SCI ENGINEERING, INC.
650 Pierce Boulevard
O'Fallon, Illinois 62269
618-624-6969
www.sciengineering.com

Structure Geotechnical Report

BRIDGE CONSTRUCTION
PTB 195 ITEM 57
IL ROUTE 162 (FAP ROUTE 586) OVER JUDY'S BRANCH
MADISON COUNTY, ILLINOIS
SECTION: 51-R
STRUCTURE NO. SN 060-0241 (PROPOSED)

Thomas J. Casey, P.E.
TCasey@SCIEngineering.com
(618) 624-6969
April 18, 2023

Prepared for:
FUHRMANN ENGINEERING
1022 EASTPORT PLAZA DRIVE
COLLINSVILLE, ILLINOIS 62234
(618) 855-8000

SCI No. 2020-0531.10

DocuSigned by:
Thomas Casey
E358897B1C3F458...

Exp.: 11/30/2023
LICENSED PROFESSIONAL ENGINEER
THOMAS
JOSEPH CASEY
062-061853
STATE OF ILLINOIS
4/18/2023

SCI ENGINEERING, INC.
EARTH • SCIENCE • SOLUTIONS
GEOTECHNICAL
ENVIRONMENTAL
NATURAL RESOURCES
CULTURAL RESOURCES
CONSTRUCTION SERVICES

April 18, 2023

Eric M. Lagemann, P.E., S.E.
Fuhrmann Engineering
1022 Eastport Plaza Drive
Collinsville, Illinois 62234

RE: Structure Geotechnical Report
Bridge Construction
PTB 195 Item 57
IL Route 162 (FAP Route 586) over Judy's Branch
Madison County, Illinois
Section: 51-R
Structure No. SN 060-0241 (Proposed)
SCI No.: 2020-0531.10

Dear Eric M. Lagemann:

Enclosed is our *Structure Geotechnical Report (SGR)*, dated April 18, 2023. This report should be read in its entirety, and our recommendations considered in the design and construction of the proposed bridge. Please call if you have any questions.

Respectfully,

SCI ENGINEERING, INC.

Prakash Paudel, E.I.
Staff Engineer

Thomas J. Casey, P.E.
Chief Geotechnical Engineer

PP/TJC/snp

Enclosure
Structure Geotechnical Report

C: Brian Schmidt, Fuhrmann Engineering

\\sciengineering.local\shared\Projects\2020\2020-0531 PTB 195, Item 57 Realignment of IL 162 at 157\Report\SN 060-0241 (P)- IL 162 over Judy's Branch\20-0531.10 IL-162 over Judy's Branch rev.docx

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Structure Geotechnical Report

BRIDGE CONSTRUCTION
PTB 195 ITEM 57
IL ROUTE 162 (FAP ROUTE 586) OVER JUDY'S BRANCH
MADISON COUNTY, ILLINOIS
SECTION: 51-R
STRUCTURE NO. SN 060-0241 (PROPOSED)

1.0 PROJECT DESCRIPTION

The geotechnical study summarized in this report was performed for the proposed construction of the bridge that carries Illinois Route 162 over Judy's Branch in Madison County, Illinois. Based on the latest TS&L provided by Fuhrmann Engineering (Fuhrmann) on March 28, 2023, the proposed structure will be a two-lane, three-span structure with a back-to-back abutment length of approximately 154 feet and an out-to-out deck width that will vary between 56.7 to 64.0 feet. We anticipate fills of up to 10 feet will be required at the abutments. The end slopes will have inclinations of 4 horizontal to 1 vertical (4H:1V) and the streambed of the creek will be capped with stone riprap used for scour protection. The location of the site is shown on the *Vicinity and Topographic Map*, Figure 1.

2.0 SUBSURFACE EXPLORATION

2.1 Area Geology

The project is located approximately 7.5 miles east of the Mississippi River in the floodplain known locally as the American Bottoms. According to Surficial Geology of Monks Mound Quadrangle, Madison and St. Clair Counties, Illinois 2007, the near-surface soils are of the Cahokia Formation that mainly consist of silt loam with occasional thin sand and diamicton beds; soft and weakly stratified and up to 15 feet thick. These alluviums were deposited by distributary channels in fans including redeposited loess and some mud flows.

According to *Bedrock Geologic Map, Monks Mound Quadrangle, Madison and St. Clair Counties, Illinois 2001*, the bedrock at this site belongs to the Carbondale and Tradewater formations. The Carbondale formation is dominated by dark gray carbonaceous and pyritic shales with siltstone intervals while the Tradewater formation is dominated by shale or claystone sandstone and commonly shows rooting.

2.2 Exploration Procedures

Two standard penetration test (SPT) borings, designated B-3 and B-4 were drilled near the proposed abutment locations, as shown on the *Aerial Photograph*, Figure 2 and *Site Plan*, Figure 3. The boring locations were selected and staked in the field by SCI personnel, however the elevations were estimated from publicly available LIDAR data. The stations and offsets were estimated from the TS&L plans provided and included in Appendix F. The field exploration was performed in general accordance with procedures outlined in the *2020 IDOT Geotechnical Manual*.

Personnel from SCI were with the drill rig to supervise drilling, log the borings, and perform field unconfined compressive strength tests of the borings. A CME 550X all-terrain-mounted drill rig, equipped with both hollow stem augers and mud-rotary, was used to advance the borings. SPTs were performed with a split-spoon sampler at 2½-foot intervals to 30 feet, and at 5-foot intervals thereafter to the termination depth of the borings. Relatively undisturbed Shelby tube samples were collected at selected intervals in lieu of SPT samples for additional testing. The unconfined compressive strength of the cohesive soils was determined with a Rimac test apparatus. A pocket penetrometer was used to measure the compressive strength if the soils were not conducive to Rimac testing. While auger refusal did not occur in any of the borings, split spoon sampler refusal did occur within the shale bedrock in both soil test borings at depths of 87 to 89 feet, as detailed on the appended boring logs. Split-spoon sampler refusal is a designation applied to any material that results in SPT N-values in excess of 100 blows per foot (bpf) or 50 blows over the advancement depth of less than 6 inches.

2.3 Subsurface Conditions

Detailed information regarding the nature and thickness of the soils and rock encountered, and the results of the field sampling and laboratory testing are shown on the Boring Logs in Appendix A. The generalized soil profile is included on the *Subsurface Profile,* Figure 4.

The boring B-3 encountered 10 feet of fill consisting of brown silty loam with cinders and sand while no fill was encountered in boring B-4. Standard Penetration Test (SPT) N-values (the sum of the second and third blow count numbers in each sampling interval from the SPT) in the existing fill ranged from 4 to 14 blows per foot (bpf) with an average of approximately 10 bpf.

Underlying the fill, the natural soils generally consisted of loose loam to silty clay loam (A-4) underlain by or interbedded with loose to medium dense fine sand (A-3) to the depth of 50 to 55 feet. Beneath the loam and sand layer, the profile consisted of medium stiff to stiff clay to silty clay loam (A-6 or A-7) followed by a thin layer of clayey shale nearing the sampler refusal at depths ranging from 87 to 89 feet (El. 349 to 350).

In general, the natural cohesive soils were very soft to medium stiff in consistency, with a majority of the N-values ranging between 0 to 28 blows per foot (bpf) with an average of 9 bpf. Unconfined compressive strengths obtained from Rimac ranged between 0.2 to 3.6 tons per square foot (tsf) with an average of 1.2 tsf. The sandy and loamy soils were generally loose to medium dense, with a majority of the N-values ranging between 2 to 33 bpf with an average of 13 bpf. Moisture contents in the native soil samples ranged from 12 to 36 percent, with an average of approximately 26 percent. Table 2.1 presents a summary of the depth and elevation of the top of bedrock that was first encountered in each of the borings.

Table 2.1 – Summary of Bedrock Elevations

Boring	Ground Surface Elevation (feet)	Depth to Bedrock (feet)	Top of Bedrock Elevation (feet)
B-3	±437	85.5	351.5
B-4	±438	87.5	350.5

2.4 Groundwater Conditions

Groundwater levels observed at the time of drilling are summarized in Table 2.2. It should be noted that the groundwater level is subject to seasonal and climatic variations, the water level in the adjacent canal, and other factors; and may be present at different depths in the future. In addition, without extended periods of observation, measurement of the true groundwater levels may not be possible.

Table 2.2 – Summary of Approximate Groundwater Levels

Boring	Ground Surface Elevation (feet)	Depth to Groundwater during Drilling (feet)	Groundwater Elevation during Drilling (feet)
B-3	±437	13.5	423.5
B-4	±438	18.5	419.5

3.0 GEOTECHNICAL EVALUATIONS

In order to provide design recommendations for founding the structure, we performed the following evaluations based on all available data collected and reviewed at the time of this report. This information includes subsurface explorations performed by SCI, existing plans, and communications with Fuhrmann Engineering personnel familiar with the project.

3.1 Seismic Considerations

3.1.1 Design Earthquake

Ground shaking at the foundation of structures and liquefaction of the soil under the foundation are the principle seismic hazards to be considered in design of earthquake-resistant structures. Soil liquefaction is possible within loose sand and low plastic silt deposits below the groundwater table. Liquefaction occurs when a rapid development in water pressure, caused by the ground motion, pushes sand particles apart, resulting in a loss of strength and later densification as the water pressure dissipates. This loss of strength can cause bearing capacity failure while the densification can cause excessive settlement. Potential earthquake damage can be mitigated by structural and/or geotechnical measures or procedures common to earthquake resistant design.

For the purposes of seismic design the bridge has been classified as *Regular* and *Essential*. According to the Illinois Department of Transportation Bridge Manual 2012 edition, the structure should be designed to a design earthquake with a 7 percent Probability of Exceedance (PE) over a 75-year exposure period (i.e. a 1,000-year design earthquake). The design earthquake has a Moment Magnitude (Mw) of 7.7 and a site coefficient (A_s) of 0.25g, as determined from data provided by the United States Geological Survey (USGS) National Seismic Hazard Mapping Project and procedures outlined in the All Geotechnical Manual Users (AGMU) 10.1, *Liquefaction Analysis Procedure*.

3.1.2 Site Class Determination

The seismic site soil classification for the bridge site was determined from the design earthquake data, the subsurface data, and the procedures described in AGMU Memo 09.1, *Seismic Site Class Definition*, of the IDOT Bridge Manual Design Guides. The Site Class was evaluated using methods defined as B and C, which include evaluating the SPT N-values and undrained shear strength, S_u. The following results were calculated:

- Method B using N: 11 bpf (Site Class E)
- Method C using N_{ch}: 13 bpf (Site Class E)
- Method C using S_u: 1,150 psf (Site Class D)

Based on the span and overall bridge lengths and the guidelines in the AGMU, we recommend that Site Class D be used for the project. Based on Table 3.15.2-1 the Seismic Performance Zone is 2. Seismic design parameters for the site are summarized in Table 3.1.

Table 3.1 – Seismic Design Parameters

Site Class	D
PGA	0.17
Spectral Acceleration at 0.2 sec. (S_S)	0.35g
Spectral Acceleration at 1.0 sec.(S_1)	0.10g
F_{pga}	1.46
F_a	1.52
F_v	2.40
Site Coefficient (As)	0.25
Design Spectral Acceleration at 0.2 sec. (S_{DS})	0.53g
Design Spectral Acceleration at 1.0 sec. (S_{D1})	0.23g
Seismic Design Category	B
Seismic Performance Zone	2

3.1.3 Liquefaction Potential Analysis

The liquefaction potential analysis for the site was conducted using field and laboratory data and the techniques outlined in AGMU 10.1. For the seismic hazard evaluation, it is generally not prescribed to assume that earthquakes would coincide with other extreme loading events, (i.e., reoccurring flood events) unless the structure is considered critical, at which time engineering judgement may be used to provide additional conservatism to the analysis, if necessary. The average seasonal groundwater elevation used in the analysis was estimated from the end of boring conditions and the seasonal weather conditions to be 10 feet below the finished grade fill surface. Sands located above the groundwater table are not susceptible to liquefaction.

Based on our analyses, a majority of the soils observed have sufficient strength and/or a plasticity index that make the threat of liquefaction minimal during the design earthquake. However, isolated relatively thin (<5 feet) layers of loose sands encountered at depths of 15 feet (El. 422) and 22.5 feet (El. 414.5) may be susceptible to liquefaction. The potentially liquefiable soils were encountered in boring B-3 only. It is anticipated that all the piles will extend through the potentially liquefiable soils and bear on or in the underlying bedrock. Additionally, the unbraced length of the piles during liquefaction should not be a concern as the potentially liquefiable layers are relatively thin and do not uniformly occur across the site. The detailed input parameters and results of the Liquefaction Analyses are provided in Appendix B.

3.2 Abutment and Pier Settlement

Based on the maximum fill height of approximately 8 feet near the west abutment and approximately 5 feet near the east abutment, settlements of approximately 0.8 and 2.5 inches, respectively, are anticipated. According to the TS&L, approximately 10 to 12 feet of cut is planned at the interior pier locations. Therefore, the effects of down drag on axial pile capacity need not to be considered for the interior pier locations; however, it needs to be considered for both the abutments. The driven pile inputs for the downdrag case are included in Driven Pile Capacity Sheets (Appendix C).

3.3 Bridge Approach Slabs

Based on available information, the bridge approach slabs will likely bear on newly placed low plastic structural fill. In evaluating the bearing resistance of the slabs, we recommend using a modulus of subgrade reaction of 100 pounds per square inch per inch of deflection (pci).

3.4 Slope Stability

The global slope stability of the end slope near both east and west approach embankment was analyzed for end-of-construction (short-term), long-term, and seismic (pseudo-static) loading conditions. The analyses were conducted using limit equilibrium slope stability methods and the commercially available software program Slide 2018 (developed by Rocscience, Inc.). The analyses considered soil properties from the subsurface exploration data, and the given slope geometries. To account for traffic loading, a surcharge load of 250 psf was applied to the analyses. For the seismic evaluation, the peak ground acceleration (PGA) from the design earthquake along with procedures for seismic slope stability outlined in Federal Highway Administration (FHWA) publication FHWA-HI-99-012 *Geotechnical Earthquake Engineering* were utilized. Soil parameters used in the analyses and the results of the analyses are shown on the output plots in Appendix-E.

A Morgenstern-Price analysis with a circular mode of failure was used to search for the critical factor of safety (FS). The required minimum factors of safety were obtained from Section 6.10.4 of the 2020 IDOT Geotechnical Manual for the global slope stability. The results of the global slope stability analyses are presented in Table 3.2 below. The analysis results indicate that the calculated factor of safety meets the required minimum factor of safety. Therefore, the end slopes will perform satisfactorily under short term, long term, and seismic conditions.

Table 3.2 – Summary of Estimated Global Slope Stability Factors of Safety

Analyzed End Slope	Short-Term Static Condition		Long-Term Static Condition		Seismic Condition	
	Required FOS	Estimated FOS	Required FOS	Estimated FOS	Required FOS	Estimated FOS
East Abutment	1.50	1.60	1.50	1.59	1.00	1.26
West Abutment	1.50	1.52	1.50	1.62	1.00	1.21

3.5 Scour

The pile capacity is dependent on the scour elevation and suitable protection should be provided to the foundation elements. Per IDOT Bridge Manual Section 2.3.6.3.2, open abutments protected with class RR4 or RR5, stone dumped riprap, should set the design scour elevation at the bottom of the abutment. Based on the provided TS&L, the design scour elevations for the 100-year and 200-year events for the abutment and interior bents are shown in Table 3.3 below.

Table 3.3 – Summary of Design Scour Elevations

Event	Design Scour Elevation (feet)				Item 113
	W. Abutment	Pier 1 (Int W. Pier)	Pier 2 (Int E. Pier)	E. Abutment	
Q100	439.38	415.46	415.46	439.25	**5**
Q200	439.38	415.46	415.16	439.25	
Design	439.38	415.46	415.16	439.25	
Check	439.38	415.46	415.16	439.25	

3.6 Bridge Foundations

The foundation supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loads. As per the TS&L, integral abutments are planned for this bridge. Per the IDOT Bridge Manual, this type of abutment requires either H-Piles or metal shell piles to accommodate the deflection needs of the superstructure. The piles must be configured in a single non-battered row and oriented with their weak axis of bending placed at 90 degrees to the centerline of the bridge. The piles must also extend 2 feet into the abutment to create a fixed condition, which helps the pile withstand the lateral forces and resulting moment while at the same time carrying axial loads.

