STRUCTURE GEOTECHNICAL REPORT

BRIDGE REPLACEMENT
FAP 322 (US 51) OVER LOUSE RUN TRIBUTARY

Section 26BR
Marion County, Illinois
Job No. D-98-016-06
Contract No. 76B42
PTB 207-41
Existing Structure No. 061-0003
Proposed Structure No. 061-0095

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1.0 Project Description and Scope

1.1 Introduction

The geotechnical investigation summarized herein was performed for the proposed bridge at US 51 over Louse Run Tributary in Marion County, Illinois. See Appendix A for Location Map. The purpose of this report is to provide geotechnical design and construction recommendations to aid in the structure planning, final design plans and specification preparation.

1.2 Existing Structure Information

SN 061-0003 - Originally built in 1920, the existing structure is a single span concrete bridge. The 0 degree skew structure is 26'-0" from back to back abutments and had an out-to-out bridge deck width of 22'-0".

Later reconstructed in 1958, the bridge was widened to 46'-4" out to out of bridge deck, with a roadway width of 43'-0". 15'-2" was added on the east side and 9'-2" on the west side. Concrete curbs and type 2399 steel railing, as well as ± 2" bituminous wearing surface were added to the structure. There are no expansion joints at either abutment of this structure.

Both the original and widened portions of the bridge are supported by reinforced concrete closed abutments with spread footings. No piles are present under the footings, T-type wingwalls are located at each corner of the bridge.

SN 061-0003 has a sufficiency rating of 86.7 with a deck rating of 6 in satisfactory condition – minor deterioration, superstructure rating of 6 in satisfactory condition – minor deterioration, and a substructure rating of 6 in satisfactory condition – minor deterioration.

1.3 Proposed Structure Information

SN 061-0095 - The proposed replacement structure is a 3 span, steel W27 beam bridge with a 0 degree skew. The proposed bridge is supported by integral abutments on steel H-piles and solid wall piers on steel H-piles. Proposed back-to-back abutment length is 140'-0" with span lengths of 40'-6" – 59'-0" – 40'-6". The out to out width of 38'-10" consists of two 6'-0" shoulders and two 12'-0" traffic lanes. The roadway will be closed during construction with traffic being detoured. For further proposed structure information, see Appendix B for Type, Size, and Location Plan (TS&L).

2.0 Field Exploration

2.1 Subsurface Exploration and Testing

The subsurface investigation consisted of four borings drilled by Geotechnology as a sub-contractor to Kaskaskia Engineering Group in February 2022. A boring was taken near the proposed north and south abutment locations as well as a boring taken next to each proposed pier location. Soil boring exploration was performed by drilling methods using CME 550 rotary drill rig equipped with hollow stem augers. Rock coring is performed with a split barrel coring method. In addition, laboratory testing was performed on the soil samples to estimate index properties. Moisture contents and Atterberg limit tests were performed on selected cohesive samples. See Appendix C for Subsurface Data Profile Plot and Appendix D for Soil Boring and Rock Core Logs.

Table 2.1 - Boring Log Summary

Location	Boring No.	Station	Offset	Ground Surface Elevation	Top of Rock Elevation
N. Abut.	SB-01	919+88	15' RT	497.1	458.6
Pier 1	SB-02	920+42	18' LT	496.8	459.8
Pier 2	SB-03	921+15	15' RT	497.3	458.8
S. Abut.	SB-04	921+85	18' LT	497.5	459.0

2.2 Subsurface Conditions

The groundwater conditions at each soil boring varies between 11 and 23.5 feet. See Table 2.2 below. Temperature, seasonal variations, and recent rainfall conditions may influence the levels of groundwater table. Without extended periods of observation, the measurement of groundwater conditions may not give a true indication of typical groundwater levels. The volume of water depends on the permeability of the soil.

Table 2.2 – Groundwater Conditions Summary

Location	Boring No.	First Encounter	Upon Completion	After 24 Hours
N. Abut.	SB-01	486.1	-----	-----
Pier 1	SB-02	485.8	-----	-----
Pier 2	SB-03	486.8	-----	-----
S. Abut.	SB-04	474.0	-----	-----

2" to 3" of gravel fill is encountered below the groundline followed by 5.5'-8.5' of cohesive fill, which appears to have been used to build up the surrounding elevation to construct this bridge. The cohesive fill has SPT (N) values ranging from 3 to 11 and is mostly comprised of sandy clay, lean clay, and clayey silt. The fill has moisture content percentages ranging from 19% to 29% and Qu values from 0.1 to 2.5 tsf.

Below the fill, the soil consists of lean/sandy clays, and some sand to depths of 37'-38.5'. The borings show brown and grey stiff to medium stiff cohesive soils, with occasional soft sections with SPT (N) values ranging from 3 to 34 blows per foot, Q_u values of 0.5 to >4.5 tsf, and moisture contents ranging between 11% and 26%.

Below the layers above, top of rock was encountered by evidence of split-spoon sampler refusal. The split barrel rock core logs show variations of gray shale, limestone and sandstone. As shown in the table above, the top of rock elevation was consistent throughout the borings with elevations between Elev. 458.6 to 459.0.

3.0 Geotechnical Evaluations and Recommendations

3.1 Settlement

Based on the provided plan and profile, there is an anticipated fill up to 6 feet at the bridge approaches. We estimate approximately 1 inch of settlement due to consolidation of the underlying compressible cohesive layers. Approximately 80% of the anticipated settlement should occur as the fill is being placed and the following 3 months after. The estimated settlements are based on anticipated fill loads, soil boring logs, correlation with consolidation properties, IDOT Cohesive Soil Settlement Estimate spreadsheet and past geotechnical experience. See Appendix E for Settlement Analysis.

Per IDOT Geotechnical Manual Section 6.9.2, driven pile capacity needs to account for downdrag with total settlement of soil around the piling is more than 0.4 inches. Downdrag to be included in the Strength Limit State load group for the abutment pile capacities herein.

3.2 Slope Stability

Slope stability analyses of the end slopes at both abutments of each structure were performed due to the seismic region and proposed embankment material required. Engineering soil properties taken from the subsurface exploration descriptions were input and slope stability was evaluated using the software program StablPro. The Bishop's method analysis was used to search for the critical circular failure surface to calculate the factor of safety for the slope.

A critical factor of safety was calculated for three modeled conditions: short term static, long term static, and seismic. Short term conditions capture full cohesive values, while long term conditions assume drained soil properties. A live load surcharge of 250 psf was considered at both abutments. For seismic analysis, a horizontal acceleration coefficient of 0.24g was calculated according to guidance in the FHWA-NHI-11-032, LFRD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations.

See Table 3.1 below for slope stability factors of safety at each abutment. Each abutment location achieved the minimum factor of safety of 1.5 for static conditions and 1.0 for seismic conditions. See Appendix F for soil parameters and individual output of the analyses presented in the table.

Table 3.1 - Summary of Slope Stability Calculated Factors of Safety

Location	Short Term Static	Long Term Static	Seismic
N. Abut.	4.4	2.7	1.4
S. Abut.	3.8	2.6	1.4

3.3 Seismic Considerations

LRFD Seismic Soil Site Class Definition was determined based on the methodology described in IDOT AGMU 9.1 and the IDOT BBS 149 form for Seismic Site Class Determination. See Appendix G for determination.

Further seismic parameters were determined using the figures and tables provided in AASHTO LRFD Bridge Design Specifications, Article 3.10 for Earthquake Effects, EQ. These parameters are based on a 1000 Year Return Period with a Probability of Exceedance of 7% in 75 years. See table below for a summary of seismic parameters.

Table 3.2 - Summary of Seismic Parameters

Parameter	Value
Seismic Soil Site Class	C
Spectral Acceleration Coefficient at period of 0.2 sec., Ss	0.3975g
Spectral Acceleration Coefficient at period of 1.0 sec., S1	0.108g
Site Factor, Short Period, Fa	1.20
Site Factor, Long Period, Fv	1.69
Design Spectral Acceleration at 0.2 sec. (SDS)	0.477g
Design Spectral Acceleration at 1.0 sec. (SD1)	0.182g
Seismic Performance Zone	SPZ 2

The Spectral Acceleration Coefficient at T=1.0 sec. (SD1) and Seismic Performance Zone were confirmed using Bridge Manual Planning Section 2.3.10.3.

3.4 Scour

Scour calculations for the proposed structure were performed by IDOT Region 5/District 8. See Design Scour Elevation Table below. Stone Riprap, Class A5 is proposed to the protect the bridge embankment side slopes and streambed.

Table 3.3 – Design Scour Elevation Table

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	N. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	496.0*	486.6	486.6	496.0*	5
Q200	496.0*	486.5	486.5	496.0*	
Design	496.0*	486.6	486.6	496.0*	
Check	496.0*	486.5	486.5	496.0*	

* Should be equal to the corresponding bottom of abutment cap elevation.

Scour loss shall be accounted for in the pier pile capacity design calculations. The design event shall be considered for the Strength Limit State and the check event shall be considered for the Extreme Event II Limit State.

3.5 Mining Activity

Reviewing the Illinois State Geological Survey (ISGS) "Directory of Coal Mines in Illinois" for Marion County, no mining activity is present at the bridge location. The closest mining activity is 8 miles south of the bridge location.

3.6 Liquefaction

A liquefaction analysis was performed using the IDOT Liquefaction Analysis spreadsheet. At the time of seismic event, the groundwater is assumed to be approximately at a depth of 11 feet below the existing ground surface. The results from the liquefaction analysis show no liquefaction concern within the subject soil profile for any of the borings; thus, liquefaction was not considered for the pile capacity tables below. See Appendix H for Liquefaction Analysis.

3.7 Lateral Load Analysis

The tables below provide soil parameters to structural engineer for lateral or displacement analysis of the foundations. The values were estimated based on the descriptions given in the soil boring logs. For soil conditions, full cohesion was used with a friction angle of 0 degrees for cohesive soils. No specific analyses were performed on the soil to determine the estimated parameters.

Table 3.4 –Soil Parameters for Lateral Load Analysis at North Abutment (SB-1)

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	c' (psf)	θ (deg.)	K (pci)	ε50
1	Medium Stiff Silty Clay Fill	494.1	120	1.5	0	300	0.007
2	Soft Clayey Silt Fill	491.6	115	1.1	0	100	0.01
3	Medium Stiff Sandy Clay Fill	489.1	120	1.1	0	300	0.007
4	Stiff Shaley Clay	486.6	125	1.1	0	300	0.007
5	Stiff Clay	484.1	125	1.7	0	300	0.007
6	Medium Sandy Clay Till	479.1	120	1.7	0	300	0.007
7	Medium Stiff Sandy Clay	474.1	120	0.8	0	300	0.007
8	Sandy Clay Till	458.6	125	1.2	0	300	0.007
9	Moderately Hard Shale	---	130	0	45	---	0.001

Table 3.5 –Soil Parameters for Lateral Load Analysis at Pier 1 (SB-2)

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	c' (psf)	θ (deg.)	K (pci)	ε50
1	Medium Stiff Silty Clay Fill	493.8	120	1.5	0	300	0.007
2	Soft Clayey Silt Fill	491.3	115	0.1	0	100	0.01
3	Medium Stiff Sandy Clay Fill	489.8	120	0.1	0	300	0.007
4	Medium Dense Sand Fill	488.3	120	0	30	100	---
5	Stiff Shaley Clay	484.8	120	1.2	0	300	0.007
6	Medium Dense Sand	483.8	120	0	30	100	---
7	Medium Stiff Sandy Clay Till	459.8	120	0.5	0	300	0.007
8	Moderately Hard Shale	---	130	0	45	---	0.001

Table 3.6 –Soil Parameters for Lateral Load Analysis at Pier 2 (SB-3)

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	c' (psf)	θ (deg.)	K (pci)	ε50
1	Silty Clay Fill	494.8	120	0.4	0	300	0.007
2	Medium Stiff Clay Fill	491.8	120	1.0	0	300	0.007
3	Soft Sandy Clay	486.8	115	0.6	0	100	0.01
4	Medium Stiff Sandy Clay Till	468.8	120	0.9	0	300	0.007
5	Stiff Clay	463.8	125	1.9	0	300	0.007
6	Sandy Clay	458.8	125	1.8	0	300	0.007
7	Moderately Hard Shale	---	130	0	45	---	0.001

Table 3.7 –Soil Parameters for Lateral Load Analysis at South Abutment (SB-4)

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	c' (psf)	θ (deg.)	K (pci)	ε50
1	Medium Stiff Silty Clay Fill	494.5	120	2.5	0	300	0.007
2	Medium Stiff Sandy Clay Fill	491.0	120	2.5	0	300	0.007
3	Soft Sandy Clay	486.0	115	0.5	0	100	0.01
4	Medium Stiff Sandy Clay Till	478.0	120	2.5	0	300	0.007
5	Medium Dense Sand	477.0	120	0	30	100	---
6	Stiff Sandy Clay Till	475.5	125	4.5	0	300	0.007
7	Medium Dense Sand	474.5	120	0	30	100	---
8	Stiff Sandy Clay Till	468.5	125	4.5	0	300	0.007
9	Medium Stiff Clay	463.5	120	2.5	0	300	0.007
10	Dense Clayey Sand	459.0	125	0	40	100	---
11	Moderately Hard Shale	---	130	0	45	---	0.001

4.0 Foundation Recommendations

4.1 Abutments

Preliminary superstructure loads for the proposed structure configuration discussed above were provided by ESCA Consultants, Inc. See tables below for total factored loads at each substructure. These loads include the approach slab and abutment self-weight.

Table 4.1 –Abutment Loads

Location	Total Factored Reaction (k)
N. Abut.	900
S. Abut.	900

Integral abutments are preferred to eliminate joints in the bridge decks, decreasing maintenance costs and increasing service life. The results of the preliminary Integral Abutment Feasibility Analysis show integral abutments are applicable. See Appendix I for analysis. The designer shall

verify integral abutment feasibility analysis with final configuration. See IDOT Bridge Manual 3.8.3 for further integral abutment design guidance.

Foundation type for integral abutments shall be pile supported with a pile placed under each beam. Due to the presence of shale at the subject site and H-piles being most effective in point bearing applications, H-piles are recommended over metal shell piles.

The tables below summarize the nominal required bearing (R_N), factored resistance available (R_F), estimated pile length and estimated pile tip elevation for the strength limit state. R_N indicates the resistance of the pile during driving, which assists the Contractor from causing damage to the pile. R_F represents the net long term axial geotechnical resistance available to support the factored structure loads. The estimated pile lengths include a 2-foot embedment into the abutment. Analyses have been performed using the IDOT Static Method of Estimating Pile Length. See Appendix J.

The factored resistance available values shown in the tables are intended to provide the designer with a range of feasible options for the anticipated vertical loading. Piles shall be evaluated for lateral resistance in final design.

Table 4.2 – H-Pile Capacity at North Abutment (SB-1) – Strength Limit State

Pile Type	Max Nominal Required Bearing, R_N (kips)	Factored Resistance Available, R_F (kips)	Estimate Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x63	497	249	44	454.0
HP 14x73	578	289	44	454.0
HP 14x89	705	388	46	452.0

Table 4.3 – H-Pile Capacity at South Abutment (SB-4) – Strength Limit State

Pile Type	Max Nominal Required Bearing, R_N (kips)	Factored Resistance Available, R_F (kips)	Estimate Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x63	497	273	43	455.0
HP 14x73	578	318	43	455.0
HP 14x89	705	388	45	453.0

The designer shall note the actual factored resistance may be larger than shown in the tables above and be aware of this value's relation to the maximum nominal required bearing of the final pile selected.

One test pile is recommended at each abutment location. Due to the presence of moderately hard shale, pile shoes are recommended.

