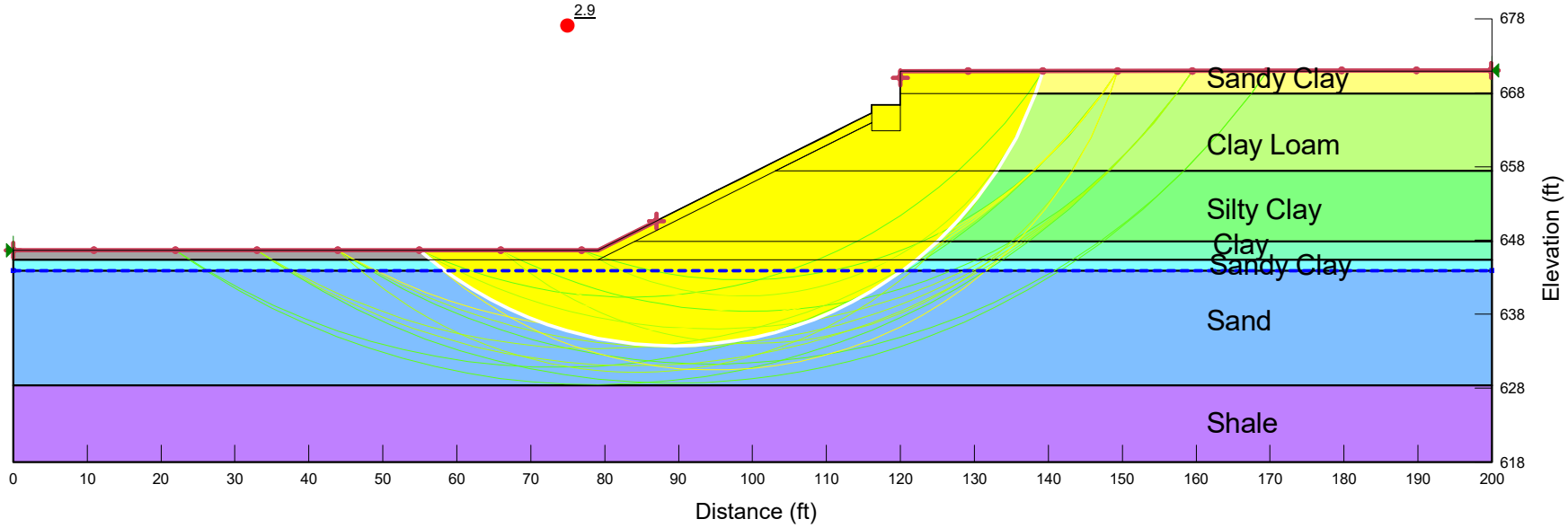
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1 - Clay Loam	Mohr-Coulomb	120	1,050	0
	2 - Silty Clay	Mohr-Coulomb	120	730	0
	3 - Sandy Clay	Mohr-Coulomb	120	300	0
	4 - Sand	Mohr-Coulomb	115	0	34
	5 - Shale	Mohr-Coulomb	144	10,000	12
	6- Riprap	Mohr-Coulomb	145	0	42
	7 - Concrete	Mohr-Coulomb	150	25,000	45

US 67 over Henderson Creek
North Abutment (Boring SB-03)
Long Term Analysis (Drained Condition)



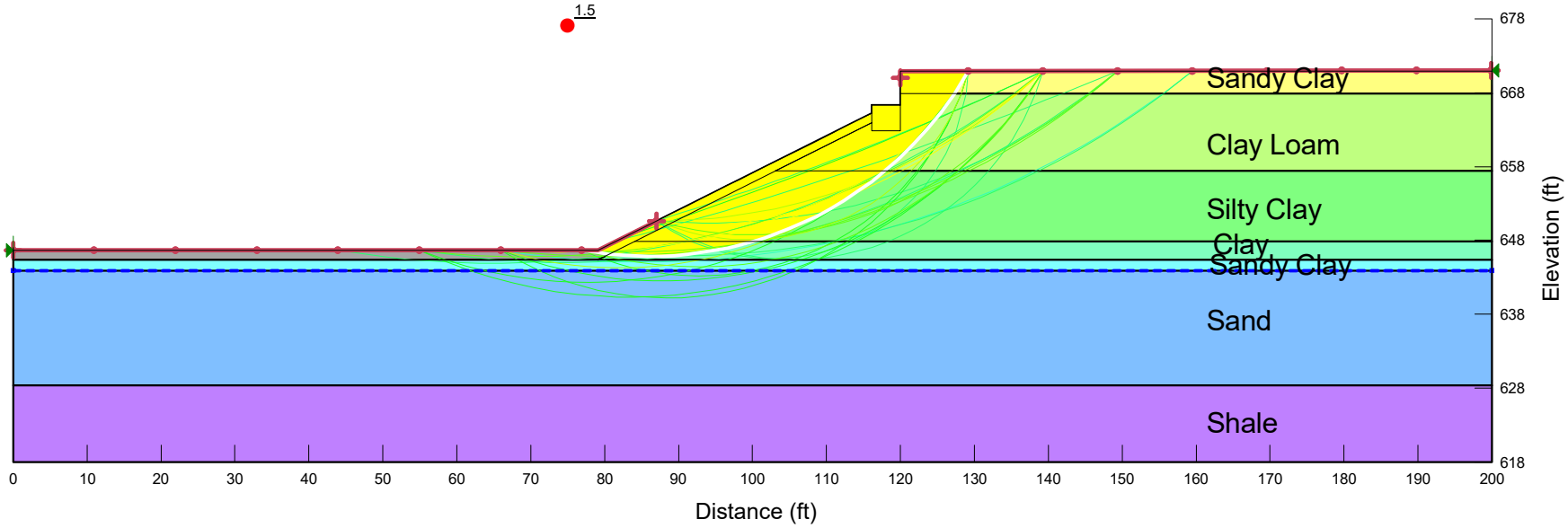
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1 - Clay Loam	Mohr-Coulomb	120	100	26
	2 - Silty Clay	Mohr-Coulomb	120	100	26
	3 - Sandy Clay	Mohr-Coulomb	120	50	30
	4 - Sand	Mohr-Coulomb	115	0	34
	5 - Shale	Mohr-Coulomb	144	10,000	12
	6- Riprap	Mohr-Coulomb	145	0	42
	7 - Concrete	Mohr-Coulomb	150	25,000	45