For the interior piers, several potential foundation options were considered for supporting the new bridge structure that included driven steel H-Piles, metal shell piles, drilled shafts, and shallow foundations. Shallow foundations are not recommended due to the relatively soft consistency of the shallow subsurface conditions encountered. Drilled shaft foundations were determined to be too costly, given the size of the proposed structure. SCI should be contacted for additional recommendations if drilled shafts will be considered. Driven steel H-piles and metal shell piles are feasible for both the abutments and the piers for the bridge. However, as per the latest TS&L provided on March 28,2023, steel H-piles are planned for the bridge and hence the design information for only driven steel H-piles is included in Appendix C. No structure loads were provided at the time of writing this report. Therefore, a preliminary load of 1,700 kips was assumed for both abutments and the interior piers.

For the driven steel foundation options, we recommend a minimum of one test pile be installed to verify the length of the piles. The test pile can be installed at either side of the creek in the general area of the abutment to help verify the pile length.

3.6.1 Driven Steel Piles

The structural capacity of driven piles depends on the allowable stress and cross-sectional areas of steel and concrete. The pile recommendations in this report assume that Steel H-piles will conform to ASHTO M270 Grade 50 (ASTM 709 Gr 50) or equivalent with a minimum yield stress of 50 kips per square inch (ksi) and metal shell piles will conform to ASTM A252 grade 3 (or equivalent) with a minimum yield stress of 45 ksi.

Based on the most current IDOT Bridge Manual, All Geotechnical Manual User Memorandums (AGMUs), and Guide Bridge Special Provisions (GBSP), a geotechnical resistance factor (φ_G) of 0.55 was used for the design of the driven pile foundations. Geotechnical losses due to down drag are considered for both the abutment locations as mentioned above. Similarly, geotechnical losses associated with scour were considered and the scour elevations at the pier locations are determined as according to Table 3.3. During the seismic event the Bridge Manual allows the use of a Geotechnical Resistance Factor (φ_G) of 1.0.

All estimates of capacity were calculated using the "Modified IDOT Static Method" spreadsheet associated with the IDOT Bridge Manual, and appropriate AGMUs and GMSPs, and assume construction verification will follow the "WSDOT" formula outlined in Section 512 of the most current IDOT Standard Specifications for Road and Bridge construction. The tip elevations were calculated from the Modified IDOT Static Method spreadsheets based on the available factored resistance. It should be noted that the Static Pile Tables for Pier 1 (Interior West Pier) and Pier 2 (Interior East Pier) were the compilation of data from the nearby borings to provide the best engineering estimate for the design.

A summary of the design capacities, or factored resistance available (R_F), seismic factored resistance (R_{Fseis}), and nominal required bearing (R_N) as well as estimated pile lengths, is presented in Appendix C for each H-pile. It should be noted that H-piles driven into shale may run shorter than the IDOT spreadsheet predicts. The estimated pile lengths should be adjusted based on the test pile results. The maximum nominal required bearing and the available maximum factored resistance for typical steel H-piles for the abutments and the interior piers are shown in Table 3.4.

Table 3.4 – Maximum Nominal Required Bearing for Steel H-Piles

Abutment/ Pier	**Pile Size**	**Maximum Nominal Required Bearing, R_{Nmax} (kips)**	**Maximum Factored Resistance Available (kips)**	**Maximum Factored Resistance Available Considering Geotechnical Losses due to Downdrag/Scour (kips)**	**Estimated Length of Pile at Refusal (feet)**
West Abutment	HP 12X74	589	324	306	96
	HP 12X84	664	365	348	97
	HP 14X89	705	388	367	96
	HP 14X117	929	511	490	99
Pier 1 (Int. West Pier)	HP 12X74	589	324	321	96
	HP 12X84	664	365	363	97
	HP 14X89	705	388	385	96
	HP 14X117	929	511	508	99
Pier 2 (Int. East Pier)	HP 12X74	589	324	319	95
	HP 12X84	664	365	361	96
	HP 14X89	705	388	382	95
	HP 14X117	929	511	505	98

Table 3.4 – Maximum Nominal Required Bearing for Steel H-Piles (continued)

Abutment/ Pier	Pile Size	Maximum Nominal Required Bearing, R_{Nmax} (kips)	Maximum Factored Resistance Available (kips)	Maximum Factored Resistance Available Considering Geotechnical Losses due to Downdrag/Scour (kips)	Estimated Length of Pile at Refusal (feet)
East Abutment	HP 12X74	589	324	308	95
	HP 12X84	664	365	349	96
	HP 14X89	705	388	369	94
	HP 14X117	929	511	492	98

We recommend a minimum driven pile center to center spacing of three pile diameters, as recommended by the IDOT Bridge Manual. The maximum spacing shall be limited to 3.5 times the effective footing thickness plus 1 foot, but not to exceed 8 feet. Once the final spacing is determined, the piles should be evaluated for group effects.

3.7 Lateral Pile Response

A representation of the shaft response under lateral loading exceeding 3 kips per pile is required for design of the bridge superstructure per Section 3.10.1.10 of the 2012 Bridge Manual. The lateral response can be developed by modeling the soil/shaft interaction with the computer program LPILE. Discrete elements are used in LPILE to represent the shaft and non-linear soil using springs. The non-linear soil springs are commonly referred to as P-Y curves. Tables for the pier and abutment locations summarizing approximate soil and rock parameters for the LPILE analyses are included in Appendix D (Reference: LPILE User's Manual, Ensoft, Inc., 2019).

4.0 CONSTRUCTION CONSIDERATIONS

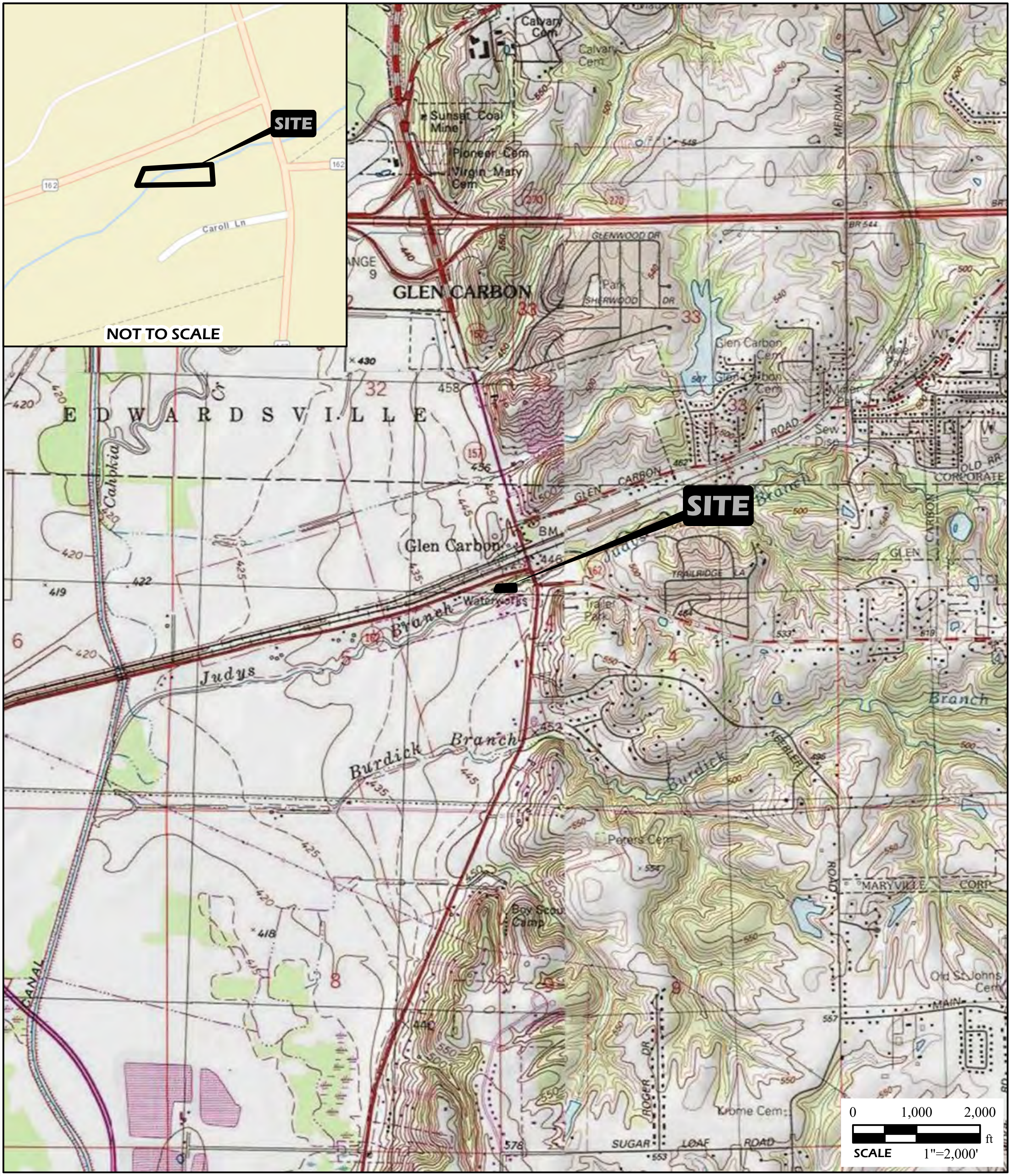
The construction activities should be performed in accordance with the current *IDOT Standard Specifications for Road and Bridge Construction* and any pertinent Special Provisions or policies. For the driven steel piles, cofferdams will likely be required for the two interior piers. The cofferdam should be properly designed and submitted to review by IDOT prior to construction.

4.1 Cofferdams for Pier Construction

Due to the proximity of the piers to the Design Head Water (DHW) elevation of 440.6, cofferdams are likely required for the construction of the pier foundations. As per the latest TS&L, a Type 1 cofferdam is planned for the construction of the interior piers. We anticipate the bottom elevation of the cofferdam will be likely in between 415 and 420. As such, silty to loamy to sandy soils are anticipated at the base of the cofferdam. The presence of these soils at the base will likely require aggressive dewatering with the combination of seal slab at the bottom may be required inside the cofferdam for relatively dry working conditions. In addition, the top of the cofferdam shall be set at a sufficient height that allows construction to continue during varying levels of water inside the creek. We recommend the need for a seal slab be evaluated based on the final configuration of piles and cofferdam sizing.

5.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of Fuhrmann Engineering and IDOT. They are specific only to the project described and are based on subsurface information obtained at two boring locations within the bridge area, our understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. SCI should be contacted if conditions encountered during construction are not consistent with those described.



PROJECT NAME

PTB 195, ITEM 57
IL-162 OVER JUDY'S BRANCH
MADISON COUNTY, ILLINOIS

VICINITY AND TOPOGRAPHIC MAP

DRAWN BY	RCV	**DATE**	**JOB NUMBER**
CHECKED BY	PP	04/2023	2020-0531.10

GENERAL NOTES/LEGEND

USGS TOPOGRAPHIC MAPS
WOOD RIVER, ILLINOIS QUADRANGLE
DATED 1994
10' CONTOURS
EDWARDSVILLE, ILLINOIS QUADRANGLE
DATED 1991
10' CONTOURS

MONKS MOUND, ILLINOIS QUADRANGLE
DATED 1954, REVISED 1993
10' CONTOURS
COLLINSVILLE, ILLINOIS QUADRANGLE
DATED 1991
10' CONTOURS

STREET MAP
HTTP://GOTO.ARCGISONLINE.COM/MAPS/WORLD_STREET_MAP

FIGURE
1

PROJECT NAME
PTB 195, ITEM 57
IL-162 OVER JUDY'S BRANCH
MADISON COUNTY, ILLINOIS

AERIAL PHOTOGRAPH

DRAWN BY KMC
CHECKED BY PP
DATE 04/2023
JOB NUMBER 2020-0531.10

GENERAL NOTES/LEGEND

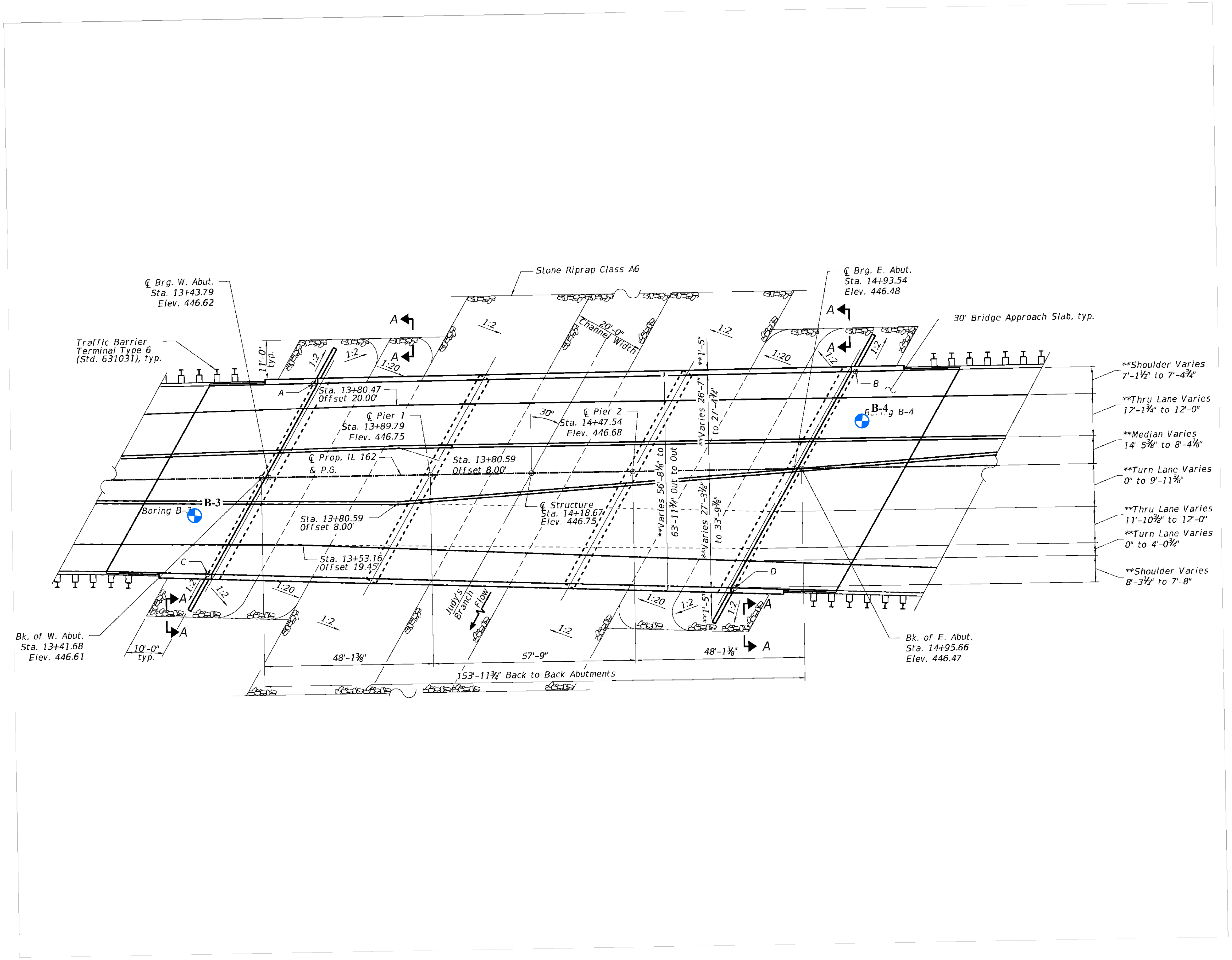
◐ APPROXIMATE STB LOCATIONS

AERIAL PHOTOGRAPH OBTAINED FROM ARCGIS ONLINE, WORLD IMAGERY.