4.2 Piers

Preliminary superstructure loads for the proposed structure configuration discussed above were provided by ESCA Consultants, Inc. See tables below for total factored loads at each substructure.

Table 4.4 – Pier Loads

Location	Total Factored Reaction (k)
Pier 1	1,300
Pier 2	1,300

Pile-supported bent piers are recommended for this structure as driven piles appear to be the most efficient pier foundation type. In addition, driven piles are recommended at the abutments so pile driving equipment will already be mobilized. Similar to the abutments, H-piles are recommended over metal shell piles due to the presence of shale.

The tables below summarize the nominal required bearing (R_N), factored resistance available (R_F), estimated pile length and estimated pile tip elevation. R_N indicates the resistance of the pile during driving, which assists the Contractor from causing damage to the pile. R_F represents the net long term axial geotechnical resistance available to support the factored structure loads. The estimated pile lengths include a 1-foot embedment into the pier cap. Analysis has been performed using the IDOT Static Method of Estimating Pile Length. See Appendix J.

The piles shown in the tables below match the recommended abutment pile options. The factored resistance available values shown in the tables are intended to provide the designer with a range of feasible options for the anticipated vertical loading. Piles shall be evaluated for lateral resistance in final design.

Table 4.5 – H-Pile Capacity at Pier 1 (SB-2) – Strength Limit State

Pile Type	Max Nominal Required Bearing, R_N (kips)	Factored Resistance Available, R_F (kips)	Estimate Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x63	497	273	45	453.5
HP 14x73	578	318	44	454.5
HP 14x89	705	388	46	452.5

Table 4.6 – H-Pile Capacity at Pier 2 (SB-3) – Strength Limit State

Pile Type	Max Nominal Required Bearing, R_N (kips)	Factored Resistance Available, R_F (kips)	Estimate Pile Length (ft.)	Estimated Pile Tip Elevation (ft.)
HP 12x63	497	273	45	453.5
HP 14x73	578	318	45	453.5
HP 14x89	705	388	47	451.5

Per scour discussion herein, the design and check scour events were considered in the pile design for their respective load combinations. Though, the difference in pile capacity between events was negligible. Thus, the pier pile tables above conservatively assume the check event for the Strength Limit State.

One test pile is recommended at each pier location. Pile shoes are recommended when driving into moderately hard shale.

5.0 Construction Considerations

5.1 Construction Activities

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

5.2 Temporary Shoring

Due to US Route 51 being closed during construction, temporary shoring will not be required to construct the abutments. At the piers, Type 1 Cofferdams will be required during construction with less than 6 feet of water anticipated above the bottom of the pier.

5.3 Foundation Construction

Conventional pile driving equipment and methodologies shall be assumed.

5.4 Excavation

Excavation shall be performed in accordance with IDOT Standard Specifications Section 202. Substructure construction shall occur after removal of the existing structure is complete.

A Joint Utility Locating Information for Excavators (J.U.L.I.E.) locate shall be performed prior to commencing construction activities to determine underground utilities within the project limits. In addition, IDOT shall be contacted to locate private utilities.

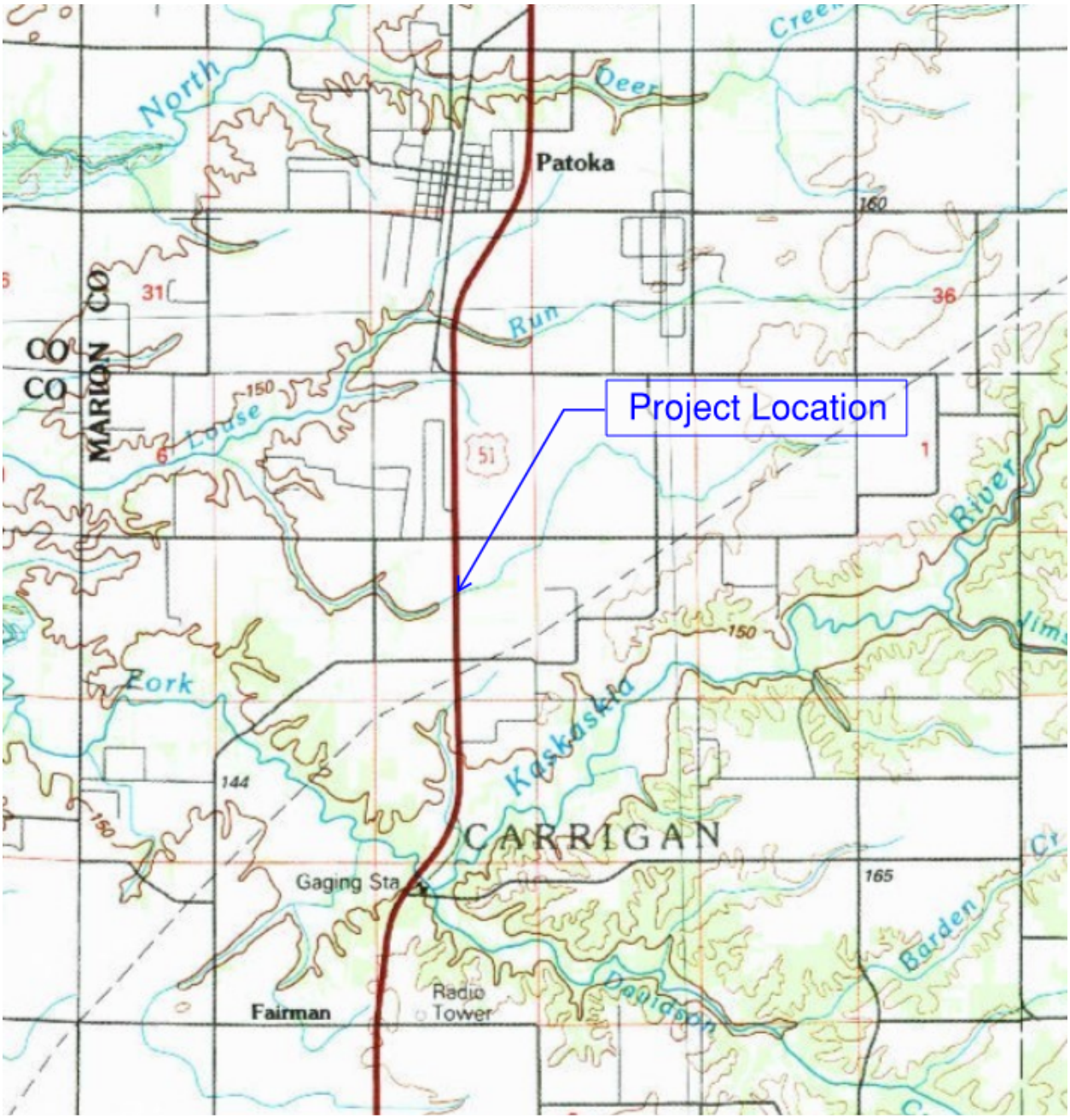
At foundation and structural fill locations, the exposed subgrade shall be proof rolled to aid in locating any unstable and unsuitable materials. Unstable and unsuitable materials shall be removed and replaced with compacted structural fill.

6.0 Limitations

The analysis and discussion provided herein are for the exclusive use of IDOT District 8 and its structural consultant. The recommendations in the report are based upon the subsurface data obtained at four (4) soil boring locations within the bridge area and are specific to the project described, our understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. This report may not reflect all the variations that may occur between boring locations. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

Appendix A

Location Map



Location Map

US 51 over Louse Run Tributary

Proposed SN 061-0095

Marion County

Appendix B

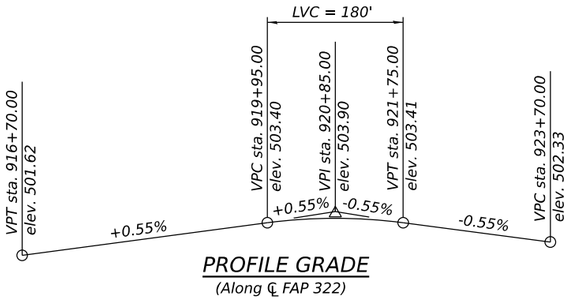
Type, Size, and Location Plan (TS&L)

BENCHMARK:
BM 734 – Cut square on top of the northeast wingwall of SN 061-0003, sta. 920+70.8, 24.0' left, elev. 497.863 (NAVD 88).

EXISTING STRUCTURE:
SN 061-0003 was originally constructed in 1920 as SBI Route 2, Section 26. It was widened in 1958 under SBI Route 2, Section 26BY. The bridge is a single-span reinforced concrete slab supported by closed reinforced concrete abutments on spread footings. The bridge is 26'-0" long back-to-back abutments. The out-to-out width of superstructure is 46'-4". The bridge is not skewed. US Route 51 will be closed during construction, and traffic will be detoured.

Excavation behind existing abutment walls shall be performed to balance front and back soil pressure before removing the existing superstructure.

No salvage.



PROFILE GRADE
(Along ℄ FAP 322)

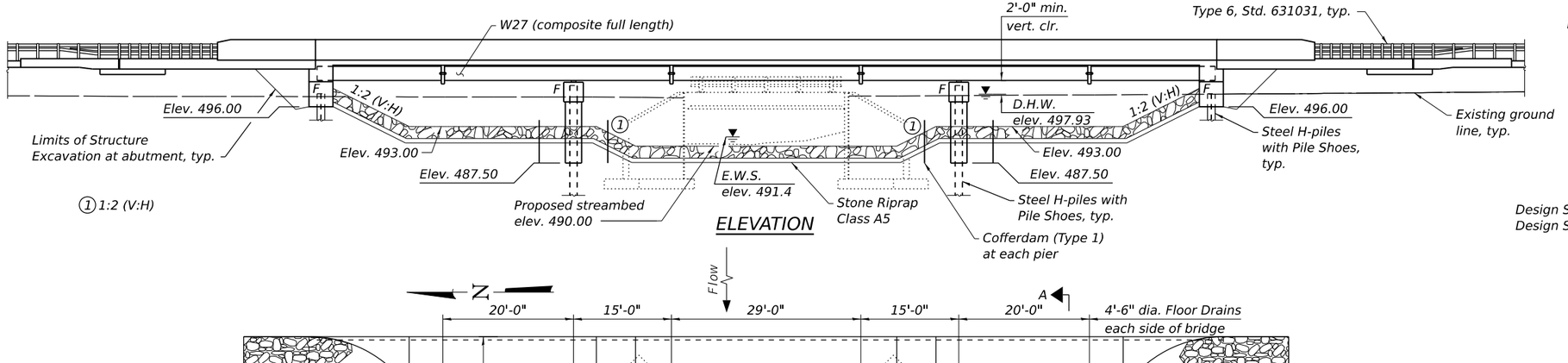
LOADING HL-93
Allow 50 psf for future wearing surface

DESIGN STRESSES
FIELD UNITS
f'c = 3,500 psi (substructure)
f'c = 4,000 psi (superstructure)
fy = 50,000 psi (AASHTO M270, Grade 50), all structural steel shall be painted
fy = 60,000 psi (reinforcement)

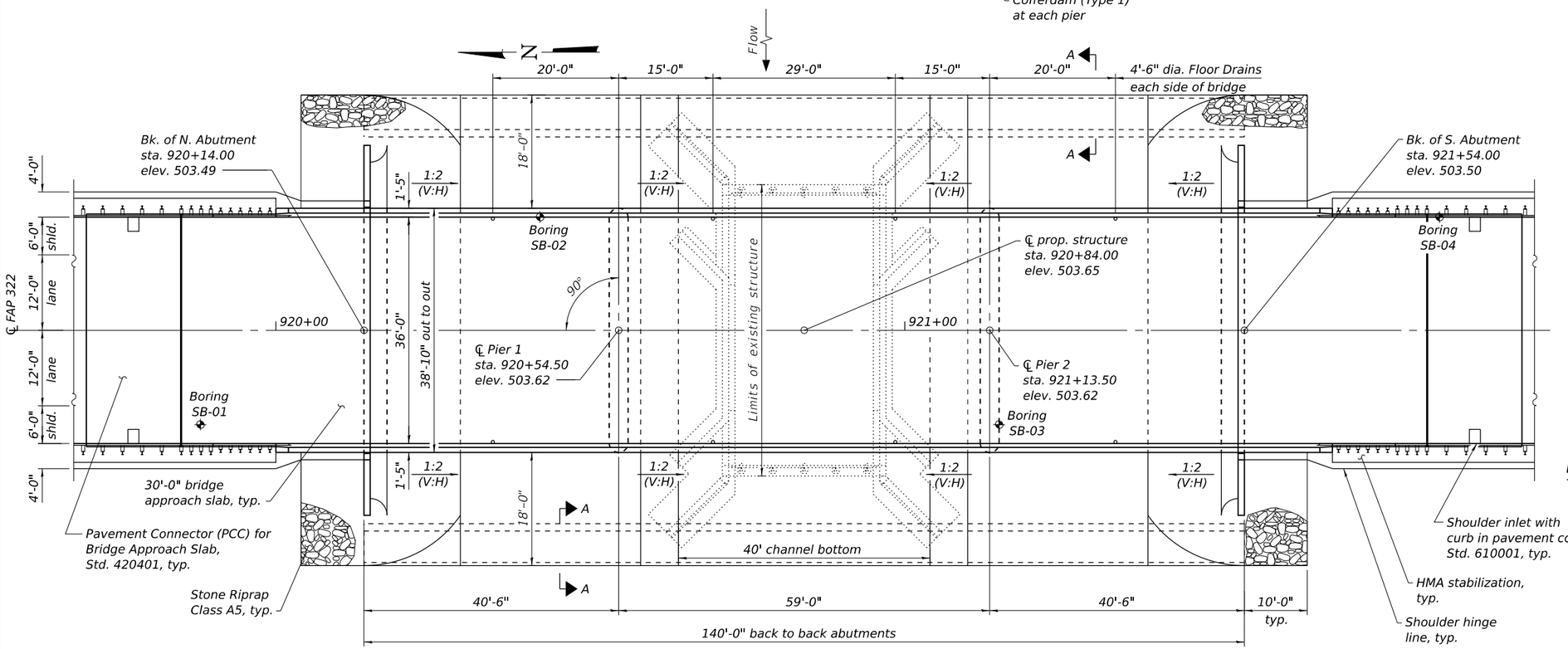
DESIGN SPECIFICATIONS
2020 AASHTO LRFD
Bridge Design Specifications, 9th Edition

HIGHWAY CLASSIFICATION
FAP 322 (US 51)
Functional Class: Other Principal Arterial
ADT: 3163(2024) / 3659(2044)
ADTT: 443(2024) / 512(2044)
DHV: 365(2044)
Design Speed: 55 mph
Posted Speed: 55 mph
Two-Way Traffic
Directional Distribution: 50:50

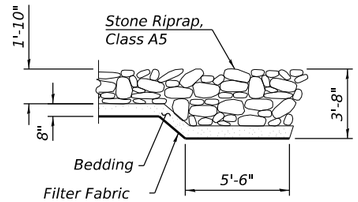
SEISMIC DATA
Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.182 g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.477 g
Soil Site Class = C



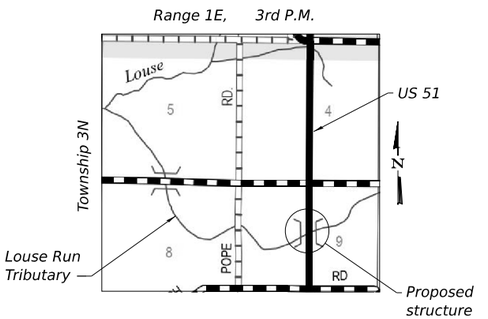
ELEVATION



PLAN



SECTION A-A



LOCATION SKETCH

GENERAL PLAN & ELEVATION
US 51 OVER LOUSE RUN TRIBUTARY
FAP ROUTE 322 – SECTION 26BR
MARION COUNTY
STATION 920+84.00
STRUCTURE NO. 061-0095