US 67 over Henderson Creek
South Abutment (Boring SB-01)
End of Construction (Undrained Condition)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1 - Sandy Clay	Mohr-Coulomb	120	1,700	0
	2 - Clay Loam	Mohr-Coulomb	120	1,400	0
	3 - Silty Clay	Mohr-Coulomb	100	2,400	0
	4 - Clay	Mohr-Coulomb	120	800	0
	5 - Sandy Clay II	Mohr-Coulomb	120	400	0
	6 - Sand	Mohr-Coulomb	115	0	34
	7 - Shale	Mohr-Coulomb	144	10,000	12
	8 - Riprap	Mohr-Coulomb	145	0	42
	9 - Concrete	Mohr-Coulomb	150	25,000	45

US 67 over Henderson Creek
South Abutment (Boring SB-01)
Long Term Analysis (Drained Condition)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	1 - Sandy Clay	Mohr-Coulomb	120	100	30
	2 - Clay Loam	Mohr-Coulomb	120	100	26
	3 - Silty Clay	Mohr-Coulomb	100	100	26
	4 - Clay	Mohr-Coulomb	120	100	26
	5 - Sandy Clay II	Mohr-Coulomb	120	100	30
	6 - Sand	Mohr-Coulomb	115	0	34
	7 - Shale	Mohr-Coulomb	144	10,000	12
	8 - Riprap	Mohr-Coulomb	145	0	42
	9 - Concrete	Mohr-Coulomb	150	25,000	45

EXHIBIT H

PILE LENGTH/PILE TYPE

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== North Abutment
REFERENCE BORING ========== SB-03
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 661.19 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 659.19 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 659.19 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1539 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 353.49 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 132.56 KIPS

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
929 KIPS	**872** KIPS	**480** KIPS	**40** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 117

Pile Perimeter========== 4.850 FT. Unplugged Pile Perimeter========== 7.117 FT.
Pile End Bearing Area========== 1.469 SQFT. Unplugged Pile End Bearing Area========= 0.239 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
657.89	1.30	1.50			6.1		10.2	8.9		***9.6***	10	0	0	5	3
655.39	2.50	0.20			2.0	4.1	32.8	2.9	0.7	***15.8***	16	0	0	9	6
652.89	2.50	1.20			9.9	24.7	34.5	14.6	4.0	***29.1***	29	0	0	16	8
649.89	3.00	0.80			8.6	16.5	***34.8***	12.6	2.7	40.3	35	0	0	19	11
647.89	2.00	0.40			3.1	8.2	***40.0***	4.5	1.3	45.2	40	0	0	22	13
645.39	2.50	0.50			4.7	10.3	***38.5***	6.9	1.7	51.1	39	0	0	21	16
642.89	2.50	0.20			2.0	4.1	***38.4***	2.9	0.7	53.7	38	0	0	21	18
640.39	2.50	0.10			1.0	2.1	***43.6***	1.5	0.3	55.9	44	0	0	24	21
638.39	2.00	0.30			2.3	6.2	***54.4***	3.4	1.0	60.7	54	0	0	30	23
637.89	0.50		4	Medium Sand	0.2	14.6	80.2	0.3	2.4	***65.1***	65	0	0	36	23
635.39	2.50		11	Medium Sand	2.4	40.3	225.4	3.6	6.5	***91.9***	92	0	0	51	26
630.89	4.50		50	Medium Sand	29.7	183.0	255.1	43.6	29.8	***135.5***	136	0	0	75	30
629.89	1.00			Shale	60.4	183.0	315.5	88.7	29.8	***224.2***	224	0	0	123	31.3
628.89	1.00			Shale	60.4	183.0	375.9	88.7	29.8	***312.8***	313	0	0	172	32.3
627.89	1.00			Shale	60.4	183.0	436.4	88.7	29.8	***401.5***	401	0	0	221	33.3
626.89	1.00			Shale	60.4	183.0	496.8	88.7	29.8	***490.1***	490	0	0	270	34.3
626.18	0.71			Shale	42.9	183.0	722.7	62.9	29.8	***582.8***	583	0	0	321	35
625.43	0.75			Limestone	90.6	366.1	***630.3***	133.0	59.5	686.0	630	0	0	347	35.8
624.43	1.00			Shale	60.4	183.0	***690.7***	88.7	29.8	774.7	691	0	0	380	36.8
623.43	1.00			Shale	60.4	183.0	***751.1***	88.7	29.8	863.4	751	0	0	413	37.8
622.43	1.00			Shale	60.4	183.0	***811.5***	88.7	29.8	952.0	812	0	0	446	38.8
621.43	1.00			Shale	60.4	183.0	***872.0***	88.7	29.8	1040.7	872	0	0	480	39.8
620.43	1.00			Shale	60.4	183.0	***932.4***	88.7	29.8	1129.3	~~932~~	~~0~~	~~0~~	~~513~~	~~40.8~~
619.43	1.00			Shale	60.4	183.0	***992.8***	88.7	29.8	1218.0	~~993~~	~~0~~	~~0~~	~~546~~	~~41.8~~
618.43	1.00			Shale		183.0			29.8						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== South Abutment
REFERENCE BORING ========== SB-01
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 664.79 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 662.79 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== DD
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 649.69 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1539 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 34.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 353.53 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 132.57 KIPS