DIMENSIONS AND LOCATIONS ARE APPROXIMATE; ACTUAL MAY VARY. DRAWING SHALL NOT BE USED OUTSIDE THE CONTEXT OF THE REPORT FOR WHICH IT WAS GENERATED.

N
W
E
S

FIGURE
2



0 15 30 ft

SCALE 1"=30'

GENERAL NOTES/LEGEND

● APPROXIMATE STB LOCATIONS

BASED ON THE UNDATED PLANS RECEIVED FROM FUHRMANN ENGINEERING ON MARCH 28, 2023

DIMENSIONS AND LOCATIONS ARE APPROXIMATE; ACTUAL MAY VARY. DRAWING SHALL NOT BE USED OUTSIDE THE CONTEXT OF THE REPORT FOR WHICH IT WAS GENERATED.

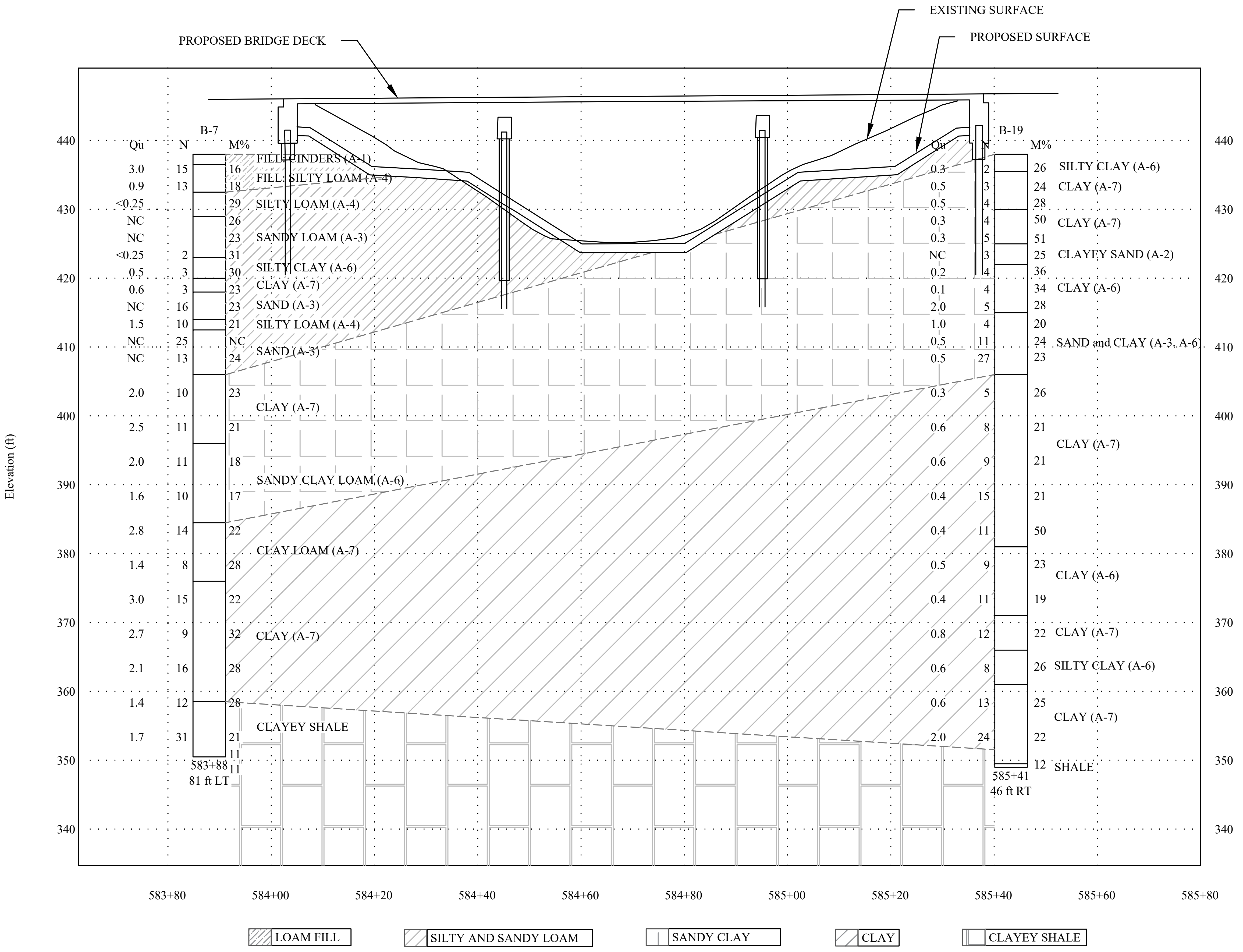
PROJECT NAME

PTB 195, ITEM 57
IL-162 OVER JUDY'S BRANCH
MADISON COUNTY, ILLINOIS

SITE PLAN

N
W E
S

JOB NUMBER	2020-0531.10
DATE	04/2023
DRAWN BY	JTM
CHECKED BY	PP
FIGURE	3



General Notes/Legend

VARIATIONS IN SUBSURFACE CONDITIONS MAY AND LIKELY EXIST BETWEEN BORINGS. DASHED HORIZONS ARE INTERPRETED AND ARE SHOWN FOR ILLUSTRATION ONLY.

PROJECT NAME
PTB 195 ITEM 157
IL - ROUTE 157 OVER JUDY'S BRANCH
MADISON COUNTY, ILLINOIS

SUBSURFACE PROFILE

SCALE	1" = 15' V 1" = 20' H
JOB NUMBER	2020-0531.10
DATE	04/2023
DRAWN BY	JTM
CHECKED BY	PP
FIGURE	4

Appendix A

SCI ENGINEERING, INC.
650 Pierce Boulevard
O'Fallon, Illinois 62269
618-624-6969
www.sciengineering.com

BORING LOG LEGEND AND NOMENCLATURE

Depth is in feet below ground surface. **Elevation** is in feet mean sea level, site datum, or as otherwise noted.

Sample Type

SS	Split-spoon sample, disturbed, obtained by driving a 2-inch-O.D. split-spoon sampler (ASTM D 1586).
NX	Diamond core bit, nominal 2-inch-diameter rock sample (ASTM D 2113).
ST	Thin-walled (Shelby) tube sample, relatively undisturbed, obtained by pushing a 3-inch-diameter, tube (ASTM D 1587).
CS	Continuous sample tube system, relatively undisturbed, obtained by split-barrel sampler in conjunction with auger advancement.
SV	Shear vane, field test to determine strength of cohesive soil by pushing or driving a 2-inch-diameter vane, and then shearing by torquing soil in existing and remolded states (ASTM D 2573).
BS	Bag sample, disturbed, obtained from cuttings.

Recovery is expressed as a ratio of the length recovered to the total length pushed, driven, cored.

Blows Numbers indicate blows per 6 inches of split-spoon sampler penetration when driven with a 140-pound hammer falling freely 30 inches. The number of total blows obtained for the second and third 6-inch increments is the N value (Standard Penetration Test or SPT) in blows per foot (ASTM D 1586). Practical refusal is considered to be 50 or more blows without achieving 6 inches of penetration, and is expressed as a ratio of 50 to actual penetration, e.g., 50/2 (50 blows for 2 inches).

For analysis, the N value is used when obtained by a cathead and rope system. When obtained by an automatic hammer, the N value may be increased by a factor of 1.3.

Vane Shear Strength is expressed as the peak strength (existing state) / the residual strength (remolded state).

Description indicates soil constituents and other classification characteristics (ASTM D 2488) and the Unified Soil Classification (ASTM D 2487). Secondary soil constituents (expressed as a percentage) are described as follows:

Trace	<5
Few	5-15
With	>15-30

Stratigraphic Breaks may be observed or interpreted, and are indicated by a dashed line. Transition between described materials may be gradual.

Laboratory Test Results

- Natural moisture content (ASTM D 2216) in percent.
- Dry density in pounds per cubic foot (pcf).
- Hand penetrometer value of apparently intact cohesive sample in kips per square foot (ksf).
- Unconfined compressive strength (ASTM D 2166) in kips per square foot (ksf).
- Liquid and Plastic Limits (ASTM D 4318) in percent.

RQD (Rock Quality Designation) is the ratio between the total length of core segments 4 inches or more in length and the total length of core drilled. RQD (expressed as a percentage) indicates insitu rock quality as follows:

Excellent	90 to 100
Good	75 to 90
Fair	50 to 75
Poor	25 to 50
Very Poor	0 to 25

Illinois Department of Transportation

Division of Highways
SCI Engineering, Inc.

SOIL BORING LOG

Date 2/25,28/2022

ROUTE Route 157/162 **DESCRIPTION** PTB 195, Item 57 IL-162 over Judy's Branch **LOGGED BY** SCI

SECTION 51-1R **LOCATION** Madison County, Illinois, **SEC.** 4, **TWP.** 3N, **RNG.** 8W
Lat 38.740588 **Long** -90.003715

COUNTY Madison **DRILLING METHOD** CME 550 w/HSA and Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. SN 060-0241
Station 14+18.67

BORING NO. B-3
Station 13+20
Offset 13 ft RT
Ground Surface Elev. 437.0 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 423.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
FILL: Brown SILTY LOAM (A-4), trace rocks and cinders, moist, stiff		2 3 8	2.5 P	17
434.0				
FILL: Brown CINDERS w/ layers of Silty Loam (A-2), medium dense	-5	6 8 6	3.8 P	17
431.5				
FILL: Brown SAND w/ Silty Loam (A-2), moist		3 5 5	2.3 P	18
429.0				
FILL: Brown CINDERS w/ layers of Silty Loam (A-2), medium dense	-10	2 2 2	NC	24
426.5				
Gray and Brown LOAM (A-4) w/ sand deposits, moist, soft *Percentage finer than #200 test performed (22.5% finer)*		WOH 1 2	0.3 B/20%	30
424.0	▼			
Brown SAND (A-2), loose, fine to coarse, trace coal, organics and fine gravel *Percentage finer than #200 test performed (20.6% finer)*	-15	2 1 1	NC	NC
		2 4 3	NC	NC
419.0				
Gray SILTY CLAY LOAM (A-6), very moist, soft 418.0 *Percentage finer than #200 test performed (19.1% finer)*	-20	2 5 7	NC	25

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Brown SAND (A-3), fine, wet, medium dense *Percentage finer than #200 test performed (26.4% finer) (continued)* Becomes very loose		WOH WOH WOH	NC	NC
Becomes medium dense	-25	5 5 5	NC	NC
		5 7 9	NC	NC
409.0				
Brown and Gray SILTY LOAM (A-4), very moist, stiff	-30	4 6 4	3.6 S/15%	26
404.5		5 3 10	NC	26
Gray SAND (A-3), fine, moist, medium dense	-35	11 12 12	NC	NC
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted

Illinois Department of Transportation

Division of Highways
SCI Engineering, Inc.

SOIL BORING LOG

Date 2/25,28/2022

ROUTE Route 157/162 **DESCRIPTION** PTB 195, Item 57 IL-162 over Judy's Branch **LOGGED BY** SCI

SECTION 51-1R **LOCATION** Madison County, Illinois, **SEC.** 4, **TWP.** 3N, **RNG.** 8W
Lat 38.740588 **Long** -90.003715

COUNTY Madison **DRILLING METHOD** CME 550 w/HSA and Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. SN 060-0241
Station 14+18.67

BORING NO. B-3
Station 13+20
Offset 13 ft RT
Ground Surface Elev. 437.0 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 423.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray SAND (A-3), fine, moist, medium dense *(continued)*				
Becomes very dense	-45	13 14 17	NC	NC
390.0				
Gray SAND (A-2), fine to coarse, moist, medium dense, trace fine gravel				
387.5				
Gray SANDY CLAY LOAM (A-6), moist, stiff	-50	14 6 5	1.5 B/20%	20
385.0				
Gray SILTY CLAY (A-6), moist, stiff	-55	5 5 8	2.6 B/20%	23
Becomes brown, trace gravel	-60	4 4 6	1.2 B/20%	22

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray SILTY CLAY (A-6), moist, stiff *(continued)*				
375.0				
Brown SILTY CLAY LOAM (A-6), moist, stiff, w/ sand deposits	-65	3 5 4	0.8 B/20%	22
370.0				
Gray CLAY (A-7), moist, very stiff	-70	4 7 8	2.7 B/20%	27
	-75	4 5 7	2.2 B/20%	25
	-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation

Division of Highways
SCI Engineering, Inc.

SOIL BORING LOG

Page 3 **of** 3

Date 2/25,28/2022

ROUTE Route 157/162 **DESCRIPTION** PTB 195, Item 57 IL-162 over Judy's Branch **LOGGED BY** SCI

SECTION 51-1R **LOCATION** Madison County, Illinois, **SEC.** 4, **TWP.** 3N, **RNG.** 8W
Lat 38.740588 **Long** -90.003715

COUNTY Madison **DRILLING METHOD** CME 550 w/HSA and Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. SN 060-0241
Station 14+18.67

BORING NO. B-3
Station 13+20
Offset 13 ft RT
Ground Surface Elev. 437.0 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter 423.5 **ft** ▼
Upon Completion N/A **ft**
After N/A **Hrs.** N/A **ft**

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray CLAY (A-7), moist, very stiff *(continued)*				
355.0				
Gray CLAY LOAM (A-7), moist, hard w/ weathered clayey shale				
	-85	12 14 19	2.6 S/15%	27
351.2				
Gray CLAYEY SHALE		50/5.5" 50/2.5"		13
350.0				
Sampler Refusal at 87 feet. Borehole grouted upon completion.		50/4.5" 50/1.5"		13
	-90			
	-95			
	-100			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted

Illinois Department of Transportation

Division of Highways
SCI Engineering, Inc.

SOIL BORING LOG

Page 1 **of** 3

Date 03/03/22

ROUTE Route 157/162 **DESCRIPTION** PTB 195, Item 57 IL-162 over Judy's Branch **LOGGED BY** SCI

SECTION 51-1R **LOCATION** Madison County, Illinois, **SEC.** 4, **TWP.** 3N, **RNG.** 8W
Lat 38.740693 **Long** -90.003037

COUNTY Madison **DRILLING METHOD** CME 550 w/HSA and Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. SN 060-0241
Station 14+18.67

BORING NO. B-4
Station 15+14
Offset 14 ft LT
Ground Surface Elev. 438.0 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 419.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

		DEPTH (ft)	**BLOWS (/6")**	**UCS Qu (tsf)**	**MOIST (%)**
Brown SILTY CLAY LOAM (A-6), trace roots, medium stiff					
	436.5				
Brown SILTY LOAM (A-4), moist, medium stiff			2 4 3	1.5 P	27
		-5	2 1 2	0.2 S/10%	20
Becomes soft	432.5				
Brown SILTY CLAY LOAM (A-6), moist, soft			1 2 1	0.3 S/10%	28
	430.0				
Brown SILTY LOAM (A-4), moist, soft *Percentage finer than #200 test performed (22.6% finer)*		-10	1 2 1	0.2 S/10%	29
	427.5				
Brown with Gray SILTY CLAY LOAM (A-6), very moist, very soft *Percentage finer than #200 test performed (24.7% finer)*			WOH 1 1	<0.25 P	27
Atterberg Limits and Percentage finer than #200 test performed (25.1% passing #200, LL=35, PI=31)		-15	WOH 2 2	0.3 B/20%	31
Becomes gray with brown, moist and soft Becomes grayish brown			WOH WOH 1	0.2 B/20%	33
▼					
	418.0	-20	1 1 2	0.5 B/20%	36

		DEPTH (ft)	**BLOWS (/6")**	**UCS Qu (tsf)**	**MOIST (%)**
Brown fine SAND (A-3), loose					
	416.5				
Grayish Brown SILTY CLAY LOAM (A-6), moist, soft			3 1 3	0.5 P	34
	415.0				
Brown fine SAND (A-3), wet, medium dense		-25	5 7 11	NC	NC
	412.5				
Gray SILTY LOAM (A-4) w/ clay deposits, moist, stiff			7 5 8	2.0 P	23
		-30	5 6 5	1.5 P	26
	406.0				
Gray fine SAND (A-3), wet, medium dense		-35	8 10 13	NC	20
	401.0				
Brown SILTY CLAY LOAM (A-6), moist, stiff		-40	6 4 6	1.3 S/15%	23

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation

Division of Highways
SCI Engineering, Inc.