MODEL: PLOT
FILE NAME: Y:\IDOT\1406-01-76842\CADD\TSL\061O095-76842-TSL-1.dgn
5/22/2024 9:08:01 AM

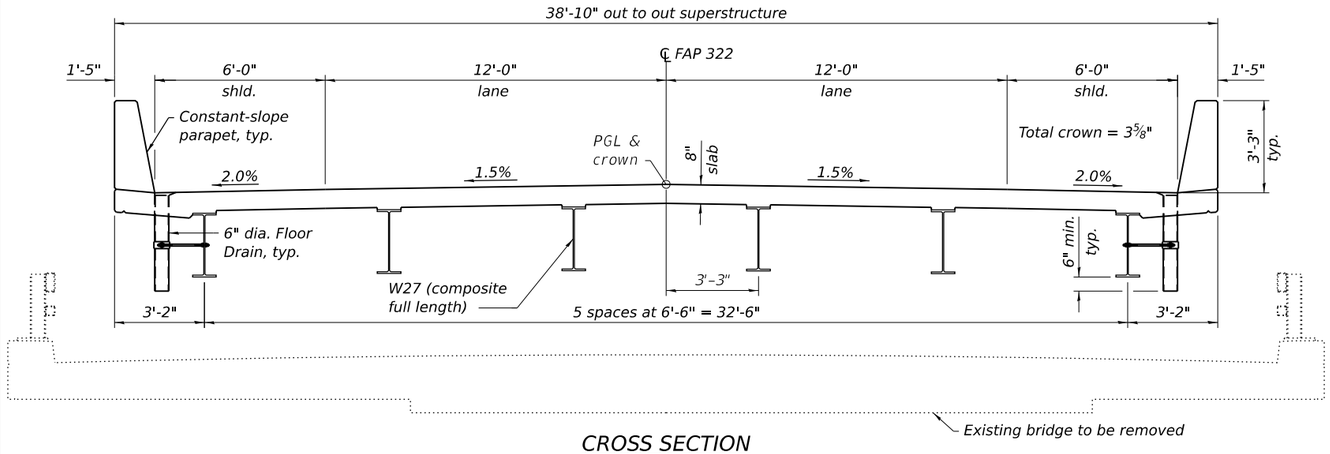
ESCA CONSULTANTS, INC.

USER NAME = nhc	DESIGNED - ELH 02/24	REVISED -
ESCA PROJECT NO.= 1406.01	CHECKED - ELH 02/24	REVISED -
PLOT SCALE = 0:2 ':' / in.	DRAWN - NHC 02/24	REVISED -
PLOT DATE = 5/22/2024	CHECKED - ELH 02/24	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

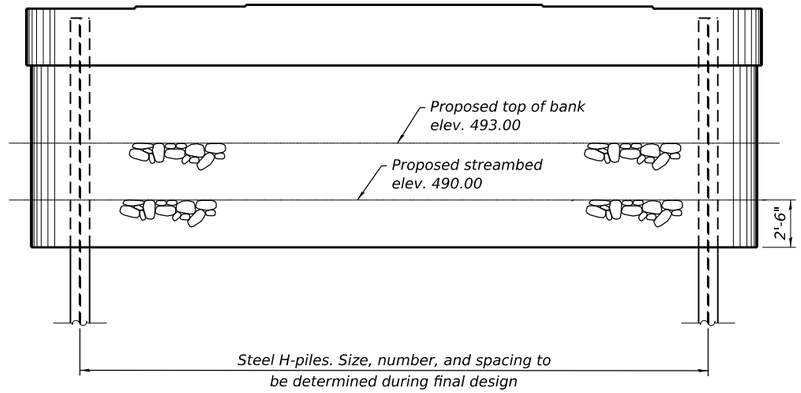
SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
322	26BR	MARION		
		CONTRACT NO. 76B42		
	ILLINOIS	FED. AID PROJECT		

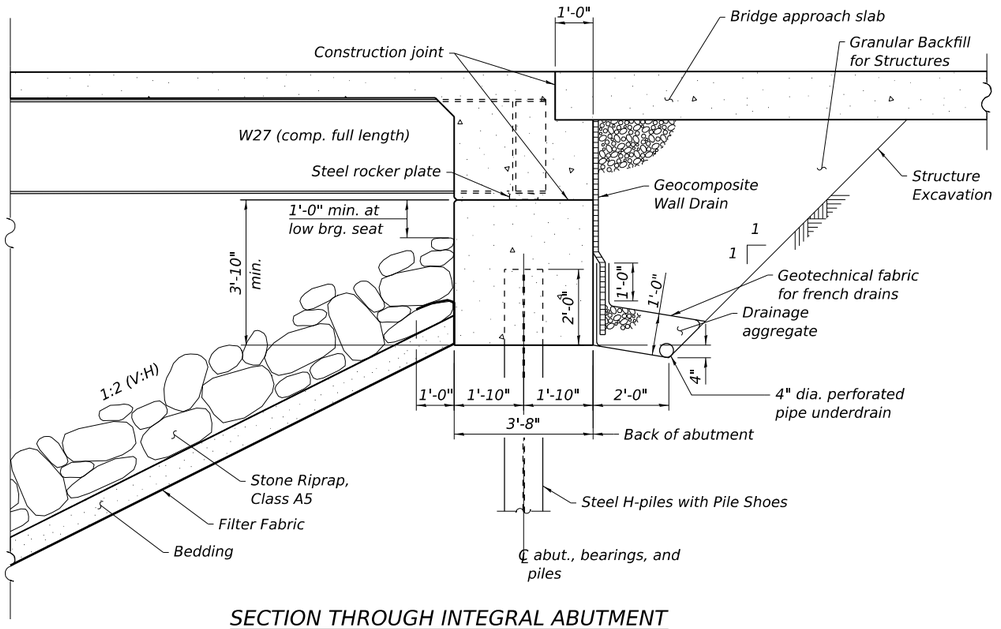


CROSS SECTION

(Looking South)



PIER SKETCH



SECTION THROUGH INTEGRAL ABUTMENT

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				Item 113
	N. Abut.	Pier 1	Pier 2	S. Abut.	
Q100	496.0	486.6	486.6	496.0	5
Q200	496.0	486.5	486.5	496.0	
Design	496.0	486.6	486.6	496.0	
Check	496.0	486.5	486.5	496.0	

WATERWAY INFORMATION

Drainage Area = 3.03 sq. mi.

Existing Overtopping Elev. 497.53 at Sta. 920+58.10
Proposed Overtopping Elev. 501.39 at Sta. 916+00.00

Flood	Freq. Yr.	Discharge (c.f.s.)	Waterway Opening (sq. ft.)		Natural H.W.E. (ft.)	Head (ft.)		Headwater Elevation (ft.)	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
	10	791	124	602	496.93	1.09	0.15	498.02	497.08
Design	50	1,280	124	730	497.93	0.66	0.19	498.59	498.12
Base	100	1,490	124	775	498.27	0.53	0.22	498.80	498.49
Scour Design Check	200	1,750	124	817	498.59	0.39	0.23	498.98	498.82
Overtop Existing	7	680	124	566	496.64	0.88	0.13	497.52	496.77
Max. Calc.	500	2,020	124	870	498.99	0.22	0.26	499.21	499.25

10-year velocity through existing bridge = 5.94 ft/s
10-year velocity through proposed bridge = 1.31 ft/s

DETAILS
US 51 OVER LOUSE RUN TRIBUTARY
FAP ROUTE 322 – SECTION 26BR
MARION COUNTY
STATION 920+84.00
STRUCTURE NO. 061-0095

MODEL: PLOT
FILE NAME: Y:\IDOT\1406-01-76842\CADD\TSL\0610095-76842-TSL-2.dgn
5/22/2024 10:58:31 AM

ESCA CONSULTANTS, INC. CIVIL & STRUCTURAL ENGINEERS

USER NAME = nhc	DESIGNED - ELH 05/24	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	SHEET 2 OF 2 SHEETS
ESCA PROJECT NO.= 1406.01	CHECKED - ELH 05/24	REVISED -		
PLOT SCALE = 0:2 ':" / in.	DRAWN - NHC 05/24	REVISED -		
PLOT DATE = 5/22/2024	CHECKED - ELH 05/24	REVISED -		

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	26BR	MARION		
		CONTRACT NO. 76B42		
	ILLINOIS	FED. AID PROJECT		

Appendix C

Subsurface Data Profile Plot

Boring SB-01
STA 919+88
OFFSET 15 FT RT CL
EL 497.10 FT
2/28/2022

	D	N	Qu	W%
GRAVEL FILL: 3" 496.9		–	–	–
SILTY CLAY FILL: Brown, medium stiff 494.1		4	1.5 P	29
CLAYEY SILT FILL: Gray, soft, moist 491.6	5	6	1.1 B	22
SANDY CLAY FILL: Brown, medium stiff 489.1		7	1.1 B	19
SHALEY CLAY: Brown, stiff, moist 486.6	10	7	1.1 B	14
CLAY: Brown, stiff, wet 484.1		11	1.7 B	12
SANDY CLAY TILL: Gray, medium stiff	15	16	1.7 B	11
479.1		13	1.8 B	14
SANDY CLAY: Gray, medium stiff	20	13	1.1 B	14
474.1		13	0.8 S	13
SANDY CLAY TILL: Gray	25	17	4.8 B	12
		14	1.2 B	12
	30	16	1.3 B	12
	35	–	–	–
458.6		29	1.3 B	19
SHALE: Gray, moderately hard	40	–	–	–
453.6		50/1"	0.9 S	16
SHALE: Greenish-gray, soft 452.1	45	50/1"	–	–

End of Boring

Boring SB-02
STA 920+42
OFFSET 18 FT LT CL
EL 496.80 FT
2/23/2022

	D	N	Qu	W%
GRAVEL FILL: 2" 496.6		–	–	–
SILTY CLAY FILL: Brown, medium stiff 493.8		4	1.5 P	27
CLAYEY SILT FILL: Gray, soft 491.3	5	3	0.1 B	29
SANDY CLAY FILL: Brown, medium stiff, moist 489.8		7	0.1 B	22
SAND FILL: Brown, coarse, medium dense 488.3	10	7	1.2 B	26
SHALEY CLAY: Brown, stiff, moist 484.8		15	0.5 B	17
SAND: Brown, medium coarse, medium dense, wet 483.8	15	9	1.3 B	13
SANDY CLAY TILL: Gray, medium stiff		14	2.4 B	11
	20	8	0.9 B	14
	25	8	1.3 B	18
		14	1.7 B	11
	30	14	0.5 B	13
		8	0.7 B	13
	35	–	–	–
459.8		12	1.1 B	13
SHALE: Greenish-gray, moderately hard to soft	40	–	–	–
		50/4"	–	9
451.8	45	50/3"	–	19

End of Boring

PR ℄ PROFILE

Boring SB-03
STA 921+15
OFFSET 15 FT RT CL
EL 497.30 FT
2/28/2022

	D	N	Qu	W%
GRAVEL FILL: 2" 497.1		–	–	–
SILTY CLAY FILL: Brown, with organics and rubble 494.8	5	4	0.4 B	21
CLAY FILL: Gray, with some rubble, medium stiff 491.8		6	1.0 B	20
SANDY CLAY: Brown, soft		5	0.7 B	16
486.8	10	6	0.6 B	16
SANDY CLAY TILL: Gray, medium stiff, wet		10	0.9 B	13
	15	10	1.1 B	14
		16	2.4 B	11
	20	20	4.4 B	11
		14	2.2 B	13
	25	10	1.5 B	15
468.8		25	1.3 B	14
CLAY: Grayish-blue, stiff, wet	30	13	1.9 B	14
463.8		–	–	–
SANDY CLAY: Grayish-blue	35	50/3"	1.8 B	19
458.8		–	–	–
SHALE: Gray, moderately hard, wet	40	25	–	17
		–	–	–
	45	86	–	15
447.3	50	50/2"	–	10

End of Boring

Boring SB-04
STA 921+85
OFFSET 18 FT LT CL
EL 497.50 FT
2/22/2022

EL	D	N	Qu	W%
GRAVEL FILL: 2" 497.3		–	–	–
SILTY CLAY FILL: Gray, with organics, medium stiff 494.5	5	11	2.5 P	20
SANDY CLAY FILL: Gray, medium stiff 491.0		5	2.5 P	22
SANDY CLAY: Brown, with some gravel, soft	10	3	0.8 P	20
486.0		4	0.5 P	13
SANDY CLAY TILL: Gray, medium stiff	15	13	2.5 P	13
		13	>4.5 P	12
478.0	20	16	3.5 P	12
SAND: Gray, coarse, medium dense with pieces of cherty limestone 477.0		29	3.5 P	12
SANDY CLAY TILL: Gray, stiff, wet 475.5	25	33	>4.5 P	11
SAND: Gray, fine, with some gravel, medium dense, wet 474.5		23	>4.5 P	12
SANDY CLAY TILL: Gray, stiff 468.5	30	34	>4.5 P	12
CLAY: Gray and blue, with some gravel, medium stiff, wet		18	2.5 P	11
463.5	35	–	–	–
CLAYEY SAND: Blue-gray, with gravel, dense, wet		50/5"	–	18
459.0		–	–	–
SHALE: Gray, moderately hard, wet	40	50/4"	–	16
453.5		50/1"	–	–

End of Boring

LEGEND

EL = Elevation (FT)
D = Depth Below Existing Ground Surface (FT)
N = SPT N-VALUE (AASHTO T206)
Qu = Unconfined Compressive Strength in tons per sq. ft. (tsf)
Failure Mode (B=bulge, S=shear, P=penetrometer)
W% = Moisture Content Percentage

▽ = Groundwater Level First Encountered

Soil profile is for illustrative purposes only. Actual conditions will vary.