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
929 KIPS	**905** KIPS	**431** KIPS	**46** FT.

PILE TYPE AND SIZE ========== Steel HP 14 X 117
Pile Perimeter========== 4.850 FT. Unplugged Pile Perimeter========== 7.117 FT.
Pile End Bearing Area========== 1.469 SQFT. Unplugged Pile End Bearing Area========= 0.239 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
660.89	1.90	1.00			6.5		47.7	9.6		***16.3***	16	4	7	-2	4
657.39	3.50	2.00			19.8	41.2	***36.6***	29.0	6.7	40.3	37	14	29	-23	7
655.89	1.50	0.50			2.8	10.3	***41.5***	4.2	1.7	44.8	41	16	32	-25	9
653.39	2.50	0.60			5.6	12.4	***47.1***	8.2	2.0	52.9	47	19	38	-31	11
650.89	2.50	0.60			5.6	12.4	***56.8***	8.2	2.0	61.8	57	22	44	-35	14
647.89	3.00	0.80			8.6	16.5	***65.4***	12.6	2.7	74.4	65	22	44	-31	17
645.39	2.50	0.80			7.2	16.5	***64.3***	10.5	2.7	83.6	64	22	44	-31	19
643.89	1.50	0.40			2.3	8.2	***73.0***	3.4	1.3	88.0	73	22	44	-26	21
643.39	0.50		4	Medium Sand	0.2	14.6	***73.2***	0.3	2.4	88.3	73	22	44	-26	21
640.89	2.50		4	Medium Sand	0.9	14.6	***81.4***	1.3	2.4	90.7	81	22	44	-22	24
635.89	5.00		6	Medium Sand	2.7	22.0	245.1	3.9	3.6	***120.8***	121	22	44	0	29
630.89	5.00		50	Medium Sand	33.0	183.0	278.1	48.5	29.8	***169.3***	169	22	44	27	34
628.39	2.50		50	Medium Sand	16.5	183.0	294.6	24.2	29.8	***193.5***	194	22	44	40	36
627.39	1.00			Shale	60.4	183.0	355.0	88.7	29.8	***282.2***	282	22	44	89	37.4
626.39	1.00			Shale	60.4	183.0	415.5	88.7	29.8	***370.8***	371	22	44	137	38.4
625.39	1.00			Shale	60.4	183.0	475.9	88.7	29.8	***459.5***	459	22	44	186	39.4
624.39	1.00			Shale	60.4	183.0	719.3	88.7	29.8	***577.9***	578	22	44	251	40.4
623.79	0.60			Limestone	72.5	366.1	***608.8***	106.4	59.5	654.5	609	22	44	268	41
622.79	1.00			Shale	60.4	183.0	***669.2***	88.7	29.8	743.2	669	22	44	301	42
621.79	1.00			Shale	60.4	183.0	***729.6***	88.7	29.8	831.8	730	22	44	335	43
620.79	1.00			Shale	60.4	183.0	***790.0***	88.7	29.8	920.5	790	22	44	368	44
619.79	1.00			Shale	60.4	183.0	***850.5***	88.7	29.8	1009.1	850	22	44	401	45
618.89	0.90			Shale	54.4	183.0	***904.8***	79.8	29.8	1088.9	905	22	44	431	45.9
617.89	1.00			Shale	60.4	183.0	***965.3***	88.7	29.8	1177.6	~~965~~	~~22~~	~~44~~	~~464~~	~~46.9~~
616.89	1.00			Shale		183.0			29.8						