SOIL BORING LOG

Page 2 **of** 3

Date 03/03/22

ROUTE Route 157/162 **DESCRIPTION** PTB 195, Item 57 IL-162 over Judy's Branch **LOGGED BY** SCI

SECTION 51-1R **LOCATION** Madison County, Illinois, **SEC.** 4, **TWP.** 3N, **RNG.** 8W
Lat 38.740693 **Long** -90.003037

COUNTY Madison **DRILLING METHOD** CME 550 w/HSA and Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. SN 060-0241
Station 14+18.67

BORING NO. B-4
Station 15+14
Offset 14 ft LT
Ground Surface Elev. 438.0 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 419.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Brown SILTY CLAY LOAM (A-6), moist, stiff *(continued)*				
w/ fine sand and clay deposits	-45	3 4 6	1.8 P	25
w/ fine sand deposit, no clay deposit	-50	4 3 4	1.5 P	27
Becomes gray	-55	2 4 5	0.9 S/15%	23
381.0				
Gray CLAY (A-7), moist, stiff	-60	5 4 7	1.9 B/20%	23

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray CLAY (A-7), moist, stiff *(continued)*				
376.0				
Gray SILTY CLAY LOAM (A-6), moist, stiff	-65	4 4 4	0.3 B/20%	23
	-70	2 4 5	1.3 B/20%	26
Becomes very stiff, w/ trace gravel	-75	5 12 16	1.0 S/10%	26
361.0				
Gray CLAY (A-7), moist, stiff	-80	WOH 4 4	0.9 B/20%	24

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation

Division of Highways
SCI Engineering, Inc.

SOIL BORING LOG

Page 3 **of** 3

Date 03/03/22

ROUTE Route 157/162 **DESCRIPTION** PTB 195, Item 57 IL-162 over Judy's Branch **LOGGED BY** SCI

SECTION 51-1R **LOCATION** Madison County, Illinois, **SEC.** 4, **TWP.** 3N, **RNG.** 8W
Lat 38.740693 **Long** -90.003037

COUNTY Madison **DRILLING METHOD** CME 550 w/HSA and Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. SN 060-0241
Station 14+18.67

BORING NO. B-4
Station 15+14
Offset 14 ft LT
Ground Surface Elev. 438.0 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter 419.5 **ft** ▼
Upon Completion N/A **ft**
After N/A **Hrs.** N/A **ft**

		DEPTH (ft)	**BLOWS (/6")**	**UCS Qu (tsf)**	**MOIST (%)**
Gray CLAY (A-7), moist, stiff *(continued)*					
		-85	5 6 6	1.0 B/20%	22
	350.5				13
Gray CLAYEY SHALE, hard			35 50/3" 50/1" 50/4"		13
	349.0				
Sampler Refusal at 89 feet. Borehole grouted upon completion.		-90			
		-95			
		-100			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
AASHTO Classifications are based on visual classifications unless otherwise noted BBS, form 137 (Rev. 8-99)

Appendix B

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==================================== B-3
ELEVATION OF BORING GROUND SURFACE ========================== 437.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ======================= 13.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==================== 10.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.374
EARTHQUAKE MOMENT MAGNITUDE ================================ 5.1
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== 2.38 FT. (Fill Height)
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 6 IN.
SAMPLING METHOD=== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.362**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **443** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.1
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = NMSZ
PGA = **0.256**

	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
434.5	2.5	11						0.119	0.298	20.423	20.423	0.221	0.119	0.583	0.583	1.467	**0.765**	0.940	**0.229**	**N.L. (1)**
432	5	14						0.122	0.603	24.009	24.009	0.274	0.122	0.888	0.888	1.320	**0.853**	0.902	**0.219**	**N.L. (1)**
429.5	7.5	10						0.118	0.898	14.840	14.840	0.158	0.118	1.183	1.183	1.165	**0.436**	0.859	**0.209**	**N.L. (1)**
427	10	4		22.5				0.108	1.168	5.757	10.307	0.116	0.046	1.298	1.447	1.121	**0.307**	0.811	**0.220**	**1.395 (C)**
424.5	12.5	3	0.33	22.5	11	29.7	29.7	0.109	1.440	4.244	8.648	0.101	0.047	1.416	1.720	1.094	**0.262**	0.760	**0.224**	**1.170 (C)**
422	15	2		20.6				0.048	1.560	2.853	6.805	0.086	0.048	1.536	1.996	1.071	**0.218**	0.707	**0.223**	**0.978 (C)**
419.5	17.5	7		19.1				0.058	1.705	9.904	14.084	0.151	0.058	1.681	2.297	1.062	**0.379**	0.654	**0.217**	**1.747 (C)**
417	20	12		26.4				0.063	1.863	17.091	23.664	0.268	0.063	1.838	2.611	1.046	**0.661**	0.603	**0.208**	**3.178 (D)**
414.5	22.5	1						0.043	1.970	1.375	1.375	0.050	0.043	1.946	2.874	1.017	**0.121**	0.555	**0.199**	**0.608 (C)**
412	25	10						0.061	2.123	13.427	13.427	0.145	0.061	2.098	3.183	1.003	**0.342**	0.511	**0.188**	**1.819 (D)**
409.5	27.5	16						0.065	2.285	21.938	21.938	0.241	0.065	2.261	3.501	0.981	**0.558**	0.473	**0.178**	**3.135 (D)**
407	30	10	3.64		10	26.3	26.3	0.075	2.473	12.641	12.641	0.137	0.075	2.448	3.845	0.965	**0.313**	0.439	**0.168**	**1.863 (D)**
402	35	13						0.063	2.788	15.776	15.776	0.168	0.063	2.763	4.472	0.932	**0.370**	0.388	**0.153**	**2.418 (D)**
397	40	24						0.069	3.133	29.591	29.591	0.441	0.069	3.108	5.129	0.873	**0.911**	0.353	**0.142**	**N.L. (3)**
392	45	31						0.071	3.488	37.459	37.459	-0.016	0.071	3.463	5.796	0.822	**-0.032**	0.331	**0.135**	**N.L. (3)**
387	50	11	1.53		12	20.2	20.2	0.064	3.808	11.253	11.253	0.124	0.064	3.783	6.428	0.871	**0.256**	0.318	**0.131**	**N.L. (2)**
382	55	13	2.61		12	22.7	22.7	0.071	4.163	12.639	12.639	0.137	0.071	4.138	7.095	0.847	**0.274**	0.309	**0.129**	**N.L. (2)**
377	60	10	1.24		12	22	22	0.062	4.473	9.310	9.310	0.107	0.062	4.448	7.717	0.845	**0.214**	0.304	**0.128**	**N.L. (2)**
372	65	9	0.75		12	21.7	21.7	0.056	4.753	8.063	8.063	0.096	0.056	4.728	8.309	0.839	**0.191**	0.293	**0.125**	**N.L. (2)**
367	70	15	2.74		12	26.7	26.7	0.071	5.108	12.817	12.817	0.139	0.071	5.083	8.976	0.804	**0.264**	0.286	**0.123**	**N.L. (2)**
362	75	12	2.18		12	24.8	24.8	0.068	5.448	9.823	9.823	0.112	0.068	5.423	9.628	0.805	**0.212**	0.279	**0.121**	**N.L. (2)**
357	80	33						0.072	5.808	27.877	27.877	0.365	0.072	5.783	10.300	0.709	**0.611**	0.272	**0.118**	**N.L. (3)**
352	85	43	2.61					0.071	6.163	36.205	36.205	-0.190	0.071	6.138	10.967	0.657	**-0.295**	0.265	**0.115**	**N.L. (3)**

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

DocuSign Envelope ID: 5E1E455F-F0F9-42F7-9EB1-448B5473362B

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===================================== B-4
ELEVATION OF BORING GROUND SURFACE ========================== 438.00 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ======================= 18.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE =================== 10.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.374
EARTHQUAKE MOMENT MAGNITUDE ================================ 5.1
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== 1.25 FT. (Fill Height)
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 6 IN.
SAMPLING METHOD=== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.362**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **381** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.1
Source-To-Site Distance, R (km) = 10
Ground Motion Prediction Equations = NMSZ
PGA = **0.256**

	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
435.5	2.5	7						0.114	0.285	12.333	12.333	0.134	0.114	0.435	0.435	1.477	**0.468**	0.931	**0.226**	**N.L. (1)**
433	5	3	0.18					0.103	0.543	4.778	4.778	0.070	0.103	0.693	0.693	1.251	**0.208**	0.877	**0.213**	**N.L. (1)**
430.5	7.5	3	0.31					0.109	0.815	4.419	4.419	0.068	0.109	0.965	0.965	1.170	**0.187**	0.819	**0.199**	**N.L. (1)**
428	10	3	0.18	22.6	5	29.4	29.4	0.103	1.073	4.431	8.869	0.103	0.041	1.068	1.146	1.166	**0.285**	0.758	**0.198**	**1.439 (C)**
425.5	12.5	2		24.7				0.101	1.325	2.913	7.499	0.092	0.039	1.165	1.399	1.138	**0.247**	0.696	**0.203**	**1.217 (C)**
423	15	4	0.26		31	30.9	30.9	0.107	1.593	5.660	5.660	0.077	0.045	1.278	1.668	1.109	**0.202**	0.635	**0.202**	**N.L. (2)**
420.5	17.5	1	0.23	25.1	11	32.6	32.6	0.106	1.858	1.366	5.823	0.078	0.044	1.388	1.934	1.091	**0.202**	0.577	**0.196**	**1.031 (C)**
418	20	3	0.46	11	11	36.3	36.3	0.050	1.983	4.060	5.376	0.075	0.050	1.513	2.215	1.071	**0.189**	0.523	**0.186**	**1.016 (C)**
415.5	22.5	4						0.053	2.115	5.329	5.329	0.075	0.053	1.645	2.503	1.053	**0.185**	0.475	**0.176**	**1.051 (C)**
413	25	18						0.066	2.280	24.952	24.952	0.291	0.066	1.810	2.824	1.053	**0.723**	0.433	**0.164**	**4.409 (D)**
410.5	27.5	13						0.063	2.438	16.788	16.788	0.179	0.063	1.968	3.138	1.021	**0.430**	0.397	**0.154**	**2.792 (D)**
408	30	11						0.062	2.593	13.580	13.580	0.146	0.062	2.123	3.449	1.000	**0.345**	0.367	**0.145**	**2.379 (D)**
403	35	23	1.33					0.062	2.903	29.365	29.365	0.429	0.062	2.433	4.071	0.953	**0.965**	0.322	**0.131**	**N.L. (3)**
398	40	10						0.061	3.208	11.181	11.181	0.124	0.061	2.738	4.688	0.941	**0.275**	0.293	**0.122**	**2.254 (C)**
393	45	10						0.061	3.513	10.678	10.678	0.119	0.061	3.043	5.305	0.918	**0.258**	0.275	**0.117**	**2.205 (C)**
388	50	7	0.88		11	26.9	26.9	0.058	3.803	7.167	7.167	0.089	0.058	3.333	5.907	0.908	**0.191**	0.264	**0.114**	**1.675 (C)**
383	55	9	1.89		11	22.7	22.7	0.067	4.138	8.783	8.783	0.103	0.067	3.668	6.554	0.885	**0.214**	0.257	**0.112**	**1.911 (C)**
378	60	11	0.33		11	22.9	22.9	0.047	4.373	10.389	10.389	0.117	0.047	3.903	7.101	0.867	**0.239**	0.253	**0.112**	**2.134 (C)**
373	65	8	1.34		11	23.2	23.2	0.063	4.688	7.232	7.232	0.090	0.063	4.218	7.728	0.863	**0.183**	0.245	**0.109**	**1.679 (C)**
368	70	9	0.97		11	26.4	26.4	0.059	4.983	7.818	7.818	0.094	0.059	4.513	8.335	0.848	**0.189**	0.238	**0.107**	**1.766 (C)**
363	75	28	0.88		11	26	26	0.058	5.273	24.861	24.861	0.289	0.058	4.803	8.937	0.767	**0.524**	0.231	**0.105**	**4.990 (D)**
358	80	8	0.95		11	23.5	23.5	0.059	5.568	6.463	6.463	0.083	0.059	5.098	9.544	0.832	**0.164**	0.224	**0.102**	**1.608 (C)**
353	85	12						0.063	5.883	9.334	9.334	0.107	0.063	5.413	10.171	0.808	**0.205**	0.217	**0.099**	**2.071 (C)**

* 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 C

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== W Abutment (SN 060-0241)
REFERENCE BORING ================================ B-3
LRFD or ASD or SEISMIC ================================ LRFD
PILE CUTOFF ELEV. ================================= 441.38 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 439.38 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 ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**511** KIPS	**99** 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			NOMINAL UNPLUG'D			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
434.50	4.88		11	Very Fine Silty Sand	4.1		36.5	5.9		***11.2***	11	0	0	6	7
432.00	2.50		14	Very Fine Silty Sand	2.6	32.4	34.2	3.9	5.3	***14.3***	14	0	0	8	9
429.50	2.50		10	Very Fine Silty Sand	1.9	27.5	19.6	2.8	4.5	***14.4***	14	0	0	8	12
427.00	2.50		4	Very Fine Silty Sand	0.8	11.0	16.1	1.1	1.8	***14.8***	15	0	0	8	14
424.50	2.50	0.33	3		3.2	6.8	***18.0***	4.7	1.1	19.3	18	0	0	10	17
422.00	2.50		2	Very Fine Silty Sand	0.4	5.5	32.2	0.6	0.9	***22.1***	22	0	0	12	19
419.50	2.50		7	Very Fine Silty Sand	1.3	19.2	47.2	1.9	3.1	***26.3***	26	0	0	14	22
417.00	2.50		12	Very Fine Silty Sand	2.3	32.9	***16.5***	3.3	5.4	24.2	17	0	0	9	24
414.50	2.50		0		0.0	0.0	53.1	0.0	0.0	***30.2***	30	0	0	17	27
412.00	2.50		10	Fine Sand	2.1	36.6	77.2	3.0	6.0	***36.8***	37	0	0	20	29
409.50	2.50		16	Fine Sand	3.3	58.6	96.9	4.9	9.5	***44.3***	44	0	0	24	32
407.00	2.50	3.64	10		21.4	75.0	79.0	31.4	12.2	***69.4***	69	0	0	38	34
402.00	5.00		13	Very Fine Silty Sand	4.9	35.7	136.1	7.2	5.8	***85.0***	85	0	0	47	39
397.00	5.00		24	Fine Sand	10.0	87.9	171.7	14.6	14.3	***103.8***	104	0	0	57	44
392.00	5.00		31	Fine Sand	13.0	113.5	***102.7***	19.1	18.5	109.6	103	0	0	57	49
387.00	5.00	1.53	11		23.6	31.5	148.6	34.7	5.1	***148.0***	148	0	0	81	54
382.00	5.00	2.61	13		33.6	53.7	***154.0***	49.4	8.7	192.7	154	0	0	85	59
377.00	5.00	1.24	10		20.4	25.5	***164.3***	29.9	4.2	221.0	164	0	0	90	64
372.00	5.00	0.75	9		13.6	15.4	***218.9***	19.9	2.5	247.5	219	0	0	120	69
367.00	5.00	2.74	15		34.8	56.4	***242.1***	51.1	9.2	296.7	242	0	0	133	74
362.00	5.00	2.18	12		29.8	44.9	***347.9***	43.8	7.3	352.8	348	0	0	191	79
357.00	5.00		33	Medium Sand	16.0	120.8	***296.8***	23.4	19.6	365.3	297	0	0	163	84
350.00	7.00	2.61	43		47.1	53.7	473.1	69.1	8.7	***455.5***	455	0	0	251	91
349.00	1.00			Shale	60.4	183.0	***533.6***	88.7	29.8	544.1	534	0	0	293	92.4
348.00	1.00			Shale	60.4	183.0	***594.0***	88.7	29.8	632.8	594	0	0	327	93.4
347.00	1.00			Shale	60.4	183.0	***654.4***	88.7	29.8	721.4	654	0	0	360	94.4
346.00	1.00			Shale	60.4	183.0	***714.8***	88.7	29.8	810.1	715	0	0	393	95.4
345.00	1.00			Shale	60.4	183.0	***775.2***	88.7	29.8	898.7	775	0	0	426	96.4
344.00	1.00			Shale	60.4	183.0	***835.6***	88.7	29.8	987.4	836	0	0	460	97.4
343.00	1.00			Shale	60.4	183.0	***896.1***	88.7	29.8	1076.0	896	0	0	493	98.4
342.00	1.00			Shale	60.4	183.0	***956.5***	88.7	29.8	1164.7	~~956~~	~~*0*~~	~~*0*~~	~~*526*~~	~~*99.4*~~
341.00	1.00			Shale	60.4	183.0	***1016.9***	88.7	29.8	1253.3	~~1017~~	~~*0*~~	~~*0*~~	~~*559*~~	~~*100.4*~~
340.00	1.00			Shale	60.4	183.0	***1077.3***	88.7	29.8	1342.0	~~1077~~	~~*0*~~	~~*0*~~	~~*593*~~	~~*101.4*~~
339.00	1.00			Shale	60.4	183.0	***1137.7***	88.7	29.8	1430.6	~~1138~~	~~*0*~~	~~*0*~~	~~*626*~~	~~*102.4*~~
338.00	1.00			Shale	60.4	183.0	***1198.2***	88.7	29.8	1519.3	~~1198~~	~~*0*~~	~~*0*~~	~~*659*~~	~~*103.4*~~
337.00	1.00			Shale	60.4	183.0	***1258.6***	88.7	29.8	1608.0	~~1259~~	~~*0*~~	~~*0*~~	~~*692*~~	~~*104.4*~~
336.00	1.00			Shale		183.0			29.8						