SUBSURFACE DATA PROFILE
US 51 OVER LOUSE RUN TRIBUTARY
F.A.P. 322 - SECTION 26BR
MARION COUNTY
STATION 920+84.00
SN 061-0095

FILE NAME = X:\6XXX\62XX-63XX\6278 - PTB 207-41 D8 Bridge Bundle_ESCA\24-Structures\CAD\6278-Subsurface Data Profile.dgn	USER NAME = tziegler	DESIGNED - TAW	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
	PLOT SCALE = 2.0000 ' / in.	DRAWN - TAW	REVISED -	
Default	PLOT DATE = 10/4/2023	CHECKED - TJZ	REVISED -	
		DATE - 08/23/23	REVISED -	

SHEET 1 OF 1 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		MARION	1	1
	ILLINOIS	FED. AID PROJECT		

Appendix D

Soil Boring and Rock Core Logs

Illinois Department of Transportation
Division of Highways

SOIL BORING LOG

Date 2/28/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.716517°N, 89.095721°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-01
Station 919+88.00
Offset 15.0 ft RT
Ground Surface Elev. 497.10 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 486.1 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
496.9				GRAVEL FILL: 3"
	2			SILTY CLAY FILL: Brown, medium stiff
	2 2	1.5 P	29	
494.1				
	1			CLAYEY SILT FILL: Gray, soft, moist
	3 3	1.1 B	22	
-5				
491.6				
	1			SANDY CLAY FILL: Brown, medium stiff
	3 4	1.1 B	19	
489.1				
	1			SHALEY CLAY: Brown, stiff, moist
	3 4	1.1 B	14	
-10				
486.6				
▼	3			CLAY: Brown, stiff, wet
	5 6	1.7 B	12	
484.1				
	2			SANDY CLAY TILL: Gray, medium stiff
	8 8	1.7 B	11	
-15				
	3			
	5 8	1.8 B	14	
479.1				
	5			SANDY CLAY: Gray, medium stiff
	5 8	1.1 B	14	coal seam
-20				
	5			SANDY CLAY: Gray, medium stiff *(continued)*
	5			becomes stiff
	5 8	0.8 S	13	
474.1				
	5			SANDY CLAY TILL: Gray
	7 10	4.8 B	12	
-25				
	6			
	6 8	1.2 B	12	
	3			
	7 9	1.3 B	12	coal seam
-30				
	3			pocket of limestone, organics
	11 18	1.3 B	19	
-35				
458.6				
	13			SHALE: Gray, moderately hard
	30 50/1"	0.9 S	16	
-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 2/28/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.716517°N, 89.095721°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-01
Station 919+88.00
Offset 15.0 ft RT
Ground Surface Elev. 497.10 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 486.1 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SHALE: Gray, moderately hard *(continued)*				
453.6				
SHALE: Greenish-gray, soft [Poor Recovery]		50/1"		
452.1	-45			
End of Boring				
	-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

SOIL BORING LOG

Date 2/23/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.716358°N, 89.095606°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-02
Station 920+42.00
Offset 18.0 ft LT
Ground Surface Elev. 496.80 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 485.8 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
0				GRAVEL FILL: 2" (496.6)
	2			SILTY CLAY FILL: Brown, medium stiff
	2 2	1.5 P	27	
				(493.8)
	1			CLAYEY SILT FILL: Gray, soft
	1 2	0.1 B	29	
-5				(491.3)
	1			SANDY CLAY FILL: Brown, medium stiff, moist
	3 4	0.1 B	22	(489.8) SAND FILL: Brown, coarse, medium dense
				(488.3)
	1			SHALEY CLAY: Brown, stiff, moist
	3 4	1.2 B	26	
-10				▼
	5			
	8 7	0.5 B	17	(484.8) SAND: Brown, medium coarse, medium dense, wet
				(483.8)
	3			SANDY CLAY TILL: Gray, medium stiff
	4 5	1.3 B	13	
-15				
	5			becomes stiff
	5 9	2.4 B	11	
	2			becomes medium stiff
	3 5	0.9 B	14	
-20				
	2			SANDY CLAY TILL: Gray, medium stiff *(continued)*
	3 5	1.3 B	18	
	6			
	7 7	1.7 B	11	
-25				
	2			
	5 9	0.5 B	13	
	4			
	3 5	0.7 B	13	
-30				
	5			
	5 7	1.1 B	13	stiff, with 1/2" coal seams
-35				
				(459.8)
				SHALE: Greenish-gray, moderately hard to soft
	34			
	36 50/4"		9	
-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 2/23/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.716358°N, 89.095606°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-02
Station 920+42.00
Offset 18.0 ft LT
Ground Surface Elev. 496.80 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 485.8 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SHALE: Greenish-gray, moderately hard to soft *(continued)*				
[Poor Recovery]		50/3"		19
451.8	-45			
End of Boring				
	-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

SOIL BORING LOG

Date 2/28/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.716168°N, 89.095718°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-03
Station 921+15.00
Offset 15.0 ft RT
Ground Surface Elev. 497.30 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 486.8 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
497.1 GRAVEL FILL: 2"			
SILTY CLAY FILL: Brown, with organics and rubble	1		
	2 2	0.4 B	21
494.8 CLAY FILL: Gray, with some rubble, medium stiff			
	1		
	2 4	1.0 B	20
-5			
491.8 SANDY CLAY: Brown, soft			
	1		
	2 3	0.7 B	16
becomes gray and brown	1		
	2 4	0.6 B	16
-10			
1" sandy seam 486.8 ▼			
SANDY CLAY TILL: Gray, medium stiff, wet	4		
	4 6	0.9 B	13
	3		
	4 6	1.1 B	14
-15			
becomes stiffer	5		
	7 9	2.4 B	11
	8		
	9 11	4.4 B	11
2" sandy seam -20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SANDY CLAY TILL: Gray, medium stiff, wet *(continued)*	4		
	5 9	2.2 B	13
	3		
-25	4 6	1.5 B	15
becomes wet	3		
	8 17	1.3 B	14
468.8 CLAY: Grayish-blue, stiff, wet	4		
	5 8	1.9 B	14
-30			
463.8 SANDY CLAY: Grayish-blue	5		
	50/3"	1.8 B	19
-35			
458.8 SHALE: Gray, moderately hard, wet [Poor Recovery]	33		
	8 17		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 2/28/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.716168°N, 89.095718°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-03
Station 921+15.00
Offset 15.0 ft RT
Ground Surface Elev. 497.30 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 486.8 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SHALE: Gray, moderately hard, wet [Poor Recovery] *(continued)*				
becomes soft		9		
		36		15
	-45	50		
		50/2"		10
	447.3 -50			
End of Boring				
	-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

SOIL BORING LOG

Date 2/22/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.715967°N, 89.095603°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-04
Station 921+85.00
Offset 18.0 ft LT
Ground Surface Elev. 497.50 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 474.0 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
GRAVEL FILL - 2" 497.3				SAND: Gray, coarse, medium dense, with pieces of cherty limestone *(continued)* 477.0	9		
SILTY CLAY FILL: Gray, with organics, medium stiff	2			SANDY CLAY TILL: Gray, stiff, wet 475.5	14	>4.5	11
	5	2.5	20	SAND: Gray, fine, with some gravel, medium dense, wet 474.5	19	P	
494.5	6	P		SANDY CLAY TILL: Gray, stiff ▼			
SANDY CLAY FILL: Gray, medium stiff	1				6		
	2	2.5	22		11	>4.5	11
-5	3	P		-25	12	P	
with some gravel 491.0	0			no more organics	12		
SANDY CLAY: Brown, with some gravel, soft	1	0.8	20	6" gray, fine, medium dense sand seam	19	>4.5	12
	2	P		becomes hard, wet	15	P	
	1			468.5	6		
	1	0.5	13	CLAY: Gray and blue, with some gravel, medium stiff, wet	8	2.5	11
becomes gray and brown, moist	3	P			10	P	
-10				-30			
486.0	3						
SANDY CLAY TILL: Gray, medium stiff	5	2.5	13				
	8	P					
becomes stiff	3			463.5	25		
	5	>4.5	12	CLAYEY SAND: Blue-gray, with gravel, dense, wet	50/5"		18
-15	8	P		-35			
becomes medium stiff, with organics and wood pieces	3						
	5	3.5	12				
	11	P					
	4			459.0			
				SHALE: Gray, moderately hard, wet	12		
478.0	15	3.5	12		22		16
	14	P			50/4"		
-20				-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 2/22/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.715967°N, 89.095603°W

COUNTY Marion **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-04
Station 921+85.00
Offset 18.0 ft LT
Ground Surface Elev. 497.50 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 474.0 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
SHALE: Gray, moderately hard, wet *(continued)*				
[No Recovery] 453.5	50/1"			
Borehole continued with rock coring.				
-45				
-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 2/22/22

ROUTE FAP 322 (US 51) **DESCRIPTION** US 51 over Louse Run Creek **LOGGED BY** KEG

SECTION 26BR **LOCATION** 38.715967°N, 89.095603°W

COUNTY Marion **CORING METHOD** Split Barrel

STRUCT. NO. 061-0003
Station 920+84.00

BORING NO. SB-04
Station 921+85.00
Offset 18.0 ft LT
Ground Surface Elev. 497.50 ft

CORING BARREL TYPE & SIZE NQ
Core Diameter 2 in
Top of Rock Elev. 459.00 ft
Begin Core Elev. 453.50 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
SHALE: Gray, soft, highly weathered, wet	453.50	1	33	16	9.5	
	452.50 -45					
LIMESTONE: Gray, moderately hard	451.50					
SHALE: Gray, soft, highly weathered, wet	450.80	2	100	83	3	1028.0
LIMESTONE: Gray, moderately hard	449.50					
SANDSTONE: Gray, cemented	-50					
	446.50					
SHALE: Gray, moderately hard, weathered	444.00	3	100	83	2	341.0
SANDSTONE: Gray, cemented	-55					
	441.50					
SHALE: Gray, soft, weathered	-60	4	100	48	3.2	117.5
	436.50					
End of Boring						

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

ATTERBERG LIMITS RESULTS

Boring	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index
SB-1	1	35	23	12
	11	23	14	9
	21	23	14	9
SB-2	3.5	38	23	15
	8.5	49	23	26
	13.5	23	13	10
	28.5	25	15	10
SB-3	1	29	20	9
	28.5	30	14	16
SB-4	1	40	18	22
	28.5	29	16	13

Appendix E

Settlement Analysis

COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: North Abutment / Boring SB-01
TYPE OF SURCHARGE ========== 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) == 23.5 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ========== 120 PCF
- NEW EMBANKMENT FILL HEIGHT ========== 6 FT
- PROPOSED WIDTH AT TOP ========== 45 FT
- PROPOSED WIDTH AT BOTTOM ========== 81 FT (which is a 3.0:1 slope)

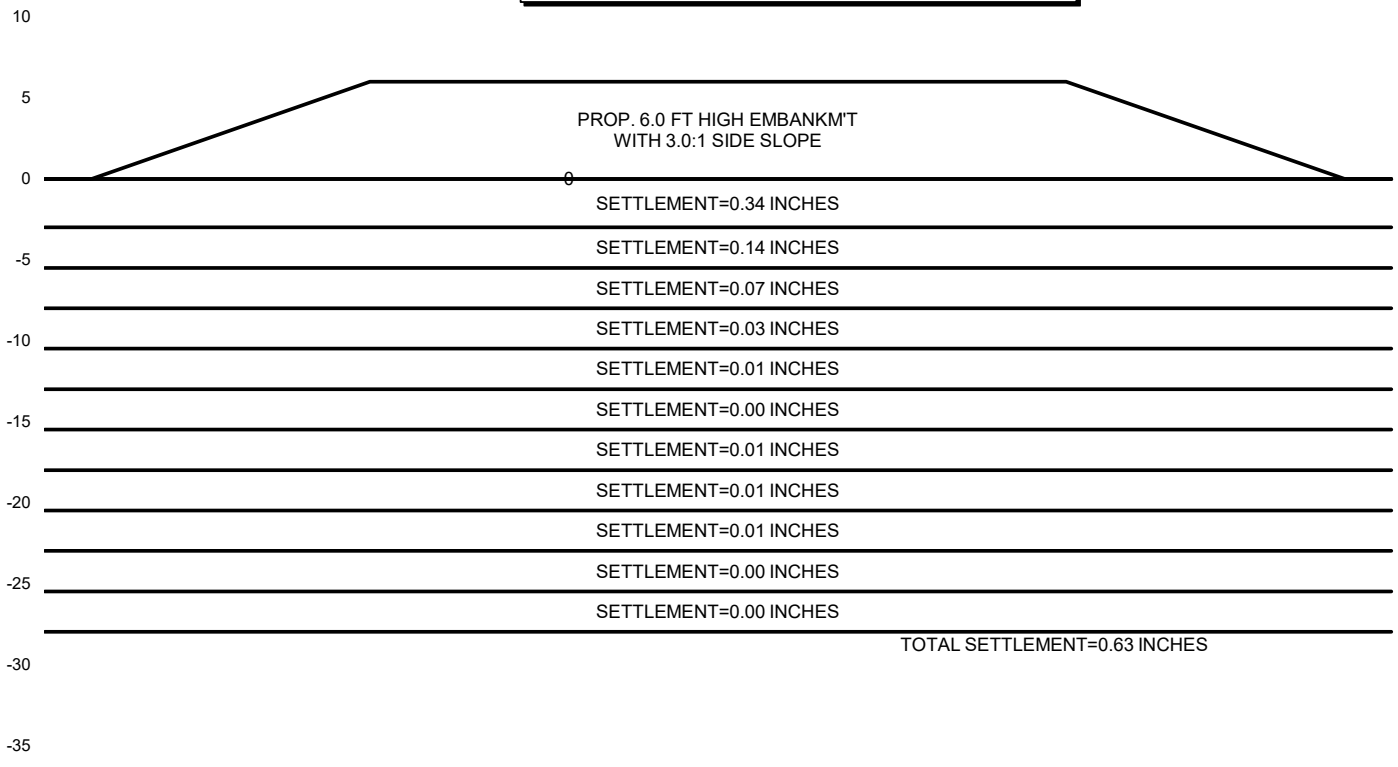
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ========== 120 PCF
- EXISTING EMBANKMENT HEIGHT ========== 0 FT
- EXISTING WIDTH AT TOP ========== 0 FT
- EXISTING WIDTH AT BASE ========== 0 FT (which is a 0.0:1 slope)

ASSUMPTIONS:
Soil Deposit is Normally Consolidated
Cohesive Layers are Saturated
Soils have a Low Sensitivity
Liquid Limit (LL)=Moist. Content (MC%)
Initial Void Ratio (Eo)=2.7*(MC%)/100
Comp. Index (Cc)=0.009*(LL-10)
Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
3.0	115	1.50	29	0.173	0.691	0.783	0.171	0.142	**0.34**
2.5	115	1.10	22	0.489	0.642	0.594	0.108	0.184	**0.14**
2.5	115	1.10	19	0.776	0.601	0.513	0.081	0.184	**0.07**
2.5	120	1.10	14	1.070	0.565	0.378	0.036	0.184	**0.03**
2.5	120	1.70	12	1.370	0.535	0.324	0.018	0.127	**0.01**
2.5	120	1.70	11	1.670	0.508	0.297	0.009	0.127	**0.00**
2.5	120	1.80	14	1.970	0.484	0.378	0.036	0.121	**0.01**
2.5	120	1.10	14	2.270	0.462	0.378	0.036	0.184	**0.01**
2.5	120	0.80	13	2.570	0.442	0.351	0.027	0.242	**0.01**
2.5	120	4.80	12	2.823	0.423	0.324	0.018	0.100	**0.00**
2.5	120	1.20	12	2.967	0.405	0.324	0.018	0.171	**0.00**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.63 IN.

EMBANKMENT AND SOIL PROFILE



COHESIVE SOIL SETTLEMENT ESTIMATE

LOCATION AND BORING USED ====: South Abutment / Boring SB-04
TYPE OF SURCHARGE ==========: 1 (1=2:1 bridge cone, 2=continuous embank., 3=rectangular surch.)
DEPTH TO WATER TABLE (below top of existing embankment) ==: 25.5 FT

NEW EMBANKMENT:
- NEW EMBANKMENT FILL UNIT WEIGHT ==========: 120 PCF
- NEW EMBANKMENT FILL HEIGHT ==========: 6 FT
- PROPOSED WIDTH AT TOP ==========: 45 FT
- PROPOSED WIDTH AT BOTTOM ==========: 81 FT (which is a 3.0:1 slope)

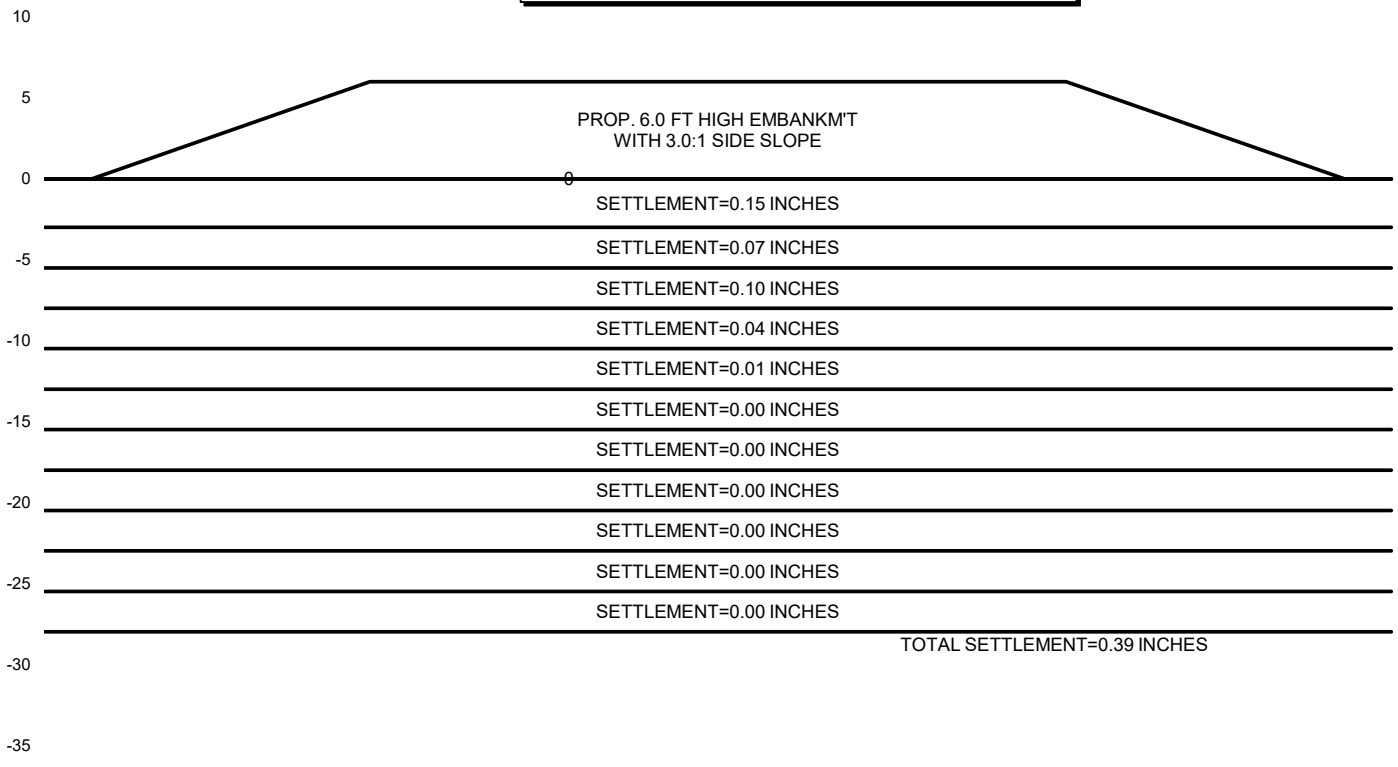
EXISTING EMBANKMENT (IF ANY):
- EXISTING EMBANKMENT UNIT WEIGHT ==========: 120 PCF
- EXISTING EMBANKMENT HEIGHT ==========: 0 FT
- EXISTING WIDTH AT TOP ==========: 0 FT
- EXISTING WIDTH AT BASE ==========: 0 FT (which is a 0.0:1 slope)

ASSUMPTIONS:
Soil Deposit is Normally Consolidated
Cohesive Layers are Saturated
Soils have a Low Sensitivity
Liquid Limit (LL)=Moist. Content (MC%)
Initial Void Ratio (Eo)=2.7*(MC%)/100
Comp. Index (Cc)=0.009*(LL-10)
Neglecting Granular & Secondary Settlem't

LAYER THICK (FT)	*TOTAL UNIT WT. (PCF)*	*UNCONF. COMP. STRENGTH (Qu) (TSF)*	*MOIST. CONTENT (%)*	*EXISTING PRESSURE (KSF)*	*PRESSURE INCREASE (KSF)*	*INITIAL VOID RATIO*	*COMPRESSION INDEX (Cc)*	*Qu CORRECTION FACTOR*	*LAYER SETTLEMENT (IN.)*
3.0	115	2.50	20	0.173	0.691	0.540	0.090	0.100	**0.15**
2.5	115	2.50	22	0.489	0.642	0.594	0.108	0.100	**0.07**
2.5	120	0.80	20	0.783	0.601	0.540	0.090	0.242	**0.10**
2.5	120	0.50	13	1.083	0.565	0.351	0.027	0.361	**0.04**
2.5	120	2.50	13	1.383	0.535	0.351	0.027	0.100	**0.01**
2.5	120	4.50	12	1.683	0.508	0.324	0.018	0.100	**0.00**
2.5	120	3.50	12	1.983	0.484	0.324	0.018	0.100	**0.00**
2.5	120	3.50	12	2.283	0.462	0.324	0.018	0.100	**0.00**
2.5	120	4.50	11	2.583	0.442	0.297	0.009	0.100	**0.00**
2.5	120	4.50	11	2.883	0.423	0.297	0.009	0.100	**0.00**
2.5	120	4.50	12	3.105	0.405	0.324	0.018	0.100	**0.00**

TOTAL SETTLEMENT UNDER CENTER OF BRIDGE CONE = 0.39 IN.

EMBANKMENT AND SOIL PROFILE



Appendix F

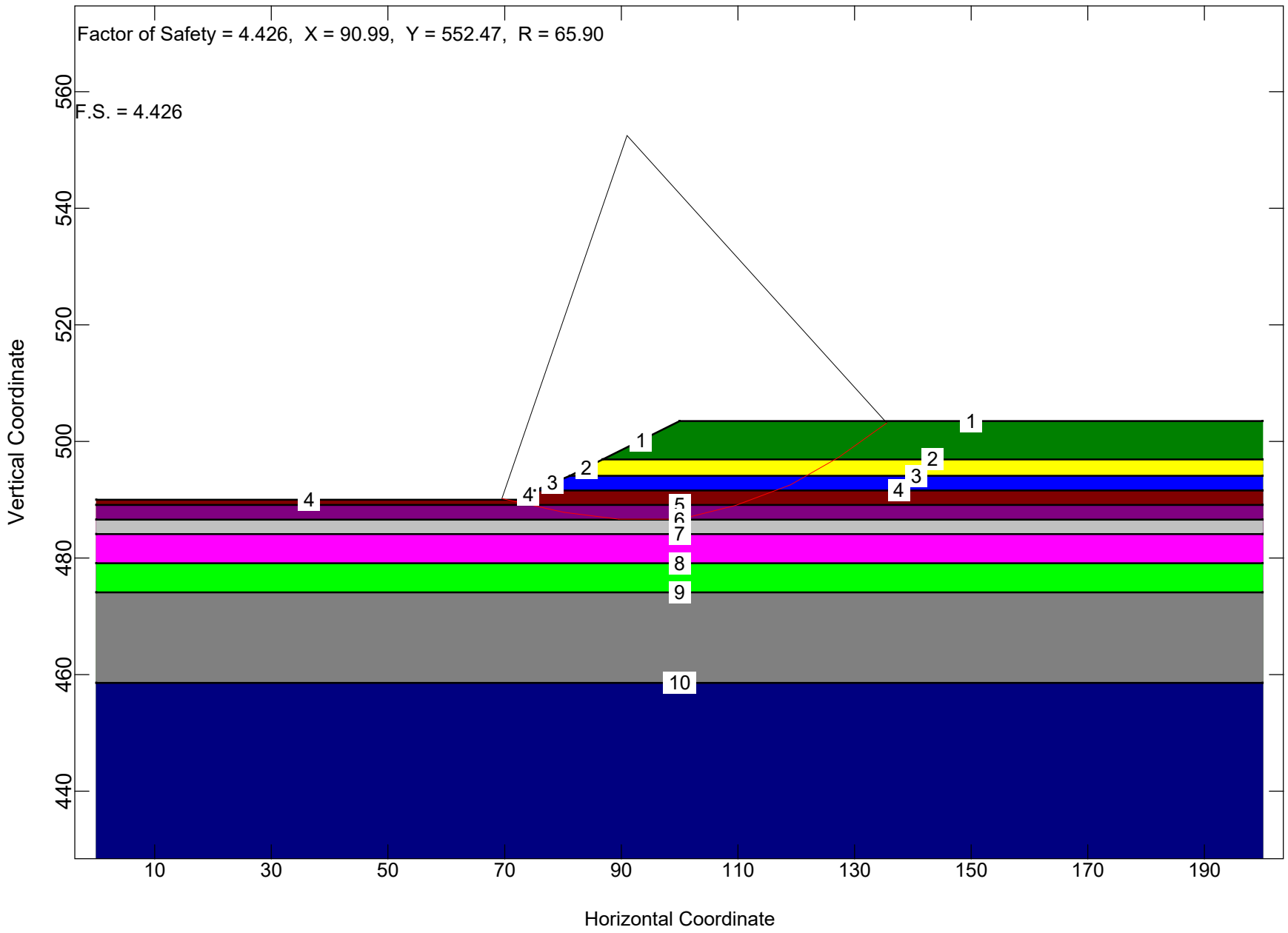
Slope Stability Analysis

Soil Parameters for Slope Stability Analysis

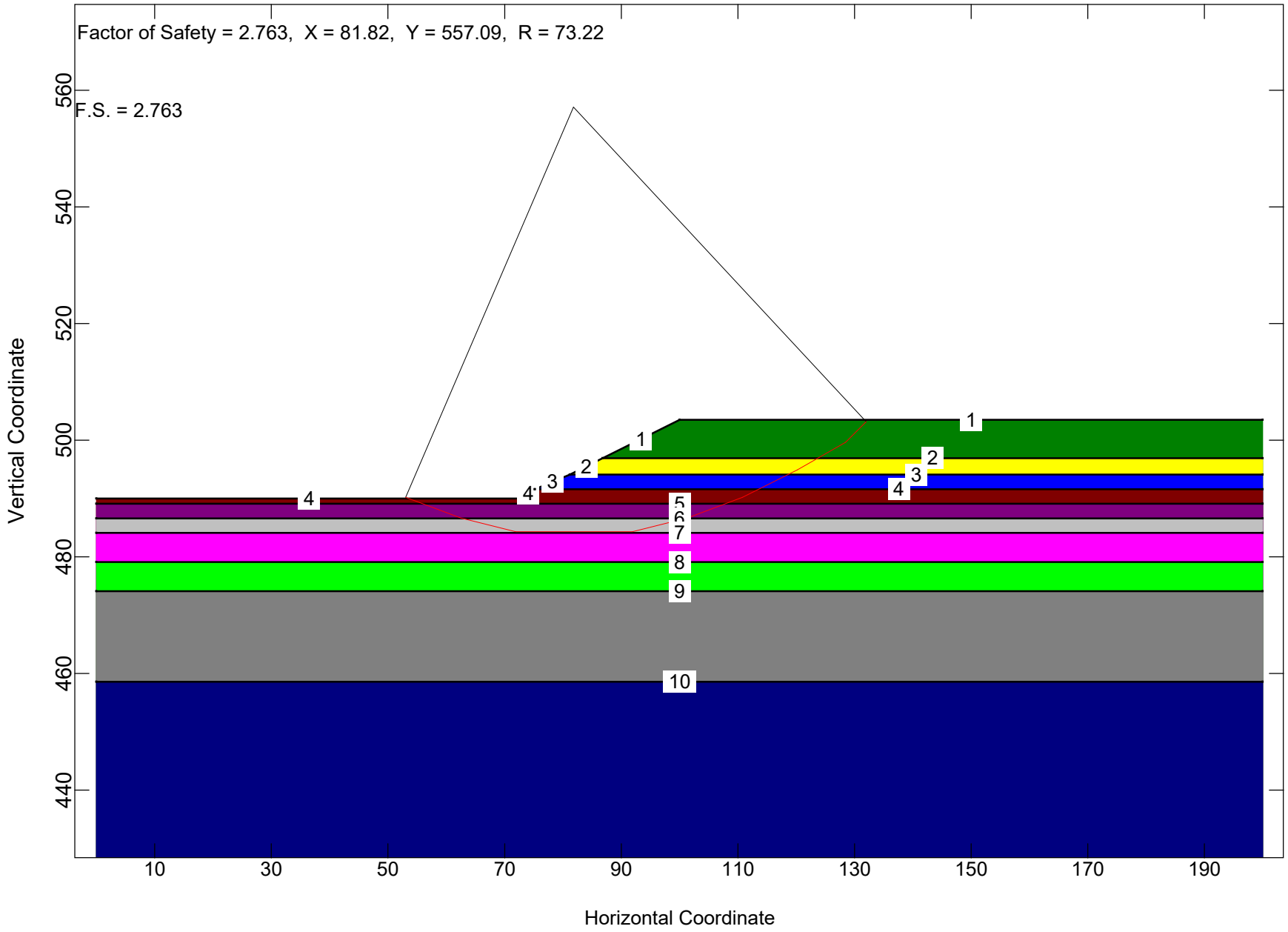
SN 061-0095 - North Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c'	θ	c'	θ
				(ksf)	(deg.)	(ksf)	(deg.)
1	Embankment	496.9	125	1.0	0	0.1	30
2	Medium Stiff Silty Clay Fill	494.1	120	1.5	0	0.1	28
3	Soft Clayey Silt Fill	491.6	115	1.1	0	0.1	26
4	Medium Stiff Sandy Clay Fill	489.1	120	1.1	0	0.1	28
5	Stiff Shaley Clay	486.6	125	1.1	0	0.1	28
6	Stiff Clay	484.1	125	1.7	0	0.1	28
7	Medium Sandy Clay Till	479.1	120	1.7	0	0.1	28
8	Medium Stiff Sandy Clay	474.1	120	0.8	0	0.1	28
9	Sandy Clay Till	458.6	125	1.2	0	0.1	28
10	Moderately Hard Shale	---	130	0	45	0	45