Pile Design Table for W Abutment (SN 060-0241) utilizing Boring #B-3

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	123	68	74
	152	83	84
	218	120	91
	286	157	94
Steel HP 10 X 42			
	108	60	64
	137	75	69
	155	85	74
	190	105	84
	282	155	91
	335	184	93
Steel HP 10 X 57			
	111	61	64
	140	77	69
	158	87	74
	194	107	84
	289	159	91
	454	250	95
Steel HP 12 X 53			
	132	73	64
	171	94	69
	191	105	74
	235	129	84
	360	198	91
	418	230	93
Steel HP 12 X 63			
	123	68	59
	133	73	64
	172	95	69
	193	106	74
	237	130	84
	364	200	91
	497	273	94
Steel HP 12 X 74			
	125	69	59
	135	74	64
	175	96	69
	196	108	74
	240	132	84
	370	203	91
	589	324	96
Steel HP 12 X 84			
	127	70	59
	137	75	64
	178	98	69
	199	109	74
	244	134	84
	376	207	91
	664	365	97
Steel HP 14 X 73			
	99	54	49
	142	78	54
	149	82	59
	159	87	64
	210	116	69
	233	128	74
	286	157	84
	436	240	91
	578	318	94
Steel HP 14 X 89			
	100	55	49
	144	79	54
	150	83	59
	161	88	64
	213	117	69
	236	130	74
	290	159	84
	443	244	91
	705	388	96
Steel HP 14 X 102			
	101	56	49
	146	80	54
	152	84	59
	162	89	64
	216	119	69
	239	132	74
	293	161	84
	448	246	91
	810	445	97
Steel HP 14 X 117			
	103	57	49
	148	81	54
	154	85	59
	164	90	64
	219	120	69
	242	133	74
	297	163	84
	455	251	91
	929	511	99

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== W Abutment (SN 060-0241)
REFERENCE BORING ================================ B-3
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================= 441.38 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 439.38 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== DD
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 423.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**490** KIPS	**99** 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			NOMINAL UNPLUG'D			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
434.50	4.88		11	Very Fine Silty Sand	4.1		36.5	5.9		***11.2***	11	2	4	-1	7
432.00	2.50		14	Very Fine Silty Sand	2.6	32.4	34.2	3.9	5.3	***14.3***	14	4	7	-3	9
429.50	2.50		10	Very Fine Silty Sand	1.9	27.5	19.6	2.8	4.5	***14.4***	14	5	9	-6	12
427.00	2.50		4	Very Fine Silty Sand	0.8	11.0	16.1	1.1	1.8	***14.8***	15	5	10	-7	14
424.50	2.50	0.33	3		3.2	6.8	***18.0***	4.7	1.1	19.3	18	7	14	-11	17
422.00	2.50		2	Very Fine Silty Sand	0.4	5.5	32.2	0.6	0.9	***22.1***	22	7	14	-9	19
419.50	2.50		7	Very Fine Silty Sand	1.3	19.2	47.2	1.9	3.1	***26.3***	26	7	14	-6	22
417.00	2.50		12	Very Fine Silty Sand	2.3	32.9	***16.5***	3.3	5.4	24.2	17	7	14	-12	24
414.50	2.50		0		0.0	0.0	53.1	0.0	0.0	***30.2***	30	7	14	-4	27
412.00	2.50		10	Fine Sand	2.1	36.6	77.2	3.0	6.0	***36.8***	37	7	14	-1	29
409.50	2.50		16	Fine Sand	3.3	58.6	96.9	4.9	9.5	***44.3***	44	7	14	4	32
407.00	2.50	3.64	10		21.4	75.0	79.0	31.4	12.2	***69.4***	69	7	14	17	34
402.00	5.00		13	Very Fine Silty Sand	4.9	35.7	136.1	7.2	5.8	***85.0***	85	7	14	26	39
397.00	5.00		24	Fine Sand	10.0	87.9	171.7	14.6	14.3	***103.8***	104	7	14	36	44
392.00	5.00		31	Fine Sand	13.0	113.5	***102.7***	19.1	18.5	109.6	103	7	14	36	49
387.00	5.00	1.53	11		23.6	31.5	148.6	34.7	5.1	***148.0***	148	7	14	61	54
382.00	5.00	2.61	13		33.6	53.7	***154.0***	49.4	8.7	192.7	154	7	14	64	59
377.00	5.00	1.24	10		20.4	25.5	***164.3***	29.9	4.2	221.0	164	7	14	70	64
372.00	5.00	0.75	9		13.6	15.4	***218.9***	19.9	2.5	247.5	219	7	14	100	69
367.00	5.00	2.74	15		34.8	56.4	***242.1***	51.1	9.2	296.7	242	7	14	112	74
362.00	5.00	2.18	12		29.8	44.9	***347.9***	43.8	7.3	352.8	348	7	14	171	79
357.00	5.00		33	Medium Sand	16.0	120.8	***296.8***	23.4	19.6	365.3	297	7	14	142	84
350.00	7.00	2.61	43		47.1	53.7	473.1	69.1	8.7	***455.5***	455	7	14	230	91
349.00	1.00			Shale	60.4	183.0	***533.6***	88.7	29.8	544.1	534	7	14	273	92.4
348.00	1.00			Shale	60.4	183.0	***594.0***	88.7	29.8	632.8	594	7	14	306	93.4
347.00	1.00			Shale	60.4	183.0	***654.4***	88.7	29.8	721.4	654	7	14	339	94.4
346.00	1.00			Shale	60.4	183.0	***714.8***	88.7	29.8	810.1	715	7	14	372	95.4
345.00	1.00			Shale	60.4	183.0	***775.2***	88.7	29.8	898.7	775	7	14	406	96.4
344.00	1.00			Shale	60.4	183.0	***835.6***	88.7	29.8	987.4	836	7	14	439	97.4
343.00	1.00			Shale	60.4	183.0	***896.1***	88.7	29.8	1076.0	896	7	14	472	98.4
342.00	1.00			Shale	60.4	183.0	***956.5***	88.7	29.8	1164.7	~~956~~	~~7~~	~~14~~	~~505~~	~~99.4~~
341.00	1.00			Shale	60.4	183.0	***1016.9***	88.7	29.8	1253.3	~~1017~~	~~7~~	~~14~~	~~539~~	~~100.4~~
340.00	1.00			Shale	60.4	183.0	***1077.3***	88.7	29.8	1342.0	~~1077~~	~~7~~	~~14~~	~~572~~	~~101.4~~
339.00	1.00			Shale	60.4	183.0	***1137.7***	88.7	29.8	1430.6	~~1138~~	~~7~~	~~14~~	~~605~~	~~102.4~~
338.00	1.00			Shale	60.4	183.0	***1198.2***	88.7	29.8	1519.3	~~1198~~	~~7~~	~~14~~	~~638~~	~~103.4~~
337.00	1.00			Shale	60.4	183.0	***1258.6***	88.7	29.8	1608.0	~~1259~~	~~7~~	~~14~~	~~671~~	~~104.4~~
336.00	1.00			Shale		183.0			29.8						

Pile Design Table for W Abutment (SN 060-0241) utilizing Boring #B-3 - DD

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	152	72	84
	218	108	91
	286	146	94
Steel HP 10 X 42			
	155	71	74
	190	91	84
	282	141	91
	335	170	93
Steel HP 10 X 57			
	158	73	74
	194	93	84
	289	145	91
	454	235	95
Steel HP 12 X 53			
	132	56	64
	171	77	69
	191	88	74
	235	112	84
	360	181	91
	418	213	93
Steel HP 12 X 63			
	133	56	64
	172	78	69
	193	89	74
	237	113	84
	364	183	91
	497	256	94
Steel HP 12 X 74			
	135	57	64
	175	79	69
	196	90	74
	240	115	84
	370	186	91
	589	306	96
Steel HP 12 X 84			
	137	58	64
	178	80	69
	199	92	74
	244	117	84
	376	189	91
	664	348	97
Steel HP 14 X 73			
	159	67	64
	210	96	69
	233	108	74
	286	137	84
	436	220	91
	578	298	94
Steel HP 14 X 89			
	161	68	64
	213	97	69
	236	110	74
	290	139	84
	443	223	91
	705	367	96
Steel HP 14 X 102			
	162	69	64
	216	98	69
	239	111	74
	293	141	84
	448	226	91
	810	425	97
Steel HP 14 X 117			
	164	70	64
	219	100	69
	242	112	74
	297	142	84
	455	230	91
	929	490	99

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== Int W Pier est. (SN060-0241)
REFERENCE BORING ================================= B-3
LRFD or ASD or SEISMIC ================================ LRFD
PILE CUTOFF ELEV. ================================= 441.38 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 425.67 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 ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**511** KIPS	**99** 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			NOMINAL UNPLUG'D			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
424.50	1.17	0.33	3		1.5		3.8	2.2		***2.6***	3	0	0	1	17
422.00	2.50		2	Very Fine Silty Sand	0.4	2.3	15.4	0.6	0.4	***5.0***	5	0	0	3	19
419.50	2.50		7	Very Fine Silty Sand	1.3	13.6	35.8	1.9	2.2	***10.0***	10	0	0	6	22
417.00	2.50		12	Very Fine Silty Sand	2.3	32.6	***5.5***	3.3	5.3	8.0	5	0	0	3	24
414.50	2.50		0		0.0	0.0	42.1	0.0	0.0	***14.0***	14	0	0	8	27
412.00	2.50		10	Fine Sand	2.1	36.6	66.1	3.0	6.0	***20.6***	21	0	0	11	29
409.50	2.50		16	Fine Sand	3.3	58.6	85.8	4.9	9.5	***28.1***	28	0	0	15	32
407.00	2.50	3.64	10		21.4	75.0	67.9	31.4	12.2	***53.1***	53	0	0	29	34
402.00	5.00		13	Very Fine Silty Sand	4.9	35.7	125.0	7.2	5.8	***68.8***	69	0	0	38	39
397.00	5.00		24	Fine Sand	10.0	87.9	160.6	14.6	14.3	***87.6***	88	0	0	48	44
392.00	5.00		31	Fine Sand	13.0	113.5	***91.7***	19.1	18.5	93.4	92	0	0	50	49
387.00	5.00	1.53	11		23.6	31.5	137.6	34.7	5.1	***131.7***	132	0	0	72	54
382.00	5.00	2.61	13		33.6	53.7	***143.0***	49.4	8.7	176.5	143	0	0	79	59
377.00	5.00	1.24	10		20.4	25.5	***153.3***	29.9	4.2	204.8	153	0	0	84	64
372.00	5.00	0.75	9		13.6	15.4	***207.8***	19.9	2.5	231.3	208	0	0	114	69
367.00	5.00	2.74	15		34.8	56.4	***231.1***	51.1	9.2	280.5	231	0	0	127	74
362.00	5.00	2.18	12		29.8	44.9	336.8	43.8	7.3	***336.6***	337	0	0	185	79
357.00	5.00		33	Medium Sand	16.0	120.8	***285.7***	23.4	19.6	349.1	286	0	0	157	84
350.00	7.00	2.61	43		47.1	53.7	462.1	69.1	8.7	***439.2***	439	0	0	242	91
349.00	1.00			Shale	60.4	183.0	***522.5***	88.7	29.8	527.9	523	0	0	287	92.4
348.00	1.00			Shale	60.4	183.0	***582.9***	88.7	29.8	616.6	583	0	0	321	93.4
347.00	1.00			Shale	60.4	183.0	***643.3***	88.7	29.8	705.2	643	0	0	354	94.4
346.00	1.00			Shale	60.4	183.0	***703.8***	88.7	29.8	793.9	704	0	0	387	95.4
345.00	1.00			Shale	60.4	183.0	***764.2***	88.7	29.8	882.5	764	0	0	420	96.4
344.00	1.00			Shale	60.4	183.0	***824.6***	88.7	29.8	971.2	825	0	0	454	97.4
343.00	1.00			Shale	60.4	183.0	***885.0***	88.7	29.8	1059.8	885	0	0	487	98.4
342.00	1.00			Shale	60.4	183.0	***945.4***	88.7	29.8	1148.5	~~945~~	~~*0*~~	~~*0*~~	~~*520*~~	~~*99.4*~~
341.00	1.00			Shale	60.4	183.0	***1005.9***	88.7	29.8	1237.1	~~1006~~	~~*0*~~	~~*0*~~	~~*553*~~	~~*100.4*~~
340.00	1.00			Shale	60.4	183.0	***1066.3***	88.7	29.8	1325.8	~~1066~~	~~*0*~~	~~*0*~~	~~*586*~~	~~*101.4*~~
339.00	1.00			Shale	60.4	183.0	***1126.7***	88.7	29.8	1414.4	~~1127~~	~~*0*~~	~~*0*~~	~~*620*~~	~~*102.4*~~
338.00	1.00			Shale		183.0			29.8						

Pile Design Table for Int W Pier est. (SN060-0241) utilizing Boring #B-3

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	117	65	74
	146	80	84
	212	116	91
	286	157	94
Steel HP 10 X 42			
	129	71	69
	147	81	74
	183	100	84
	275	151	91
	335	184	93
Steel HP 10 X 57			
	132	73	69
	151	83	74
	187	103	84
	282	155	91
	454	250	96
Steel HP 12 X 53			
	123	68	64
	162	89	69
	182	100	74
	226	124	84
	347	191	91
	418	230	93
Steel HP 12 X 63			
	124	68	64
	163	90	69
	184	101	74
	228	125	84
	354	195	91
	497	273	94
Steel HP 12 X 74			
	126	69	64
	166	91	69
	187	103	74
	231	127	84
	359	197	91
	589	324	96
Steel HP 12 X 84			
	128	70	64
	168	93	69
	189	104	74
	235	129	84
	363	200	91
	664	365	97
Steel HP 14 X 73			
	126	69	54
	138	76	59
	148	81	64
	200	110	69
	223	122	74
	275	151	84
	420	231	91
	578	318	94
Steel HP 14 X 89			
	128	71	54
	140	77	59
	150	82	64
	202	111	69
	225	124	74
	279	153	84
	427	235	91
	705	388	96
Steel HP 14 X 102			
	130	71	54
	141	78	59
	152	83	64
	205	113	69
	228	126	74
	282	155	84
	432	238	91
	810	445	97
Steel HP 14 X 117			
	132	72	54
	143	79	59
	153	84	64
	208	114	69
	231	127	74
	286	157	84
	439	242	91
	929	511	99