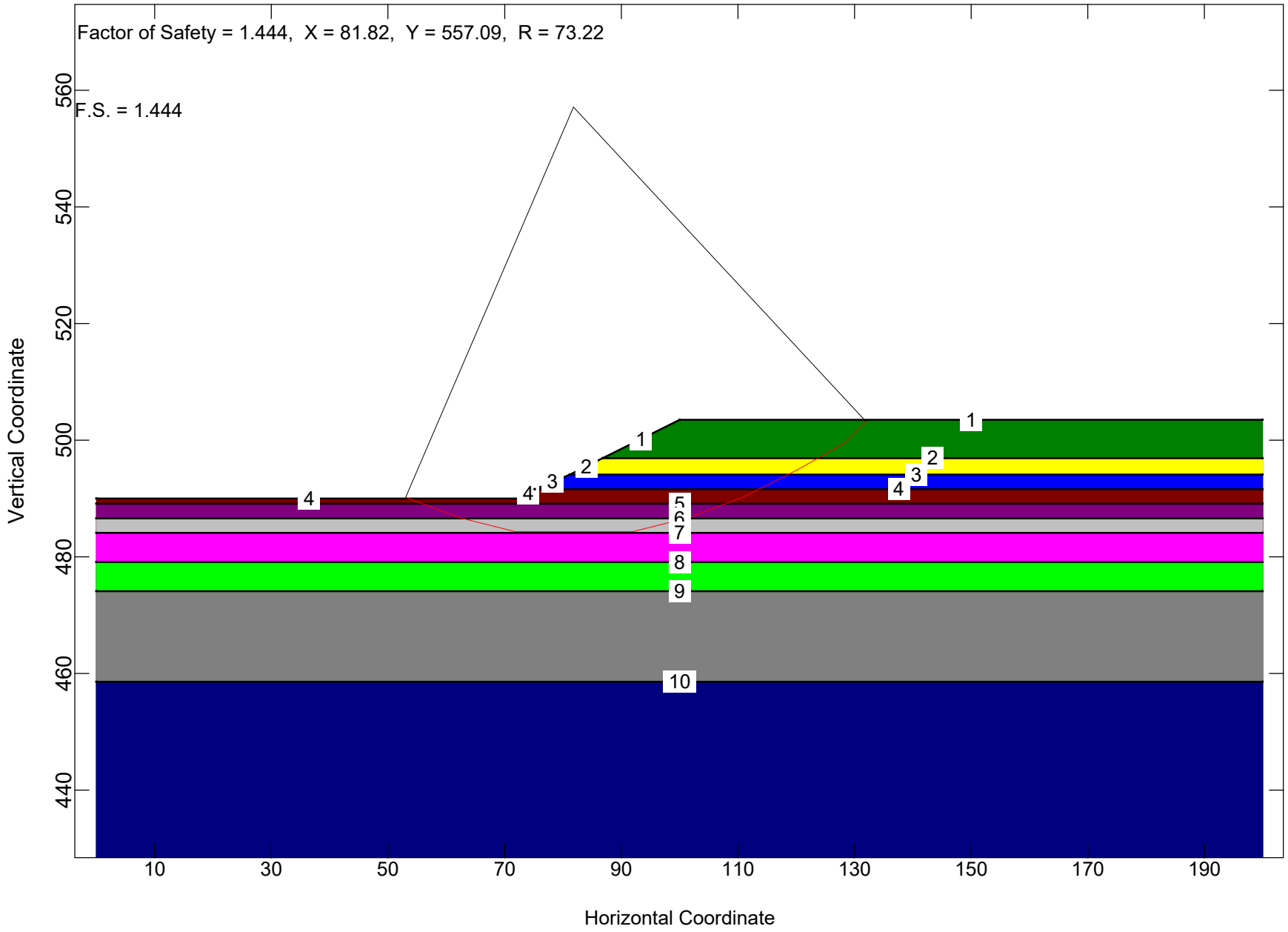
North Abutment
Short Term Strength



North Abutment
Long Term Strength



North Abutment
Seismic

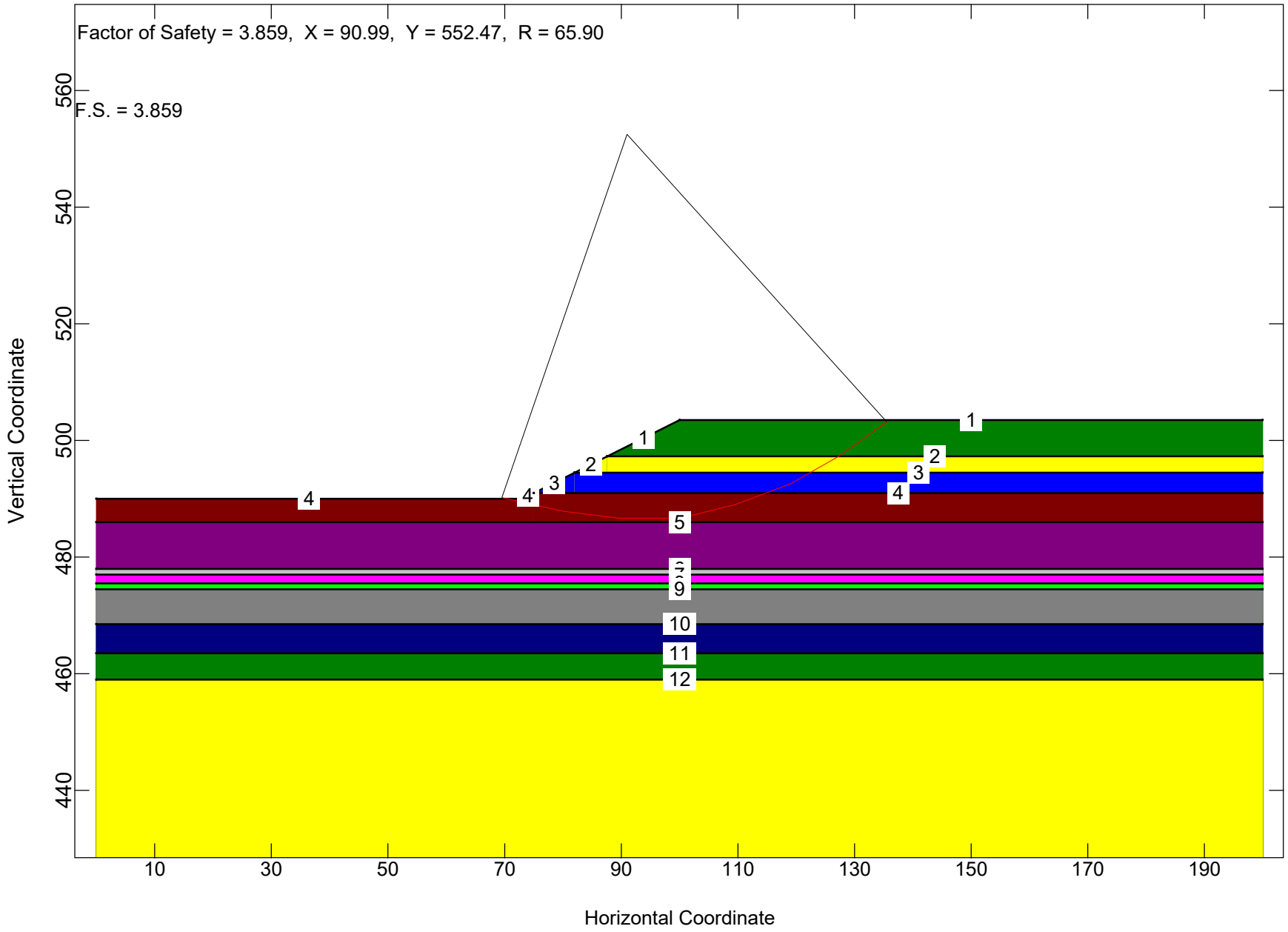


Soil Parameters for Slope Stability Analysis

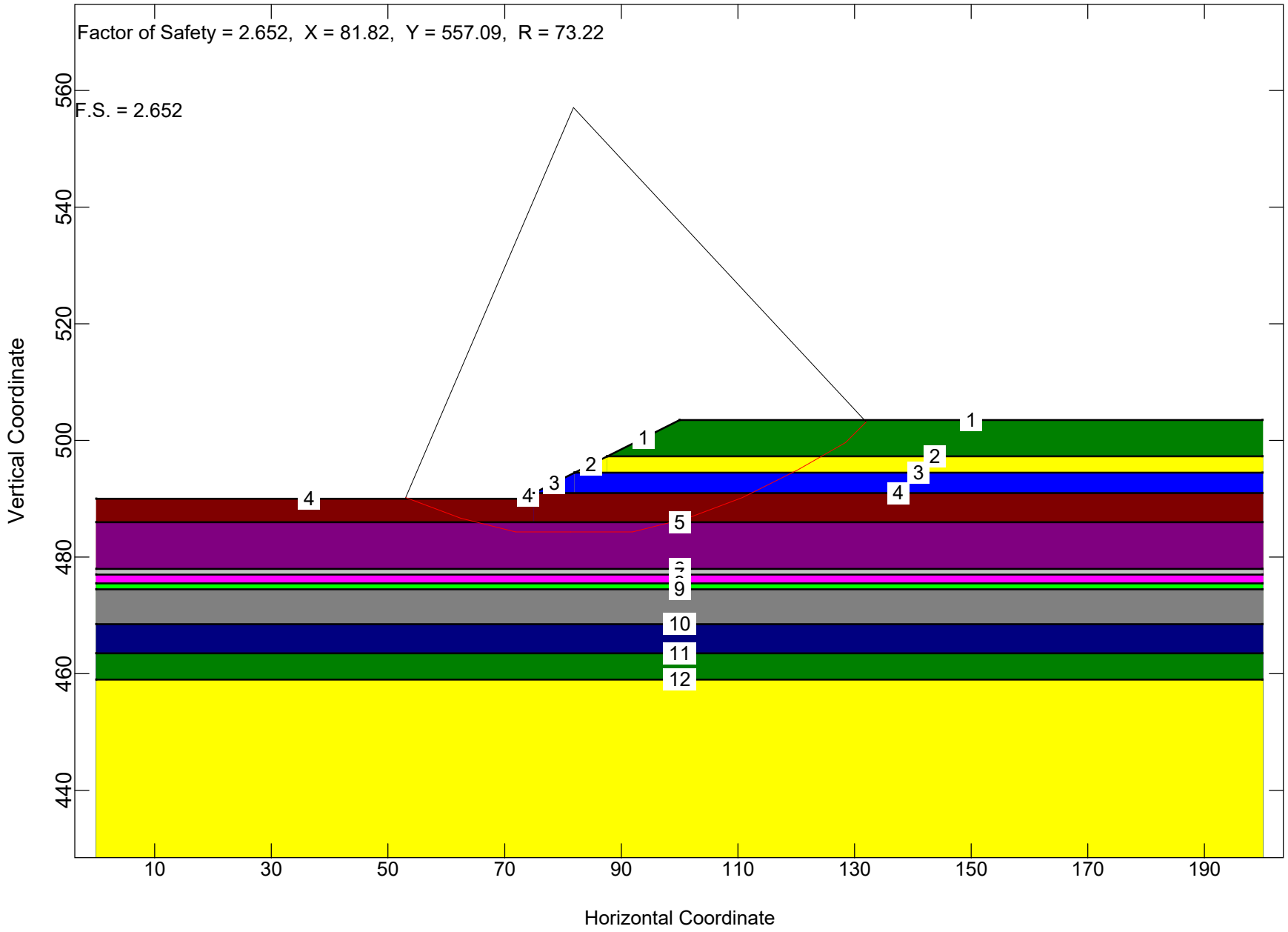
SN 061-0095 - South Abutment

Layer #	Soil Description	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term	
				c'	θ	c'	θ
				(ksf)	(deg.)	(ksf)	(deg.)
1	Embankment	497.3	125	1.0	0	0.1	30
2	Medium Stiff Silty Clay Fill	494.5	120	2.5	0	0.1	28
3	Medium Stiff Sandy Clay Fill	491.0	120	2.5	0	0.1	28
4	Soft Sandy Clay	486.0	115	0.5	0	0.1	26
5	Medium Stiff Sandy Clay Till	478.0	120	2.5	0	0.1	28
6	Medium Dense Sand	477.0	120	0	30	0	30
7	Stiff Sandy Clay Till	475.5	125	4.5	0	0.1	28
8	Medium Dense Sand	474.5	120	0	30	0	30
9	Stiff Sandy Clay Till	468.5	125	4.5	0	0.1	28
10	Medium Stiff Clay	463.5	120	2.5	0	0.1	28
11	Dense Clayey Sand	459.0	125	0	40	0	40
12	Moderately Hard Shale	---	130	0	45	0	45

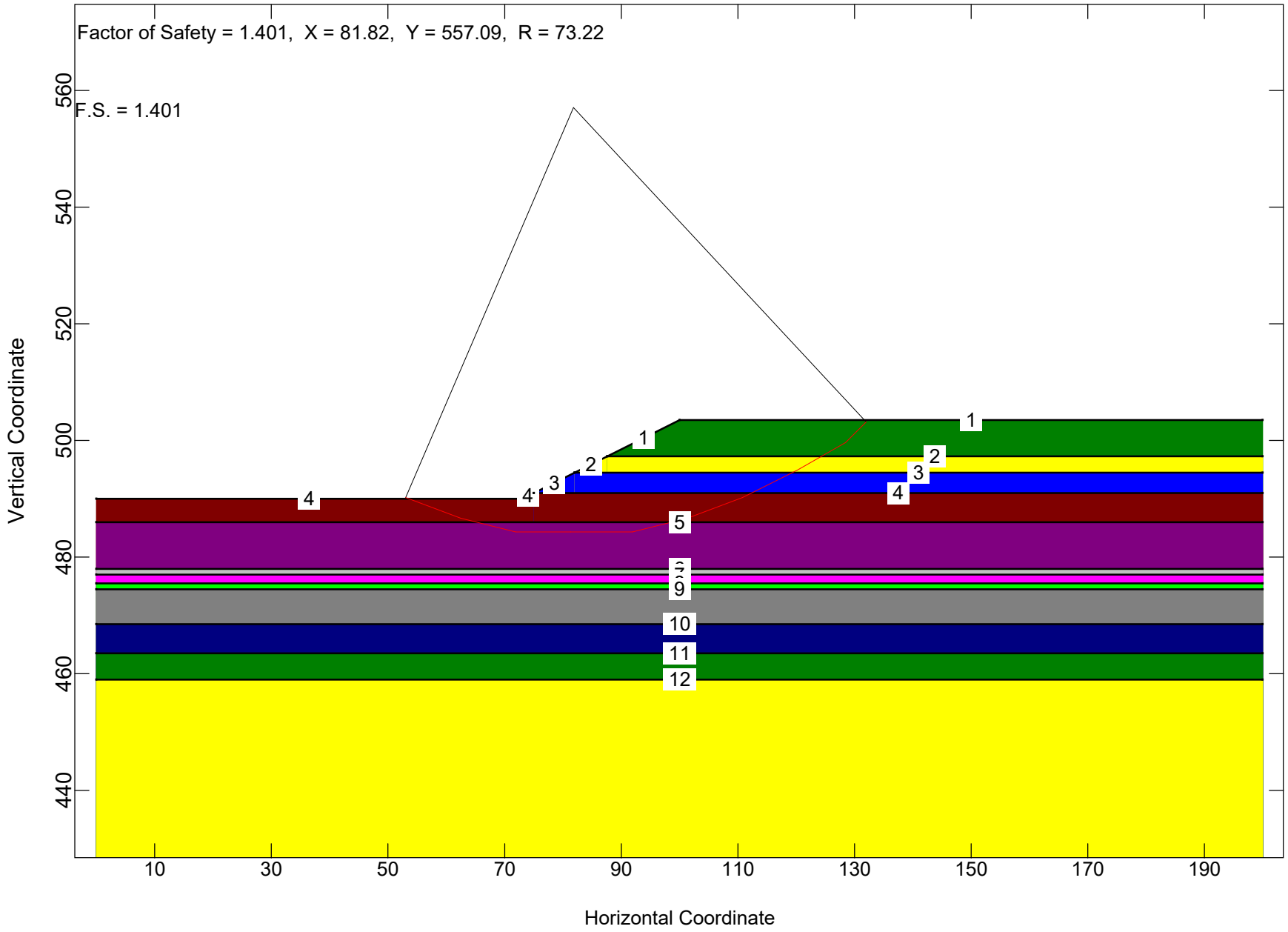
South Abutment
Short Term Strength



South Abutment
Long Term Strength



South Abutment
Seismic



Appendix G

Seismic Site Class Determination

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE=====US 51 Over Louse Run Tributary

Substructure 1

Base of Substruct. Elev. (or ground surf for bents	496	ft.
Pile or Shaft Dia.	12	inches
Boring Number	SB-1	
Top of Boring Elev.	497.1	ft.
Approximate Fixity Elev.	490	ft.

Individual Site Class Definition:

N (bar): 34 (Blows/ft.) Soil Site Class D
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 2.98 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	494.1	3.00	4	1.50	B
	491.6	2.50	6	1.10	B
0.9	489.1	2.50	7	1.10	B
3.4	486.6	2.50	7	1.10	B
5.9	484.1	2.50	11	1.70	B
8.4	481.6	2.50	16	1.70	
10.9	479.1	2.50	13	1.80	B
13.4	476.6	2.50	13	1.10	
15.9	474.1	2.50	13	0.80	B
18.9	471.1	3.00	17	4.80	
21.4	468.6	2.50	14	1.20	
26.4	463.6	5.00	16	1.30	
31.4	458.6	5.00	29	1.30	B
100.0	390.0	68.60	100	10.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents	487.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	SB-2	
Top of Boring Elev.	496.8	ft.
Approximate Fixity Elev.	481.5	ft.

Individual Site Class Definition:

N (bar): 36 (Blows/ft.) Soil Site Class D
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 3.01 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	493.8	3.00	4	1.50	B
	491.3	2.50	3	0.10	B
	488.3	3.00	7	0.10	B
	484.8	3.50	7	1.20	B
	483.8	1.00	15	0.50	B
1.2	480.3	3.50	9	1.30	
3.7	477.8	2.50	14	2.40	
6.2	475.3	2.50	8	0.90	
8.7	472.8	2.50	8	1.30	
11.2	470.3	2.50	14	1.70	
13.7	467.8	2.50	14	0.50	
18.7	462.8	5.00	8	0.70	
21.7	459.8	3.00	12	1.10	B
100.0	381.5	78.30	100	10.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents	487.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	SB-3	
Top of Boring Elev.	497.3	ft.
Approximate Fixity Elev.	481.5	ft.

Individual Site Class Definition:

N (bar): 44 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 73 (Blows/ft.) Soil Site Class C <----Controls
s_u (bar): 3.68 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	494.8	2.50	4	0.40	B
	491.8	3.00	6	1.00	B
	489.3	2.50	5	0.70	
	486.8	2.50	6	0.60	B
	483.3	3.50	10	0.90	
0.7	480.8	2.50	10	1.10	
3.2	478.3	2.50	16	2.40	
5.7	475.8	2.50	20	4.40	
8.2	473.3	2.50	14	2.20	
10.7	470.8	2.50	10	1.50	
12.7	468.8	2.00	25	1.30	B
17.7	463.8	5.00	13	1.90	B
22.7	458.8	5.00	100	1.80	B
28.2	453.3	5.50	25		B
100.0	381.5	71.80	86	10.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents	496	ft.
Pile or Shaft Dia.	12	inches
Boring Number	SB-4	
Top of Boring Elev.	497.5	ft.
Approximate Fixity Elev.	490	ft.

Individual Site Class Definition:

N (bar): 34 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 100 (Blows/ft.) Soil Site Class C
s_u (bar): 3.61 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	494.5	3.00	11	2.50	B
	491.0	3.50	5	2.50	B
1.5	488.5	2.50	3	0.80	
4.0	486.0	2.50	4	0.50	B
6.5	483.5	2.50	13	2.50	
9.0	481.0	2.50	13	4.50	
12.0	478.0	3.00	16	3.50	B
13.0	477.0	1.00	29	3.50	
15.5	474.5	2.50	33	4.50	B
18.5	471.5	3.00	23	4.50	
21.5	468.5	3.00	34	4.50	B
26.5	463.5	5.00	18	2.50	B
31.0	459.0	4.50	100		B
100.0	390.0	69.00	100	10.00	R

Global Site Class Definition: Substructures 1 through 4

N (bar): 37 (Blows/ft.) Soil Site Class D
N_{ch} (bar): (Blows/ft.) NA, H < 0.1*H (Total)
s_u (bar): 3.31 (ksf) Soil Site Class C <----Controls

Appendix H

Liquefaction Analysis

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== SB-01
ELEVATION OF BORING GROUND SURFACE ========== 497.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 11.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 11.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.240
EARTHQUAKE MOMENT MAGNITUDE ========== 5.4
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 6.00 FT. (Fill Height)
HAMMER EFFICIENCY========== 84 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.081**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **606** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.4
Source-To-Site Distance, R (km) = 22
Ground Motion Prediction Equations = CEUS
PGA = **0.144**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
496	1	4		80	12	35	29	0.108	0.108	9.032	15.839	0.169	0.108	0.828	0.828	1.287	**0.451**	0.978	**0.153**	**N.L. (1)**
493.5	3.5	6		80			22	0.113	0.391	12.666	20.200	0.218	0.113	1.111	1.111	1.210	**0.549**	0.966	**0.151**	**N.L. (1)**
491	6	7		80			19	0.114	0.676	13.487	21.184	0.231	0.052	1.241	1.303	1.175	**0.564**	0.951	**0.156**	**3.615 (D)**
488.5	8.5	7		80			14	0.114	0.961	12.885	20.462	0.221	0.052	1.371	1.589	1.138	**0.524**	0.934	**0.169**	**3.101 (D)**
486	11	11		80	9	23	12	0.119	1.258	20.578	29.694	0.448	0.181	1.823	2.197	1.055	**0.983**	0.913	**0.172**	**N.L. (2)**
483.5	13.5	16		80			11	0.065	1.421	31.489	42.786	0.198	0.065	1.986	2.516	1.027	**0.424**	0.888	**0.176**	**N.L. (3)**
481	16	13		80	9	23	14	0.063	1.578	24.549	34.459	-1.927	0.063	2.143	2.829	0.996	**-3.993**	0.860	**0.177**	**N.L. (2)**
478.5	18.5	13		80	9		14	0.063	1.736	24.086	33.903	10.554	0.063	2.301	3.143	0.969	**21.289**	0.829	**0.177**	**###### (D)**
476	21	13		80	9	23	13	0.063	1.893	23.509	33.210	1.508	0.063	2.458	3.456	0.946	**2.967**	0.796	**0.175**	**N.L. (2)**
473.5	23.5	17		80			12	0.066	2.058	30.923	42.108	0.184	0.066	2.623	3.777	0.918	**0.351**	0.761	**0.171**	**N.L. (3)**
471	26	14		80			12	0.064	2.218	24.069	33.883	8.821	0.064	2.783	4.093	0.902	**16.549**	0.726	**0.167**	**99.096 (D)**
468.5	28.5	16		80			12	0.065	2.381	27.102	37.522	-0.011	0.065	2.946	4.412	0.877	**-0.020**	0.691	**0.162**	**N.L. (3)**
463.5	33.5	29		80			19	0.071	2.736	50.415	65.497	0.449	0.071	3.301	5.079	0.838	**0.782**	0.629	**0.151**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== SB-02
ELEVATION OF BORING GROUND SURFACE ========== 497.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 11.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 11.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.240
EARTHQUAKE MOMENT MAGNITUDE ========== 5.4
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== -4.00 FT. (Cut Depth)
HAMMER EFFICIENCY========== 84 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.081**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **557** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.4
Source-To-Site Distance, R (km) = 22
Ground Motion Prediction Equations = CEUS
PGA = **0.144**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
496	1	4		80			27	0.108	0.108	9.032	15.839	0.169								
493.5	3.5	3		80	15	38	29	0.105	0.371	6.377	12.652	0.137								
491	6	7		80			22	0.114	0.656	13.579	21.294	0.232	0.114	0.228	0.228	1.500	**0.725**	0.992	**0.155**	**N.L. (1)**
488.5	8.5	7		80	26	49	26	0.114	0.941	12.959	20.551	0.222	0.114	0.513	0.513	1.500	**0.694**	0.980	**0.153**	**N.L. (1)**
486	11	15		80			17	0.123	1.248	29.364	40.236	0.133	0.123	0.821	0.821	1.462	**0.404**	0.966	**0.151**	**N.L. (1)**
483.5	13.5	9		80	10	23	13	0.060	1.398	16.588	24.905	0.290	0.122	1.126	1.126	1.228	**0.741**	0.948	**0.148**	**N.L. (1)**
481	16	14		80			11	0.064	1.558	26.847	37.216	-0.040	0.064	1.286	1.348	1.222	**-0.102**	0.927	**0.152**	**N.L. (3)**
478.5	18.5	8		80			14	0.059	1.706	14.382	22.258	0.246	0.059	1.433	1.651	1.128	**0.577**	0.901	**0.162**	**3.562 (D)**
476	21	8		80			18	0.059	1.853	14.128	21.953	0.241	0.059	1.581	1.955	1.094	**0.549**	0.872	**0.168**	**3.268 (D)**
473.5	23.5	14		80			11	0.064	2.013	25.081	35.097	-0.656	0.064	1.741	2.271	1.080	**-1.474**	0.840	**0.171**	**N.L. (3)**
471	26	14		80	10	25	13	0.064	2.173	24.327	34.192	-4.947	0.064	1.901	2.587	1.043	**-10.735**	0.804	**0.171**	**N.L. (2)**
468.5	28.5	8		80	10	25	13	0.059	2.321	13.104	20.725	0.225	0.059	2.048	2.890	1.010	**0.472**	0.766	**0.169**	**N.L. (2)**
463.5	33.5	12		80			13	0.063	2.636	18.756	27.508	0.353	0.063	2.363	3.517	0.964	**0.708**	0.688	**0.160**	**4.425 (D)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: SB-03
ELEVATION OF BORING GROUND SURFACE ==========: 497.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 11.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 11.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.240
EARTHQUAKE MOMENT MAGNITUDE ==========: 5.4
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: -4.00 FT. (Cut Depth)
HAMMER EFFICIENCY==========: 84 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.081**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **645** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.4
Source-To-Site Distance, R (km) = 22
Ground Motion Prediction Equations = CEUS
PGA = **0.144**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
496	1	4		80	9	29	21	0.108	0.108	9.032	15.839	0.169								
493.5	3.5	6		80			20	0.113	0.391	12.666	20.200	0.218								
491	6	5		80			16	0.111	0.668	9.643	16.572	0.176	0.111	0.222	0.222	1.500	**0.550**	0.997	**0.155**	**N.L. (1)**
488.5	8.5	6		80			16	0.113	0.951	11.076	18.291	0.195	0.113	0.505	0.505	1.500	**0.609**	0.991	**0.155**	**N.L. (1)**
486	11	10		80			13	0.118	1.246	18.573	27.287	0.347	0.118	0.800	0.800	1.393	**1.004**	0.985	**0.154**	**N.L. (1)**
483.5	13.5	10		80			14	0.061	1.398	18.628	27.354	0.349	0.123	1.107	1.107	1.247	**0.905**	0.976	**0.152**	**N.L. (1)**
481	16	16		80			11	0.065	1.561	31.262	42.514	0.193	0.065	1.270	1.332	1.228	**0.492**	0.966	**0.158**	**N.L. (3)**
478.5	18.5	20		80			11	0.067	1.728	39.613	52.536	0.330	0.067	1.437	1.655	1.168	**0.803**	0.953	**0.171**	**N.L. (3)**
476	21	14		80			13	0.064	1.888	25.584	35.700	-0.328	0.064	1.597	1.971	1.117	**-0.764**	0.938	**0.181**	**N.L. (3)**
473.5	23.5	10		80			15	0.061	2.041	17.160	25.593	0.304	0.061	1.750	2.280	1.065	**0.674**	0.919	**0.187**	**3.604 (D)**
471	26	25		80			14	0.069	2.213	47.113	61.535	0.415	0.069	1.922	2.608	1.040	**0.897**	0.897	**0.190**	**N.L. (3)**
468.5	28.5	13		80	16	30	14	0.063	2.371	21.525	30.830	0.539	0.063	2.080	2.922	1.007	**1.130**	0.872	**0.191**	**N.L. (2)**
463.5	33.5	50		80			19	0.076	2.751	89.698	112.638	0.817	0.076	2.460	3.614	0.942	**1.601**	0.814	**0.187**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========: SB-04
ELEVATION OF BORING GROUND SURFACE ==========: 497.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 11.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 11.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.240
EARTHQUAKE MOMENT MAGNITUDE ==========: 5.4
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 6.00 FT. (Fill Height)
HAMMER EFFICIENCY==========: 84 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.081**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **629** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.4
Source-To-Site Distance, R (km) = 22
Ground Motion Prediction Equations = CEUS
PGA = **0.144**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
496	1	11		80	22	40	20	0.119	0.119	26.803	37.163	-0.046	0.119	0.839	0.839	1.449	**-0.137**	0.982	**0.153**	**N.L. (1)**
493.5	3.5	5		80			22	0.111	0.397	10.534	17.641	0.188	0.111	1.117	1.117	1.196	**0.467**	0.972	**0.152**	**N.L. (1)**
491	6	3		80			20	0.105	0.659	5.802	11.963	0.131	0.043	1.224	1.286	1.143	**0.311**	0.960	**0.157**	**1.981 (C)**
488.5	8.5	4		80			13	0.108	0.929	7.430	13.916	0.149	0.046	1.339	1.557	1.125	**0.350**	0.946	**0.172**	**2.035 (C)**
486	11	13		80			13	0.121	1.232	25.044	35.053	-0.695	0.183	1.797	2.171	1.066	**-1.542**	0.928	**0.175**	**N.L. (3)**
483.5	13.5	13		80			12	0.063	1.389	25.050	35.060	-0.688	0.063	1.954	2.484	1.032	**-1.479**	0.907	**0.180**	**N.L. (3)**
481	16	16		80			12	0.065	1.552	31.341	42.609	0.195	0.065	2.117	2.803	1.001	**0.405**	0.883	**0.182**	**N.L. (3)**
478.5	18.5	29		80			12	0.071	1.729	61.274	78.529	0.554	0.071	2.294	3.136	0.969	**1.118**	0.855	**0.182**	**N.L. (3)**
476	21	33		80			11	0.072	1.909	68.006	86.608	0.618	0.072	2.474	3.472	0.940	**1.208**	0.825	**0.181**	**N.L. (3)**
473.5	23.5	23		80			11	0.068	2.079	43.770	57.523	0.379	0.068	2.644	3.798	0.915	**0.721**	0.793	**0.178**	**N.L. (3)**
471	26	34		80			12	0.072	2.259	66.257	84.508	0.601	0.072	2.824	4.134	0.892	**1.116**	0.759	**0.173**	**N.L. (3)**
468.5	28.5	18		80	13	29	11	0.066	2.424	30.681	41.817	0.177	0.066	2.989	4.455	0.872	**0.321**	0.726	**0.169**	**N.L. (2)**
463.5	33.5	50		80			18	0.076	2.804	88.801	111.561	0.809	0.076	3.369	5.147	0.831	**1.398**	0.663	**0.158**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Appendix I

Integral Abutment Feasibility Analysis

Illinois Department of Transportation

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

Modified 10/30/17

GENERAL DATA

STRUCTURE NUMBER	061-0095		TOTAL STRUCTURE LENGTH	140.00	FT
STRUCTURE TYPE	MULTI-SPAN		NUMBER OF SPANS	3	
STRUCTURE SKEW	0	DEGREES	END SPAN LENGTH	40.50	FT
SUPER. DATA IN REFERENCE TO SUB. DATA	ABUT 1		ADJACENT INTERIOR SPAN LENGTH	59.00	FT

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (END OR MAIN SPAN)

BEAM TYPE	WIDE FLANGE	
WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.50	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

SUPERSTRUCTURE POSITIVE MOMENT REGION DATA (ADJACENT SPAN)

WIDE FLANGE	W27X102	
BEAM SPACING PERP. TO CL	6.50	FT
SLAB THICKNESS	8.00	IN
SLAB F'C	4.00	KSI

ABUTMENT #1 DATA

ABUTMENT NAME	North	
ABUTMENT REFERENCE BORING	SB-01	
BOTTOM OF ABUTMENT ELEVATION	496	FT
ESTIMATED NUMBER OF PILES AT ABUT.	6	
PILE SPACING PERP. TO CL	6.5	FT

ABUTMENT #2 DATA

ABUTMENT NAME	South	
ABUTMENT REFERENCE BORING	SB-04	
BOTTOM OF ABUTMENT ELEVATION	496	FT
ESTIMATED NUMBER OF PILES AT ABUT.	6	
PILE SPACING PERP. TO CL	6.5	FT

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #1

BOT. OF LAYER ELEV. (FT)	*LAYER THICKNESS (FT)*	*UNCONFINED COMPRESSIVE STRENGTH (TSF)*	*N S.P.T. VALUE (BLOWS/12 IN.)*	*Qu EQUIV. FOR N VALUE (TSF)*
494.10	1.90	1.5		
491.60	2.50	1.1		
489.10	2.50	1.1		
486.60	2.50	1.1		
486.00	0.60	1.7		