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== Int W Pier est. (SN060-0241)
REFERENCE BORING ================================ B-3
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================= 441.38 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 425.67 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ============== 415.46 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**508** KIPS	**99** 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			NOMINAL UNPLUG'D			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
424.50	1.17	0.33	3		1.5		3.8	2.2		***2.6***	3	1	0	1	17
422.00	2.50		2	Very Fine Silty Sand	0.4	2.3	15.4	0.6	0.4	***5.0***	5	1	0	2	19
419.50	2.50		7	Very Fine Silty Sand	1.3	13.6	35.8	1.9	2.2	***10.0***	10	2	0	4	22
417.00	2.50		12	Very Fine Silty Sand	2.3	32.6	***5.5***	3.3	5.3	8.0	5	3	0	0	24
414.50	2.50		0		0.0	0.0	42.1	0.0	0.0	***14.0***	14	3	0	5	27
412.00	2.50		10	Fine Sand	2.1	36.6	66.1	3.0	6.0	***20.6***	21	3	0	8	29
409.50	2.50		16	Fine Sand	3.3	58.6	85.8	4.9	9.5	***28.1***	28	3	0	12	32
407.00	2.50	3.64	10		21.4	75.0	67.9	31.4	12.2	***53.1***	53	3	0	26	34
402.00	5.00		13	Very Fine Silty Sand	4.9	35.7	125.0	7.2	5.8	***68.8***	69	3	0	35	39
397.00	5.00		24	Fine Sand	10.0	87.9	160.6	14.6	14.3	***87.6***	88	3	0	45	44
392.00	5.00		31	Fine Sand	13.0	113.5	***91.7***	19.1	18.5	93.4	92	3	0	47	49
387.00	5.00	1.53	11		23.6	31.5	137.6	34.7	5.1	***131.7***	132	3	0	69	54
382.00	5.00	2.61	13		33.6	53.7	***143.0***	49.4	8.7	176.5	143	3	0	76	59
377.00	5.00	1.24	10		20.4	25.5	***153.3***	29.9	4.2	204.8	153	3	0	81	64
372.00	5.00	0.75	9		13.6	15.4	***207.8***	19.9	2.5	231.3	208	3	0	111	69
367.00	5.00	2.74	15		34.8	56.4	***231.1***	51.1	9.2	280.5	231	3	0	124	74
362.00	5.00	2.18	12		29.8	44.9	336.8	43.8	7.3	***336.6***	337	3	0	182	79
357.00	5.00		33	Medium Sand	16.0	120.8	***285.7***	23.4	19.6	349.1	286	3	0	154	84
350.00	7.00	2.61	43		47.1	53.7	462.1	69.1	8.7	***439.2***	439	3	0	239	91
349.00	1.00			Shale	60.4	183.0	***522.5***	88.7	29.8	527.9	523	3	0	284	92.4
348.00	1.00			Shale	60.4	183.0	***582.9***	88.7	29.8	616.6	583	3	0	318	93.4
347.00	1.00			Shale	60.4	183.0	***643.3***	88.7	29.8	705.2	643	3	0	351	94.4
346.00	1.00			Shale	60.4	183.0	***703.8***	88.7	29.8	793.9	704	3	0	384	95.4
345.00	1.00			Shale	60.4	183.0	***764.2***	88.7	29.8	882.5	764	3	0	417	96.4
344.00	1.00			Shale	60.4	183.0	***824.6***	88.7	29.8	971.2	825	3	0	451	97.4
343.00	1.00			Shale	60.4	183.0	***885.0***	88.7	29.8	1059.8	885	3	0	484	98.4
342.00	1.00			Shale	60.4	183.0	***945.4***	88.7	29.8	1148.5	~~945~~	~~3~~	~~0~~	~~517~~	~~99.4~~
341.00	1.00			Shale	60.4	183.0	***1005.9***	88.7	29.8	1237.1	~~1006~~	~~3~~	~~0~~	~~550~~	~~100.4~~
340.00	1.00			Shale	60.4	183.0	***1066.3***	88.7	29.8	1325.8	~~1066~~	~~3~~	~~0~~	~~583~~	~~101.4~~
339.00	1.00			Shale	60.4	183.0	***1126.7***	88.7	29.8	1414.4	~~1127~~	~~3~~	~~0~~	~~617~~	~~102.4~~
338.00	1.00			Shale		183.0			29.8						

Pile Design Table for Int W Pier est. (SN060-0241) utilizing Boring #B-3

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	117	63	74
	146	78	84
	212	115	91
	286	156	94
Steel HP 10 X 42			
	129	69	69
	147	79	74
	183	98	84
	275	149	91
	335	182	93
Steel HP 10 X 57			
	132	71	69
	151	81	74
	187	101	84
	282	153	91
	454	247	96
Steel HP 12 X 53			
	123	65	64
	162	86	69
	182	98	74
	226	122	84
	347	188	91
	418	228	93
Steel HP 12 X 63			
	124	66	64
	163	87	69
	184	99	74
	228	123	84
	354	192	91
	497	271	94
Steel HP 12 X 74			
	126	67	64
	166	89	69
	187	100	74
	231	125	84
	359	195	91
	589	321	96
Steel HP 12 X 84			
	128	68	64
	168	90	69
	189	102	74
	235	126	84
	363	197	91
	664	363	97
Steel HP 14 X 73			
	126	66	54
	138	73	59
	148	79	64
	200	107	69
	223	119	74
	275	148	84
	420	228	91
	578	315	94
Steel HP 14 X 89			
	128	68	54
	140	74	59
	150	79	64
	202	108	69
	225	121	74
	279	150	84
	427	232	91
	705	385	96
Steel HP 14 X 102			
	130	68	54
	141	75	59
	152	80	64
	205	110	69
	228	123	74
	282	152	84
	432	235	91
	810	442	97
Steel HP 14 X 117			
	132	69	54
	143	76	59
	153	81	64
	208	111	69
	231	124	74
	286	154	84
	439	239	91
	929	508	99

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== Int E Pier est. (SN060-0241)
REFERENCE BORING ================================ B-4
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 441.25 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 425.67 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

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	**929** KIPS	**511** KIPS	**98** FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

					NOMINAL			***NOMINAL UNPLUG'D***							
BOT. OF LAYER ELEV. (FT.)	***LAYER THICK. (FT.)***	***UNCONF. COMPR. STRENGTH (TSF.)***	***S.P.T. N VALUE (BLOWS)***	***GRANULAR OR ROCK LAYER DESCRIPTION***	***SIDE RESIST. (KIPS)***	***END BRG. RESIST. (KIPS)***	***TOTAL RESIST. (KIPS)***	***SIDE RESIST. (KIPS)***	***END BRG. RESIST. (KIPS)***	***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.)***
425.50	0.17		2	Very Fine Silty Sand	0.0		5.4	0.0		***0.9***	1	0	0	0	16
423.00	2.50	0.26	4		2.6	5.4	7.3	3.8	0.9	***4.6***	5	0	0	3	18
420.50	2.50	0.23	1		2.3	4.7	14.3	3.3	0.8	***8.7***	9	0	0	5	21
418.00	2.50	0.46	3		4.4	9.5	20.2	6.4	1.5	***15.4***	15	0	0	8	23
415.50	2.50		4	Very Fine Silty Sand	0.8	11.0	75.9	1.1	1.8	***25.4***	25	0	0	14	26
413.00	2.50		18	Fine Sand	3.7	65.9	49.4	5.5	10.7	***26.0***	26	0	0	14	28
410.50	2.50		13	Very Fine Silty Sand	2.5	35.7	46.4	3.6	5.8	***28.7***	29	0	0	16	31
408.00	2.50		11	Very Fine Silty Sand	2.1	30.2	102.5	3.0	4.9	***40.5***	40	0	0	22	33
403.00	5.00		23	Fine Sand	9.6	84.2	55.2	14.0	13.7	***45.3***	45	0	0	25	38
398.00	5.00	1.33	10		21.4	27.4	85.9	31.5	4.5	***78.2***	78	0	0	43	43
393.00	5.00		10	Fine Sand	4.2	36.6	***79.0***	6.1	6.0	82.6	79	0	0	43	48
388.00	5.00		7	Fine Sand	2.9	25.6	***74.4***	4.3	4.2	85.6	74	0	0	41	53
383.00	5.00	0.88	9		15.5	18.1	***110.8***	22.8	2.9	111.7	111	0	0	61	58
378.00	5.00	1.89	11		27.2	38.9	***105.9***	40.0	6.3	146.5	106	0	0	58	63
373.00	5.00	0.33	8		6.4	6.8	***133.1***	9.4	1.1	159.3	133	0	0	73	68
368.00	5.00	1.34	9		21.6	27.6	***147.0***	31.6	4.5	189.7	147	0	0	81	73
363.00	5.00	0.97	28		16.8	20.0	***162.0***	24.7	3.2	214.0	162	0	0	89	78
358.00	5.00	0.88	8		15.5	18.1	***178.9***	22.8	2.9	237.1	179	0	0	98	83
353.00	5.00	0.95	12		16.5	19.6	358.9	24.3	3.2	***287.9***	288	0	0	158	88
352.00	1.00			Shale	60.4	183.0	419.4	88.7	29.8	***376.5***	377	0	0	207	89.3
351.00	1.00			Shale	60.4	183.0	479.8	88.7	29.8	***465.2***	465	0	0	256	90.3
350.00	1.00			Shale	60.4	183.0	***540.2***	88.7	29.8	553.8	540	0	0	297	91.3
349.00	1.00			Shale	60.4	183.0	***600.6***	88.7	29.8	642.5	601	0	0	330	92.3
348.00	1.00			Shale	60.4	183.0	***661.0***	88.7	29.8	731.2	661	0	0	364	93.3
347.00	1.00			Shale	60.4	183.0	***721.4***	88.7	29.8	819.8	721	0	0	397	94.3
346.00	1.00			Shale	60.4	183.0	***781.9***	88.7	29.8	908.5	782	0	0	430	95.3
345.00	1.00			Shale	60.4	183.0	***842.3***	88.7	29.8	997.1	842	0	0	463	96.3
344.00	1.00			Shale	60.4	183.0	***902.7***	88.7	29.8	1085.8	903	0	0	496	97.3
343.00	1.00			Shale	60.4	183.0	***963.1***	88.7	29.8	1174.4	~~963~~	~~*0*~~	~~*0*~~	~~*530*~~	~~*98.3*~~
342.00	1.00			Shale	60.4	183.0	***1023.5***	88.7	29.8	1263.1	~~1024~~	~~*0*~~	~~*0*~~	~~*563*~~	~~*99.3*~~
341.00	1.00			Shale	60.4	183.0	***1084.0***	88.7	29.8	1351.7	~~1084~~	~~*0*~~	~~*0*~~	~~*596*~~	~~*100.3*~~
340.00	1.00			Shale	60.4	183.0	***1144.4***	88.7	29.8	1440.4	~~1144~~	~~*0*~~	~~*0*~~	~~*629*~~	~~*101.3*~~
339.00	1.00			Shale	60.4	183.0	***1204.8***	88.7	29.8	1529.0	~~1205~~	~~*0*~~	~~*0*~~	~~*663*~~	~~*102.3*~~
338.00	1.00			Shale	60.4	183.0	***1265.2***	88.7	29.8	1617.7	~~1265~~	~~*0*~~	~~*0*~~	~~*696*~~	~~*103.3*~~
337.00	1.00			Shale	60.4	183.0	***1325.6***	88.7	29.8	1706.3	~~1326~~	~~*0*~~	~~*0*~~	~~*729*~~	~~*104.3*~~
336.00	1.00			Shale	60.4	183.0	***1386.0***	88.7	29.8	1795.0	~~1386~~	~~*0*~~	~~*0*~~	~~*762*~~	~~*105.3*~~
335.00	1.00			Shale		183.0			29.8						

Pile Design Table for Int E Pier est. (SN060-0241) utilizing Boring #B-4

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	95	52	83
	150	83	88
	286	157	92

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	118	65	83
	187	103	88
	335	184	92
Steel HP 10 X 57			
	120	66	83
	192	105	88
	454	250	94
Steel HP 12 X 53			
	130	71	78
	143	79	83
	224	123	88
	418	230	92
Steel HP 12 X 63			
	131	72	78
	145	80	83
	229	126	88
	497	273	93
Steel HP 12 X 74			
	120	66	73
	133	73	78
	147	81	83
	233	128	88
	589	324	95

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	122	67	73
	135	74	78
	149	82	83
	237	130	88
	664	365	96
Steel HP 14 X 73			
	128	70	68
	142	78	73
	156	86	78
	173	95	83
	271	149	88
	578	318	93
Steel HP 14 X 89			
	130	71	68
	144	79	73
	158	87	78
	175	96	83
	278	153	88
	705	388	95
Steel HP 14 X 102			
	131	72	68
	145	80	73
	160	88	78
	177	97	83
	282	155	88
	810	445	96
Steel HP 14 X 117			
	106	58	63
	133	73	68
	147	81	73
	162	89	78
	179	98	83
	288	158	88
	929	511	98

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=================================== Int E Pier est. (SN060-0241)
REFERENCE BORING ================================ B-4
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================= 441.25 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 425.67 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 415.46 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**505** KIPS	**98** 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 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.)
425.50	0.17		2	Very Fine Silty Sand	0.0		5.4	0.0		***0.9***	1	0	0	0	16
423.00	2.50	0.26	4		2.6	5.4	7.3	3.8	0.9	***4.6***	5	1	0	1	18
420.50	2.50	0.23	1		2.3	4.7	14.3	3.3	0.8	***8.7***	9	3	0	2	21
418.00	2.50	0.46	3		4.4	9.5	20.2	6.4	1.5	***15.4***	15	5	0	3	23
415.50	2.50		4	Very Fine Silty Sand	0.8	11.0	75.9	1.1	1.8	***25.4***	25	6	0	8	26
413.00	2.50		18	Fine Sand	3.7	65.9	49.4	5.5	10.7	***26.0***	26	6	0	9	28
410.50	2.50		13	Very Fine Silty Sand	2.5	35.7	46.4	3.6	5.8	***28.7***	29	6	0	10	31
408.00	2.50		11	Very Fine Silty Sand	2.1	30.2	102.5	3.0	4.9	***40.5***	40	6	0	17	33
403.00	5.00		23	Fine Sand	9.6	84.2	55.2	14.0	13.7	***45.3***	45	6	0	19	38
398.00	5.00	1.33	10		21.4	27.4	85.9	31.5	4.5	***78.2***	78	6	0	38	43
393.00	5.00		10	Fine Sand	4.2	36.6	***79.0***	6.1	6.0	82.6	79	6	0	38	48
388.00	5.00		7	Fine Sand	2.9	25.6	***74.4***	4.3	4.2	85.6	74	6	0	35	53
383.00	5.00	0.88	9		15.5	18.1	***110.8***	22.8	2.9	111.7	111	6	0	55	58
378.00	5.00	1.89	11		27.2	38.9	***105.9***	40.0	6.3	146.5	106	6	0	53	63
373.00	5.00	0.33	8		6.4	6.8	***133.1***	9.4	1.1	159.3	133	6	0	68	68
368.00	5.00	1.34	9		21.6	27.6	***147.0***	31.6	4.5	189.7	147	6	0	75	73
363.00	5.00	0.97	28		16.8	20.0	***162.0***	24.7	3.2	214.0	162	6	0	84	78
358.00	5.00	0.88	8		15.5	18.1	***178.9***	22.8	2.9	237.1	179	6	0	93	83
353.00	5.00	0.95	12		16.5	19.6	358.9	24.3	3.2	***287.9***	288	6	0	153	88
352.00	1.00			Shale	60.4	183.0	419.4	88.7	29.8	***376.5***	377	6	0	202	89.3
351.00	1.00			Shale	60.4	183.0	479.8	88.7	29.8	***465.2***	465	6	0	250	90.3
350.00	1.00			Shale	60.4	183.0	***540.2***	88.7	29.8	553.8	540	6	0	292	91.3
349.00	1.00			Shale	60.4	183.0	***600.6***	88.7	29.8	642.5	601	6	0	325	92.3
348.00	1.00			Shale	60.4	183.0	***661.0***	88.7	29.8	731.2	661	6	0	358	93.3
347.00	1.00			Shale	60.4	183.0	***721.4***	88.7	29.8	819.8	721	6	0	391	94.3
346.00	1.00			Shale	60.4	183.0	***781.9***	88.7	29.8	908.5	782	6	0	425	95.3
345.00	1.00			Shale	60.4	183.0	***842.3***	88.7	29.8	997.1	842	6	0	458	96.3
344.00	1.00			Shale	60.4	183.0	***902.7***	88.7	29.8	1085.8	903	6	0	491	97.3
343.00	1.00			Shale	60.4	183.0	***963.1***	88.7	29.8	1174.4	~~963~~	~~*6*~~	~~*0*~~	~~*524*~~	~~*98.3*~~
342.00	1.00			Shale	60.4	183.0	***1023.5***	88.7	29.8	1263.1	~~1024~~	~~*6*~~	~~*0*~~	~~*557*~~	~~*99.3*~~
341.00	1.00			Shale	60.4	183.0	***1084.0***	88.7	29.8	1351.7	~~1084~~	~~*6*~~	~~*0*~~	~~*591*~~	~~*100.3*~~
340.00	1.00			Shale	60.4	183.0	***1144.4***	88.7	29.8	1440.4	~~1144~~	~~*6*~~	~~*0*~~	~~*624*~~	~~*101.3*~~
339.00	1.00			Shale	60.4	183.0	***1204.8***	88.7	29.8	1529.0	~~1205~~	~~*6*~~	~~*0*~~	~~*657*~~	~~*102.3*~~
338.00	1.00			Shale	60.4	183.0	***1265.2***	88.7	29.8	1617.7	~~1265~~	~~*6*~~	~~*0*~~	~~*690*~~	~~*103.3*~~
337.00	1.00			Shale	60.4	183.0	***1325.6***	88.7	29.8	1706.3	~~1326~~	~~*6*~~	~~*0*~~	~~*724*~~	~~*104.3*~~
336.00	1.00			Shale	60.4	183.0	***1386.0***	88.7	29.8	1795.0	~~1386~~	~~*6*~~	~~*0*~~	~~*757*~~	~~*105.3*~~
335.00	1.00			Shale		183.0			29.8						