10.00 FT = TOTAL DEPTH ENTERED

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #2

BOT. OF LAYER ELEV. (FT)	*LAYER THICKNESS (FT)*	*UNCONFINED COMPRESSIVE STRENGTH (TSF)*	*N S.P.T. VALUE (BLOWS/12 IN.)*	*Qu EQUIV. FOR N VALUE (TSF)*
494.50	1.50	2.5		
491.00	3.50	2.5		
488.50	2.50	0.8		
486.00	2.50	0.50		

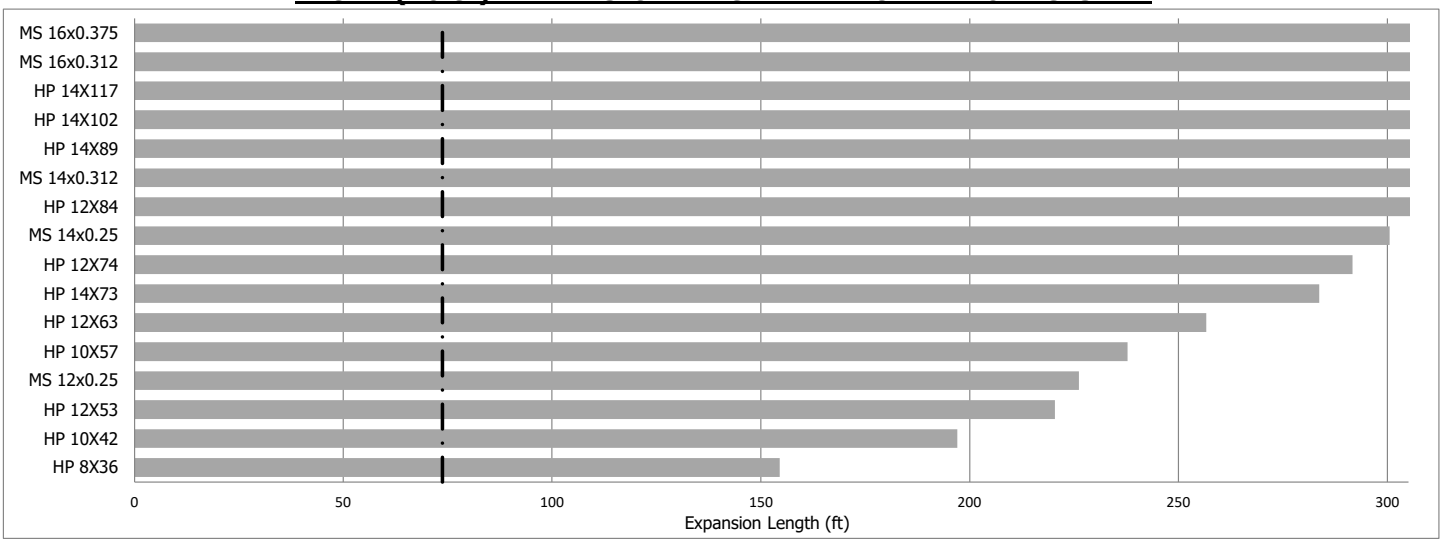
10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1	1.21	TSF	WEIGHTED AVERAGE Qu FOR ABUTMENT #2	1.58	TSF
PILE STIFFNESS MODIFIER FOR ABUTMENT #1 = 1/(1.45-[0.3*1.21])	0.92		PILE STIFFNESS MODIFIER FOR ABUTMENT #2 = 1/(1.45-[0.3*1.58])	1.02	

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [0.92*6*0+1.02*6*140]/[0.92*6+1.02*6] = 73.69 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.02*6*0+0.92*6*140]/[1.02*6+0.92*6] = 66.31 FT

ABUT 1 (North) - EXPANSION LENGTH LIMIT CHART - 0 DEG. SKEW



= Estimated expansion length for the indicated abutment. Piles with an expansion length greater than this are suitable for consideration.
(Note: The same size pile should be used at both abutments.)

Appendix J

Driven Pile Analysis

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 061-0095 (North Abut.)
REFERENCE BORING ========== SB-01
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 498.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 496.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== DD
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 491.60 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 900 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 38.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 185.42 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 69.53 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 63
Plugged Pile Perimeter========== 4.000 FT. Unplugged Pile Perimeter========== 5.883 FT.
Plugged Pile End Bearing Area========== 1.000 SQFT. Unplugged Pile End Bearing Area========= 0.128 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
497 KIPS	**497** KIPS	**249** KIPS	**45** 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.)
494.10	1.90	1.50			7.3		22.7	10.8		***12.7***	13	4	8	-5	4
491.60	2.50	1.10			7.7	15.4	30.4	11.3	2.0	***24.0***	24	8	17	-12	6
489.10	2.50	1.10			7.7	15.4	38.1	11.3	2.0	***35.3***	35	8	17	-5	9
486.60	2.50	1.10			7.7	15.4	54.1	11.3	2.0	***47.6***	48	8	17	1	11
484.10	2.50	1.70			10.5	23.8	64.6	15.4	3.0	***63.0***	63	8	17	10	14
481.60	2.50	1.70			10.5	23.8	***76.5***	15.4	3.0	78.6	76	8	17	17	16
479.10	2.50	1.80			10.9	25.2	***77.5***	16.0	3.2	93.3	78	8	17	18	19
476.60	2.50	1.10			7.7	15.4	***81.0***	11.3	2.0	104.1	81	8	17	20	21
474.10	2.50	0.80			5.9	11.2	***107.5***	8.7	1.4	115.4	107	8	17	34	24
470.60	3.50		17	Hard Till	2.6	31.8	***95.1***	3.8	4.1	117.3	95	8	17	28	27
468.10	2.50	1.20			8.2	16.8	***104.7***	12.1	2.1	129.5	105	8	17	33	30
463.10	5.00	1.30			17.4	18.2	***122.1***	25.6	2.3	155.1	122	8	17	42	35
458.60	4.50	1.30			15.7	18.2	244.1	23.0	2.3	***191.7***	192	8	17	81	39
458.00	0.60			Shale	29.9	124.6	274.0	44.0	15.9	***235.7***	236	8	17	105	40
457.00	1.00			Shale	49.8	124.6	323.8	73.3	15.9	***309.0***	309	8	17	145	41
456.00	1.00			Shale	49.8	124.6	***373.6***	73.3	15.9	382.3	374	8	17	181	42
455.00	1.00			Shale	49.8	124.6	***423.5***	73.3	15.9	455.6	423	8	17	208	43
454.00	1.00			Shale	49.8	124.6	***473.3***	73.3	15.9	528.8	473	8	17	236	44
453.53	0.47			Shale	23.4	124.6	***496.7***	34.4	15.9	563.3	497	8	17	248	44.5
452.53	1.00			Shale	49.8	124.6	***546.5***	73.3	15.9	636.6	~~547~~	~~8~~	~~17~~	~~276~~	~~45.5~~
451.53	1.00			Shale		124.6			15.9						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 061-0095 (S. Abut.)
REFERENCE BORING ========== SB-04
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 498.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 496.00 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 ========== 900 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 38.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 185.41 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 69.53 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 63
Plugged Pile Perimeter========== 4.000 FT. Unplugged Pile Perimeter========== 5.883 FT.
Plugged Pile End Bearing Area========== 1.000 SQFT. Unplugged Pile End Bearing Area========= 0.128 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
497 KIPS	**497** KIPS	**273** KIPS	**44** 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.)
494.50	1.50	2.50			8.1		43.1	11.9		***16.4***	16	0	0	9	4
491.00	3.50	2.50			18.9	35.0	***38.1***	27.7	4.5	41.1	38	0	0	21	7
488.50	2.50	0.80			5.9	11.2	***39.9***	8.7	1.4	49.2	40	0	0	22	10
486.00	2.50	0.50			3.9	7.0	71.8	5.7	0.9	***58.5***	59	0	0	32	12
483.50	2.50	2.50			13.5	35.0	***74.5***	19.8	4.5	77.0	75	0	0	41	15
481.00	2.50		13	Hard Till	1.4	24.3	81.5	2.1	3.1	***79.8***	80	0	0	44	17
478.50	2.50		16	Hard Till	1.7	29.9	107.6	2.6	3.8	***85.4***	85	0	0	47	20
476.00	2.50		29	Hard Till	3.2	54.2	118.2	4.6	6.9	***91.0***	91	0	0	50	22
473.50	2.50		33	Hard Till	3.6	61.7	103.1	5.3	7.9	***94.0***	94	0	0	52	25
471.00	2.50		23	Hard Till	2.5	43.0	126.2	3.7	5.5	***100.3***	100	0	0	55	27
468.50	2.50		34	Hard Till	3.7	63.5	***101.4***	5.5	8.1	102.1	101	0	0	56	30
463.50	5.00	2.50			26.9	35.0	330.0	39.6	4.5	***167.5***	168	0	0	92	35
459.00	4.50		95	Medium Sand	69.3	236.7	287.2	101.9	30.2	***255.1***	255	0	0	140	39
458.00	1.00			Shale	49.8	124.6	337.0	73.3	15.9	***328.4***	328	0	0	181	40
457.00	1.00			Shale	49.8	124.6	***386.8***	73.3	15.9	401.7	387	0	0	213	41
456.00	1.00			Shale	49.8	124.6	***436.7***	73.3	15.9	475.0	437	0	0	240	42
455.00	1.00			Shale	49.8	124.6	***486.5***	73.3	15.9	548.3	486	0	0	268	43
454.80	0.20			Shale	10.0	124.6	***496.5***	14.7	15.9	562.9	496	0	0	273	43.2
453.80	1.00			Shale	49.8	124.6	***546.3***	73.3	15.9	636.2	~~546~~	~~0~~	~~0~~	~~300~~	~~44.2~~
452.80	1.00			Shale	49.8	124.6	***596.1***	73.3	15.9	709.5	~~596~~	~~0~~	~~0~~	~~328~~	~~45.2~~
451.80	1.00			Shale		124.6			15.9						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 061-0095 (Pier 1)
REFERENCE BORING ========== SB-02
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 498.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 487.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 486.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 38.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 267.83 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 100.44 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 63
Plugged Pile Perimeter========== 4.000 FT. Unplugged Pile Perimeter========== 5.883 FT.
Plugged Pile End Bearing Area========== 1.000 SQFT. Unplugged Pile End Bearing Area========= 0.128 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
497 KIPS	**497** KIPS	**273** KIPS	**45** 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.)
485.30	2.20	1.20			7.2		14.2	10.6		***11.5***	12	0	0	6	13
482.80	2.50	0.50			3.9	7.0	29.3	5.7	0.9	***18.7***	19	0	0	10	16
480.30	2.50	1.30			8.7	18.2	53.4	12.8	2.3	***33.4***	33	0	0	18	18
477.80	2.50	2.40			13.1	33.6	***45.5***	19.3	4.3	50.0	46	0	0	25	21
475.30	2.50	0.90			6.5	12.6	***57.6***	9.6	1.6	60.3	58	0	0	32	23
472.80	2.50	1.30			8.7	18.2	***71.9***	12.8	2.3	73.8	72	0	0	40	26
470.30	2.50	1.70			10.5	23.8	***65.6***	15.4	3.0	87.1	66	0	0	36	28
467.80	2.50	0.50			3.9	7.0	***72.3***	5.7	0.9	93.2	72	0	0	40	31
462.80	5.00	0.70			10.5	9.8	***88.4***	15.5	1.3	109.4	88	0	0	49	36
459.80	3.00	1.10			9.2	15.4	206.8	13.5	2.0	***136.9***	137	0	0	75	39
459.50	0.30			Shale	14.9	124.6	221.7	22.0	15.9	***158.8***	159	0	0	87	39
458.50	1.00			Shale	49.8	124.6	271.6	73.3	15.9	***232.1***	232	0	0	128	40
457.50	1.00			Shale	49.8	124.6	321.4	73.3	15.9	***305.4***	305	0	0	168	41
456.50	1.00			Shale	49.8	124.6	***371.2***	73.3	15.9	378.7	371	0	0	204	42
455.50	1.00			Shale	49.8	124.6	***421.0***	73.3	15.9	452.0	421	0	0	232	43
454.50	1.00			Shale	49.8	124.6	***470.9***	73.3	15.9	525.3	471	0	0	259	44
453.98	0.52			Shale	25.9	124.6	***496.8***	38.1	15.9	563.4	497	0	0	273	44.5
452.98	1.00			Shale	49.8	124.6	***546.6***	73.3	15.9	636.7	~~547~~	~~0~~	~~0~~	~~301~~	~~45.5~~
451.98	1.00			Shale	49.8	124.6	***596.4***	73.3	15.9	710.0	~~596~~	~~0~~	~~0~~	~~328~~	~~46.5~~
450.98	1.00			Shale		124.6			15.9						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== 061-0095 (Pier 2)
REFERENCE BORING ========== SB-03
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 498.50 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 487.50 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 486.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

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

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
497 KIPS	**496** KIPS	**273** KIPS	**45** FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1300 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 38.83 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 267.83 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 100.44 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 63
Plugged Pile Perimeter========== 4.000 FT. Unplugged Pile Perimeter========== 5.883 FT.
Plugged Pile End Bearing Area========== 1.000 SQFT. Unplugged Pile End Bearing Area========= 0.128 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
485.80	1.70	0.60			3.1		15.7	4.6		***6.2***	6	0	0	3	13
483.30	2.50	0.90			6.5	12.6	25.1	9.6	1.6	***16.2***	16	0	0	9	15
480.80	2.50	1.10			7.7	15.4	50.9	11.3	2.0	***29.8***	30	0	0	16	18
478.30	2.50	2.40			13.1	33.6	67.8	19.3	4.3	***49.5***	50	0	0	27	20
475.80	2.50		20	Hard Till	2.2	37.4	63.4	3.2	4.8	***51.9***	52	0	0	29	23
473.30	2.50	2.20			12.4	30.8	***66.0***	18.2	3.9	68.8	66	0	0	36	25
470.80	2.50	1.50			9.6	21.0	***72.8***	14.1	2.7	82.6	73	0	0	40	28
468.80	2.00	1.30			7.0	18.2	***88.2***	10.2	2.3	93.9	88	0	0	48	30
463.80	5.00	1.90			22.5	26.6	***109.3***	33.1	3.4	126.9	109	0	0	60	35
458.80	5.00	1.80			21.8	25.2	230.4	32.0	3.2	***171.6***	172	0	0	94	40
458.50	0.30			Shale	14.9	124.6	245.3	22.0	15.9	***193.6***	194	0	0	106	40
457.50	1.00			Shale	49.8	124.6	295.2	73.3	15.9	***266.8***	267	0	0	147	41
456.50	1.00			Shale	49.8	124.6	345.0	73.3	15.9	***340.1***	340	0	0	187	42
455.50	1.00			Shale	49.8	124.6	***394.8***	73.3	15.9	413.4	395	0	0	217	43
454.50	1.00			Shale	49.8	124.6	***444.6***	73.3	15.9	486.7	445	0	0	245	44
453.50	1.00			Shale	49.8	124.6	***494.5***	73.3	15.9	560.0	494	0	0	272	45
453.46	0.04			Shale	2.0	124.6	***496.5***	2.9	15.9	562.9	496	0	0	273	45
452.46	1.00			Shale	49.8	124.6	***546.3***	73.3	15.9	636.2	~~546~~	~~0~~	~~0~~	~~300~~	~~46~~
451.46	1.00			Shale	49.8	124.6	***596.1***	73.3	15.9	709.5	~~596~~	~~0~~	~~0~~	~~328~~	~~47~~
450.46	1.00			Shale		124.6			15.9						