Pile Design Table for Int E Pier est. (SN060-0241) utilizing Boring #B-4

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	95	49	83
	150	80	88
	286	154	92

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	118	61	83
	187	99	88
	335	180	92
Steel HP 10 X 57			
	120	62	83
	192	102	88
	454	246	94
Steel HP 12 X 53			
	130	67	78
	143	74	83
	224	119	88
	418	226	92
Steel HP 12 X 63			
	131	68	78
	145	75	83
	229	122	88
	497	269	93
Steel HP 12 X 74			
	133	68	78
	147	76	83
	233	124	88
	589	319	95

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	135	69	78
	149	77	83
	237	126	88
	664	361	96
Steel HP 14 X 73			
	142	73	73
	156	81	78
	173	90	83
	271	144	88
	578	312	93
Steel HP 14 X 89			
	130	66	68
	144	74	73
	158	82	78
	175	91	83
	278	147	88
	705	382	95
Steel HP 14 X 102			
	131	67	68
	145	74	73
	160	83	78
	177	92	83
	282	150	88
	810	440	96
Steel HP 14 X 117			
	133	68	68
	147	75	73
	162	84	78
	179	93	83
	288	153	88
	929	505	98

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== E Abutment (SN060-0241)
REFERENCE BORING ================================ B-4
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 441.25 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 439.25 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 ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**511** KIPS	**98** 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 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.)
435.50	3.75		7	Very Fine Silty Sand	2.0		5.7	2.9		***3.5***	4	0	0	2	6
433.00	2.50	0.18	3		1.8	3.7	10.2	2.6	0.6	***6.6***	7	0	0	4	8
430.50	2.50	0.31	3		3.0	6.4	***10.5***	4.4	1.0	10.6	11	0	0	6	11
428.00	2.50	0.18	3		1.8	3.7	14.1	2.6	0.6	***13.5***	14	0	0	7	13
425.50	2.50		2	Very Fine Silty Sand	0.4	5.5	14.3	0.6	0.9	***14.1***	14	0	0	8	16
423.00	2.50	0.26	4		2.6	5.4	***16.3***	3.8	0.9	17.7	16	0	0	9	18
420.50	2.50	0.23	1		2.3	4.7	23.3	3.3	0.8	***21.8***	22	0	0	12	21
418.00	2.50	0.46	3		4.4	9.5	29.2	6.4	1.5	***28.5***	28	0	0	16	23
415.50	2.50		4	Very Fine Silty Sand	0.8	11.0	84.9	1.1	1.8	***38.5***	39	0	0	21	26
413.00	2.50		18	Fine Sand	3.7	65.9	58.4	5.5	10.7	***39.1***	39	0	0	22	28
410.50	2.50		13	Very Fine Silty Sand	2.5	35.7	55.4	3.6	5.8	***41.8***	42	0	0	23	31
408.00	2.50		11	Very Fine Silty Sand	2.1	30.2	111.4	3.0	4.9	***53.6***	54	0	0	30	33
403.00	5.00		23	Fine Sand	9.6	84.2	64.2	14.0	13.7	***58.4***	58	0	0	32	38
398.00	5.00	1.33	10		21.4	27.4	94.8	31.5	4.5	***91.4***	91	0	0	50	43
393.00	5.00		10	Fine Sand	4.2	36.6	***88.0***	6.1	6.0	95.7	88	0	0	48	48
388.00	5.00		7	Fine Sand	2.9	25.6	***83.4***	4.3	4.2	98.7	83	0	0	46	53
383.00	5.00	0.88	9		15.5	18.1	***119.7***	22.8	2.9	124.9	120	0	0	66	58
378.00	5.00	1.89	11		27.2	38.9	***114.8***	40.0	6.3	159.6	115	0	0	63	63
373.00	5.00	0.33	8		6.4	6.8	***142.0***	9.4	1.1	172.4	142	0	0	78	68
368.00	5.00	1.34	9		21.6	27.6	***156.0***	31.6	4.5	202.8	156	0	0	86	73
363.00	5.00	0.97	28		16.8	20.0	***170.9***	24.7	3.2	227.2	171	0	0	94	78
358.00	5.00	0.88	8		15.5	18.1	***187.9***	22.8	2.9	250.2	188	0	0	103	83
353.00	5.00	0.95	12		16.5	19.6	367.9	24.3	3.2	***301.0***	301	0	0	166	88
352.00	1.00			Shale	60.4	183.0	428.3	88.7	29.8	***389.7***	390	0	0	214	89.3
351.00	1.00			Shale	60.4	183.0	488.7	88.7	29.8	***478.3***	478	0	0	263	90.3
350.00	1.00			Shale	60.4	183.0	***549.2***	88.7	29.8	567.0	549	0	0	302	91.3
349.00	1.00			Shale	60.4	183.0	***609.6***	88.7	29.8	655.6	610	0	0	335	92.3
348.00	1.00			Shale	60.4	183.0	***670.0***	88.7	29.8	744.3	670	0	0	368	93.3
347.00	1.00			Shale	60.4	183.0	***730.4***	88.7	29.8	833.0	730	0	0	402	94.3
346.00	1.00			Shale	60.4	183.0	***790.8***	88.7	29.8	921.6	791	0	0	435	95.3
345.00	1.00			Shale	60.4	183.0	***851.2***	88.7	29.8	1010.3	851	0	0	468	96.3
344.00	1.00			Shale	60.4	183.0	***911.7***	88.7	29.8	1098.9	912	0	0	501	97.3
343.00	1.00			Shale	60.4	183.0	***972.1***	88.7	29.8	1187.6	~~972~~	~~*0*~~	~~*0*~~	~~*535*~~	~~*98.3*~~
342.00	1.00			Shale	60.4	183.0	***1032.5***	88.7	29.8	1276.2	~~1032~~	~~*0*~~	~~*0*~~	~~*568*~~	~~*99.3*~~
341.00	1.00			Shale	60.4	183.0	***1092.9***	88.7	29.8	1364.9	~~1093~~	~~*0*~~	~~*0*~~	~~*601*~~	~~*100.3*~~
340.00	1.00			Shale	60.4	183.0	***1153.3***	88.7	29.8	1453.5	~~1153~~	~~*0*~~	~~*0*~~	~~*634*~~	~~*101.3*~~
339.00	1.00			Shale		183.0			29.8						

Pile Design Table for E Abutment (SN060-0241) utilizing Boring #B-4

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	100	55	83
	158	87	88
	286	157	92
Steel HP 10 X 42			
	124	68	83
	196	108	88
	335	184	92
Steel HP 10 X 57			
	126	69	83
	201	110	88
	454	250	94
Steel HP 12 X 53			
	125	69	73
	137	75	78
	151	83	83
	234	129	88
	418	230	91
Steel HP 12 X 63			
	126	69	73
	138	76	78
	152	84	83
	240	132	88
	497	273	93
Steel HP 12 X 74			
	128	70	73
	140	77	78
	154	85	83
	244	134	88
	589	324	95
Steel HP 12 X 84			
	129	71	73
	142	78	78
	156	86	83
	248	136	88
	664	365	96
Steel HP 14 X 73			
	111	61	63
	137	75	68
	151	83	73
	165	91	78
	181	100	83
	284	156	88
	578	318	92
Steel HP 14 X 89			
	112	62	63
	139	76	68
	152	84	73
	167	92	78
	184	101	83
	291	160	88
	705	388	94
Steel HP 14 X 102			
	114	62	63
	140	77	68
	154	85	73
	169	93	78
	186	102	83
	295	162	88
	810	445	96
Steel HP 14 X 117			
	115	63	63
	142	78	68
	156	86	73
	171	94	78
	188	103	83
	301	166	88
	929	511	98

Illinois Department
of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== E Abutment (SN060-0241)
REFERENCE BORING ================================= B-4
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================= 441.25 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 439.25 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== DD
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ============== 423.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ================ ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1700 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 70.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 194.29 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 72.86 KIPS

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.

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	**929** KIPS	**492** KIPS	**98** 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			NOMINAL UNPLUG'D			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
435.50	3.75		7	Very Fine Silty Sand	2.0		5.7	2.9		***3.5***	4	1	2	-1	6
433.00	2.50	0.18	3		1.8	3.7	10.2	2.6	0.6	***6.6***	7	2	4	-3	8
430.50	2.50	0.31	3		3.0	6.4	***10.5***	4.4	1.0	10.6	11	4	8	-5	11
428.00	2.50	0.18	3		1.8	3.7	14.1	2.6	0.6	***13.5***	14	5	9	-7	13
425.50	2.50		2	Very Fine Silty Sand	0.4	5.5	14.3	0.6	0.9	***14.1***	14	5	10	-7	16
423.00	2.50	0.26	4		2.6	5.4	***16.3***	3.8	0.9	17.7	16	6	13	-10	18
420.50	2.50	0.23	1		2.3	4.7	23.3	3.3	0.8	***21.8***	22	6	13	-7	21
418.00	2.50	0.46	3		4.4	9.5	29.2	6.4	1.5	***28.5***	28	6	13	-3	23
415.50	2.50		4	Very Fine Silty Sand	0.8	11.0	84.9	1.1	1.8	***38.5***	39	6	13	2	26
413.00	2.50		18	Fine Sand	3.7	65.9	58.4	5.5	10.7	***39.1***	39	6	13	2	28
410.50	2.50		13	Very Fine Silty Sand	2.5	35.7	55.4	3.6	5.8	***41.8***	42	6	13	4	31
408.00	2.50		11	Very Fine Silty Sand	2.1	30.2	111.4	3.0	4.9	***53.6***	54	6	13	10	33
403.00	5.00		23	Fine Sand	9.6	84.2	64.2	14.0	13.7	***58.4***	58	6	13	13	38
398.00	5.00	1.33	10		21.4	27.4	94.8	31.5	4.5	***91.4***	91	6	13	31	43
393.00	5.00		10	Fine Sand	4.2	36.6	***88.0***	6.1	6.0	95.7	88	6	13	29	48
388.00	5.00		7	Fine Sand	2.9	25.6	***83.4***	4.3	4.2	98.7	83	6	13	27	53
383.00	5.00	0.88	9		15.5	18.1	***119.7***	22.8	2.9	124.9	120	6	13	47	58
378.00	5.00	1.89	11		27.2	38.9	***114.8***	40.0	6.3	159.6	115	6	13	44	63
373.00	5.00	0.33	8		6.4	6.8	***142.0***	9.4	1.1	172.4	142	6	13	59	68
368.00	5.00	1.34	9		21.6	27.6	***156.0***	31.6	4.5	202.8	156	6	13	67	73
363.00	5.00	0.97	28		16.8	20.0	***170.9***	24.7	3.2	227.2	171	6	13	75	78
358.00	5.00	0.88	8		15.5	18.1	***187.9***	22.8	2.9	250.2	188	6	13	84	83
353.00	5.00	0.95	12		16.5	19.6	367.9	24.3	3.2	***301.0***	301	6	13	146	88
352.00	1.00			Shale	60.4	183.0	428.3	88.7	29.8	***389.7***	390	6	13	195	89.3
351.00	1.00			Shale	60.4	183.0	488.7	88.7	29.8	***478.3***	478	6	13	244	90.3
350.00	1.00			Shale	60.4	183.0	***549.2***	88.7	29.8	567.0	549	6	13	283	91.3
349.00	1.00			Shale	60.4	183.0	***609.6***	88.7	29.8	655.6	610	6	13	316	92.3
348.00	1.00			Shale	60.4	183.0	***670.0***	88.7	29.8	744.3	670	6	13	349	93.3
347.00	1.00			Shale	60.4	183.0	***730.4***	88.7	29.8	833.0	730	6	13	383	94.3
346.00	1.00			Shale	60.4	183.0	***790.8***	88.7	29.8	921.6	791	6	13	416	95.3
345.00	1.00			Shale	60.4	183.0	***851.2***	88.7	29.8	1010.3	851	6	13	449	96.3
344.00	1.00			Shale	60.4	183.0	***911.7***	88.7	29.8	1098.9	912	6	13	482	97.3
343.00	1.00			Shale	60.4	183.0	***972.1***	88.7	29.8	1187.6	~~*972*~~	~~*6*~~	~~*13*~~	~~*516*~~	~~*98.3*~~
342.00	1.00			Shale	60.4	183.0	***1032.5***	88.7	29.8	1276.2	~~*1032*~~	~~*6*~~	~~*13*~~	~~*549*~~	~~*99.3*~~
341.00	1.00			Shale	60.4	183.0	***1092.9***	88.7	29.8	1364.9	~~*1093*~~	~~*6*~~	~~*13*~~	~~*582*~~	~~*100.3*~~
340.00	1.00			Shale	60.4	183.0	***1153.3***	88.7	29.8	1453.5	~~*1153*~~	~~*6*~~	~~*13*~~	~~*615*~~	~~*101.3*~~
339.00	1.00			Shale		183.0			29.8						

Pile Design Table for E Abutment (SN060-0241) utilizing Boring #B-4 - DD

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 8 X 36			
	100	44	83
	158	76	88
	286	147	92
Steel HP 10 X 42			
	124	55	83
	196	95	88
	335	171	92
Steel HP 10 X 57			
	126	56	83
	201	97	88
	454	236	94
Steel HP 12 X 53			
	151	67	83
	234	113	88
	418	214	91
Steel HP 12 X 63			
	152	68	83
	240	116	88
	497	258	93
Steel HP 12 X 74			
	154	69	83
	244	118	88
	589	308	95
Steel HP 12 X 84			
	156	70	83
	248	120	88
	664	349	96
Steel HP 14 X 73			
	165	72	78
	181	81	83
	284	138	88
	578	299	92
Steel HP 14 X 89			
	152	65	73
	167	73	78
	184	82	83
	291	141	88
	705	369	94
Steel HP 14 X 102			
	154	66	73
	169	74	78
	186	83	83
	295	143	88
	810	427	96
Steel HP 14 X 117			
	156	67	73
	171	75	78
	188	84	83
	301	146	88
	929	492	98

Appendix D

Appendix D - L-Pile Parameters (SN060-0241)

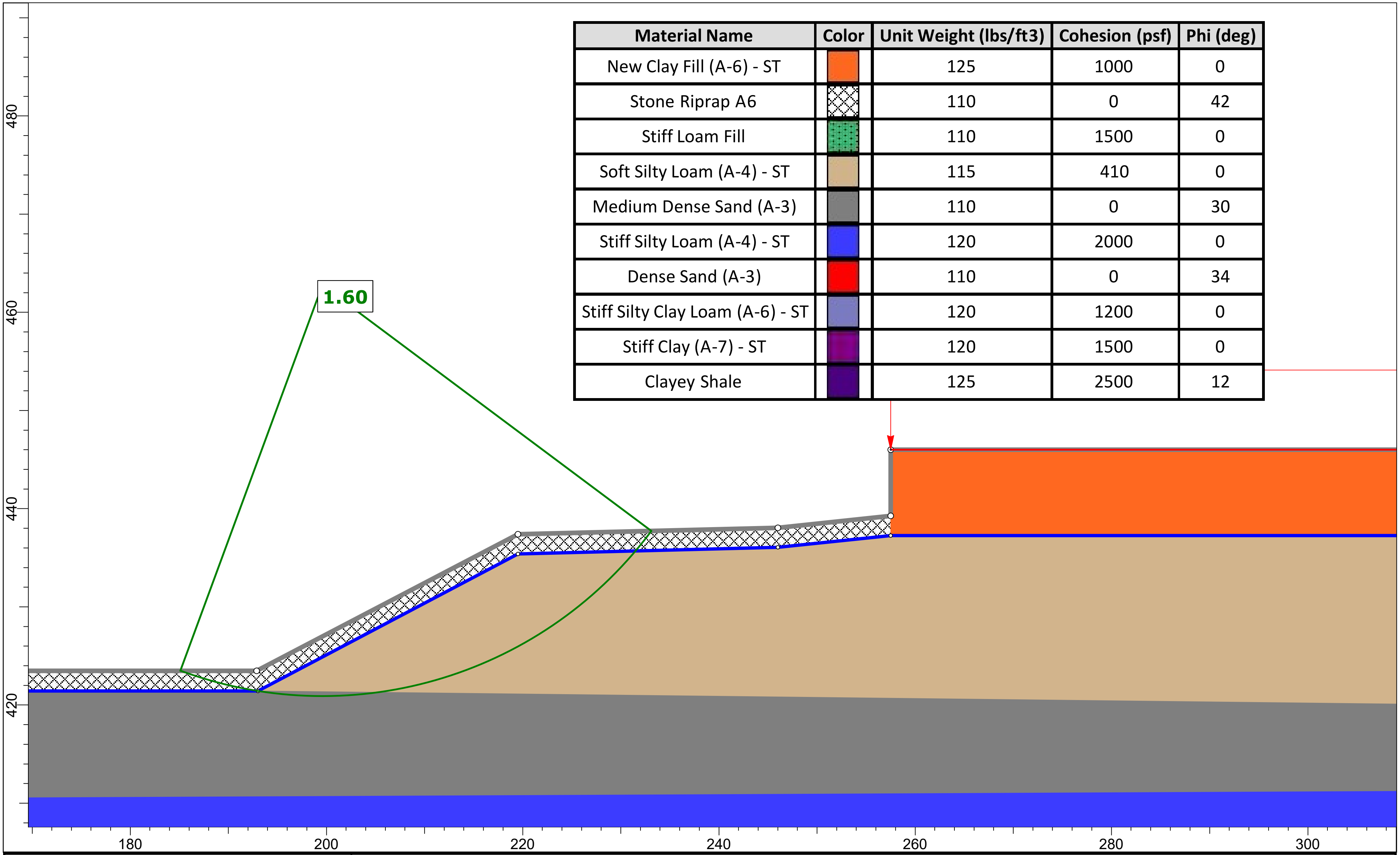
	Depth (feet)	Elevation (feet)	Abbreviated Soil Description	Effective Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)	Soil Modulus Parameter (pci)	E$_{50}$
West Abutment B-3	0 to 13.5	439.4 to 425.9	Unsubmerged Loose Sand	110	--	26	25	--
	13.5 to 24.9	425.9 to 414.5	Submerged Loose Sand	45	--	26	20	--
	24.9 to 47.4	414.5 to 392	Submerged Medium Dense Sand	45	--	30	60	--
	47.4 to 89.4	392 to 350	Stiff Clay (with free water)	55	1500	--	500	0.007
	89.4+	< 350	Shale	130	5000	44	2000	0.004

	Depth (feet)	Elevation (feet)	Abbreviated Soil Description	Effective Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)	Soil Modulus Parameter (pci)	E$_{50}$
Int. West Pier B-3	0 to 13.5	439.4 to 425.9	Unsubmerged Loose Sand	110	--	26	25	--
	13.5 to 24.9	425.9 to 414.5	Submerged Loose Sand	45	--	26	20	--
	24.9 to 47.4	414.5 to 392	Submerged Medium Dense Sand	45	--	30	60	--
	47.4 to 89.4	392 to 350	Stiff Clay (with free water)	55	1500	--	500	0.007
	89.4+	< 350	Shale	130	5000	44	2000	0.004

	Depth (feet)	Elevation (feet)	Abbreviated Soil Description	Effective Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)	Soil Modulus Parameter (pci)	E$_{50}$
Int. East Pier B-4	0 to 19.8	439.3 to 419.5	Soft Clay (Matlock) without free water	120	250	--	30	0.02
	19.8 to 35	419.5 to 404.3	Submerged Silty Sand	45	--	26	20	--
	35 to 87.5	404.3 to 351.8	Medium Stiff Clay (with free water)	55	1000	--	100	0.01
	87.5+	< 351.8	Shale	130	5000	44	2000	0.004

	Depth (feet)	Elevation (feet)	Abbreviated Soil Description	Effective Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)	Soil Modulus Parameter (pci)	E$_{50}$
East Abutment B-4	0 to 19.8	439.3 to 419.5	Soft Clay (Matlock) without free water	120	250	--	30	0.02
	19.8 to 35	419.5 to 404.3	Submerged Silty Sand	45	--	26	20	--
	35 to 87.5	404.3 to 351.8	Medium Stiff Clay (with free water)	55	1000	--	100	0.01
	87.5+	< 351.8	Shale	130	5000	44	2000	0.004

Appendix E



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
New Clay Fill (A-6) - ST	🟧	125	1000	0
Stone Riprap A6	▨	110	0	42
Stiff Loam Fill	🟩	110	1500	0
Soft Silty Loam (A-4) - ST	🟫	115	410	0
Medium Dense Sand (A-3)	⬛	110	0	30
Stiff Silty Loam (A-4) - ST	🟦	120	2000	0
Dense Sand (A-3)	🟥	110	0	34
Stiff Silty Clay Loam (A-6) - ST	🟦	120	1200	0
Stiff Clay (A-7) - ST	🟪	120	1500	0
Clayey Shale	🟪	125	2500	12

SLIDEINTERPRET 9.020

Project PTB 195 Item 57 IL-162 over Judy's Branch (SN 060-0241)

Analysis Description End Slope East Abut (Short Term)

Location Madison County, Illinois

Drawn By PP

Reviewed By: TJC

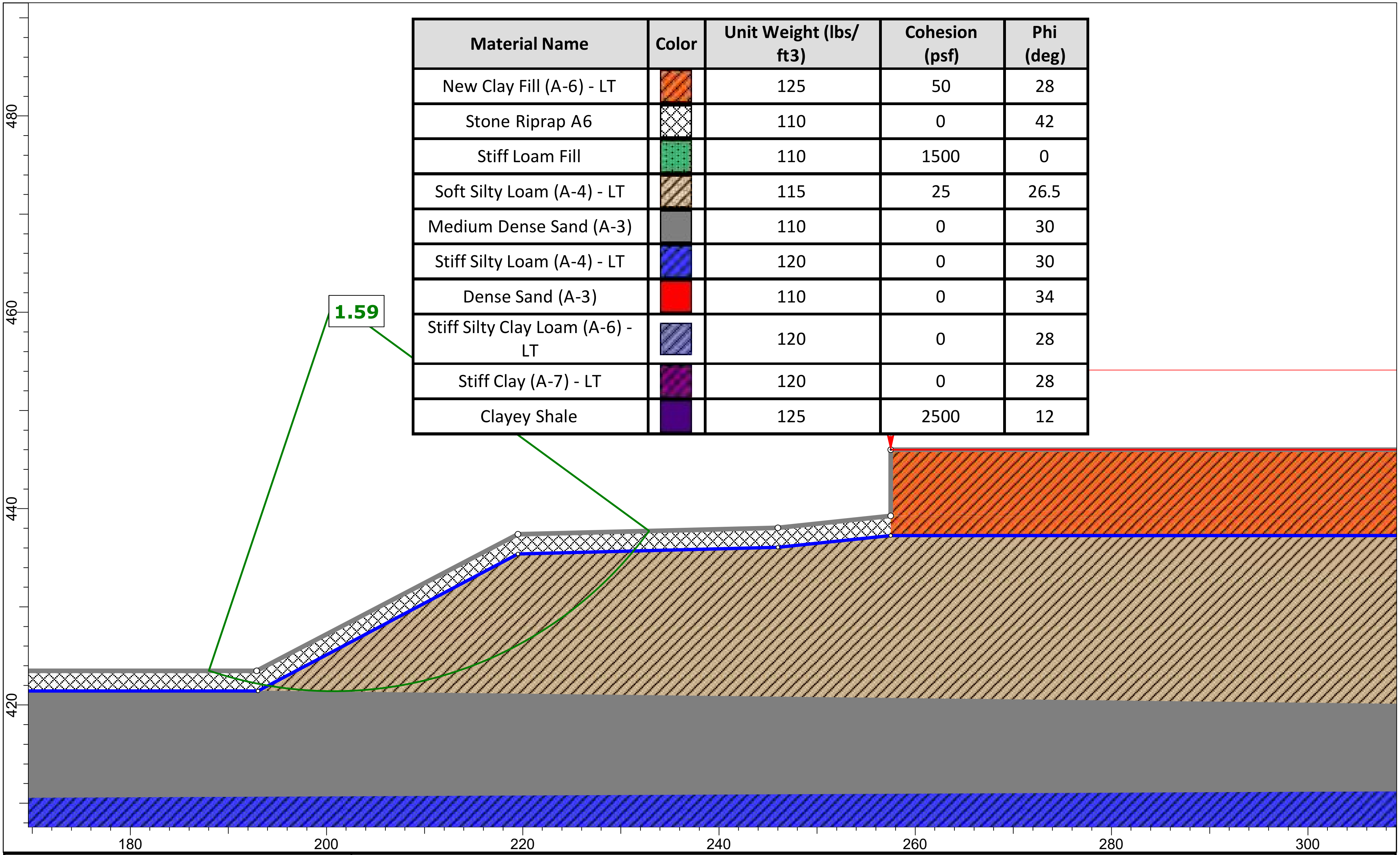
Scale 1:162

Company SCI Engineering, Inc.

Date 5/16/2022

Project # 2020-0531.10

File Name Slope Stability Analysis.slmd



Material Name	Color	Unit Weight (lbs/ ft3)	Cohesion (psf)	Phi (deg)
New Clay Fill (A-6) - LT	🟧	125	50	28
Stone Riprap A6	▨	110	0	42
Stiff Loam Fill	🟩	110	1500	0
Soft Silty Loam (A-4) - LT	🟫	115	25	26.5
Medium Dense Sand (A-3)	⬛	110	0	30
Stiff Silty Loam (A-4) - LT	🟦	120	0	30
Dense Sand (A-3)	🟥	110	0	34
Stiff Silty Clay Loam (A-6) - LT	▨	120	0	28
Stiff Clay (A-7) - LT	🟪	120	0	28
Clayey Shale	🟪	125	2500	12

SLIDEINTERPRET 9.020

Project PTB 195 Item 57 IL-162 over Judy's Branch (SN 060-0241)

Analysis Description End Slope East Abut (Long Term)

Location Madison County, Illinois

Drawn By PP

Reviewed By: TJC

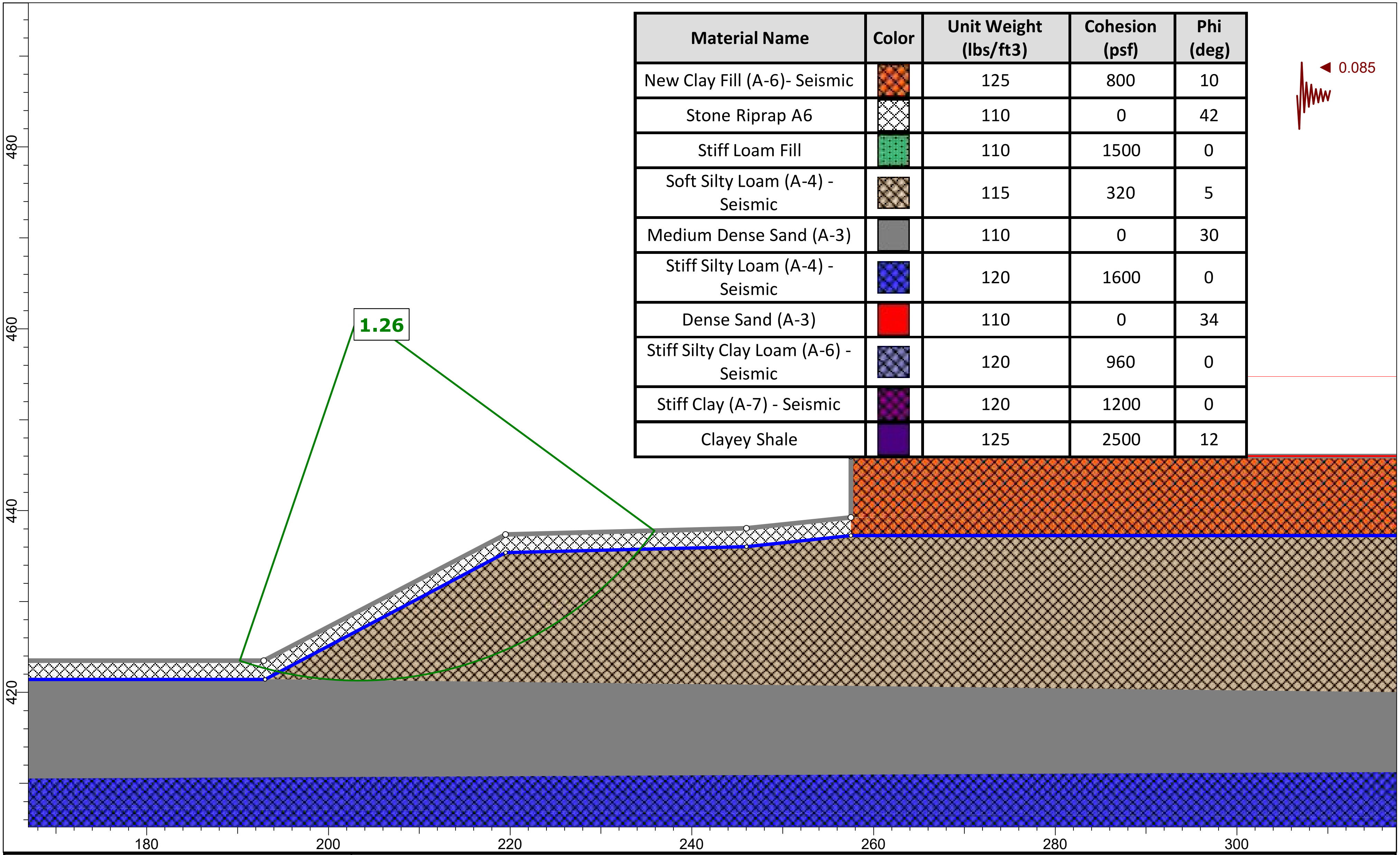
Scale 1:162

Company SCI Engineering, Inc.

Date 5/16/2022

Project # 2020-0531.10

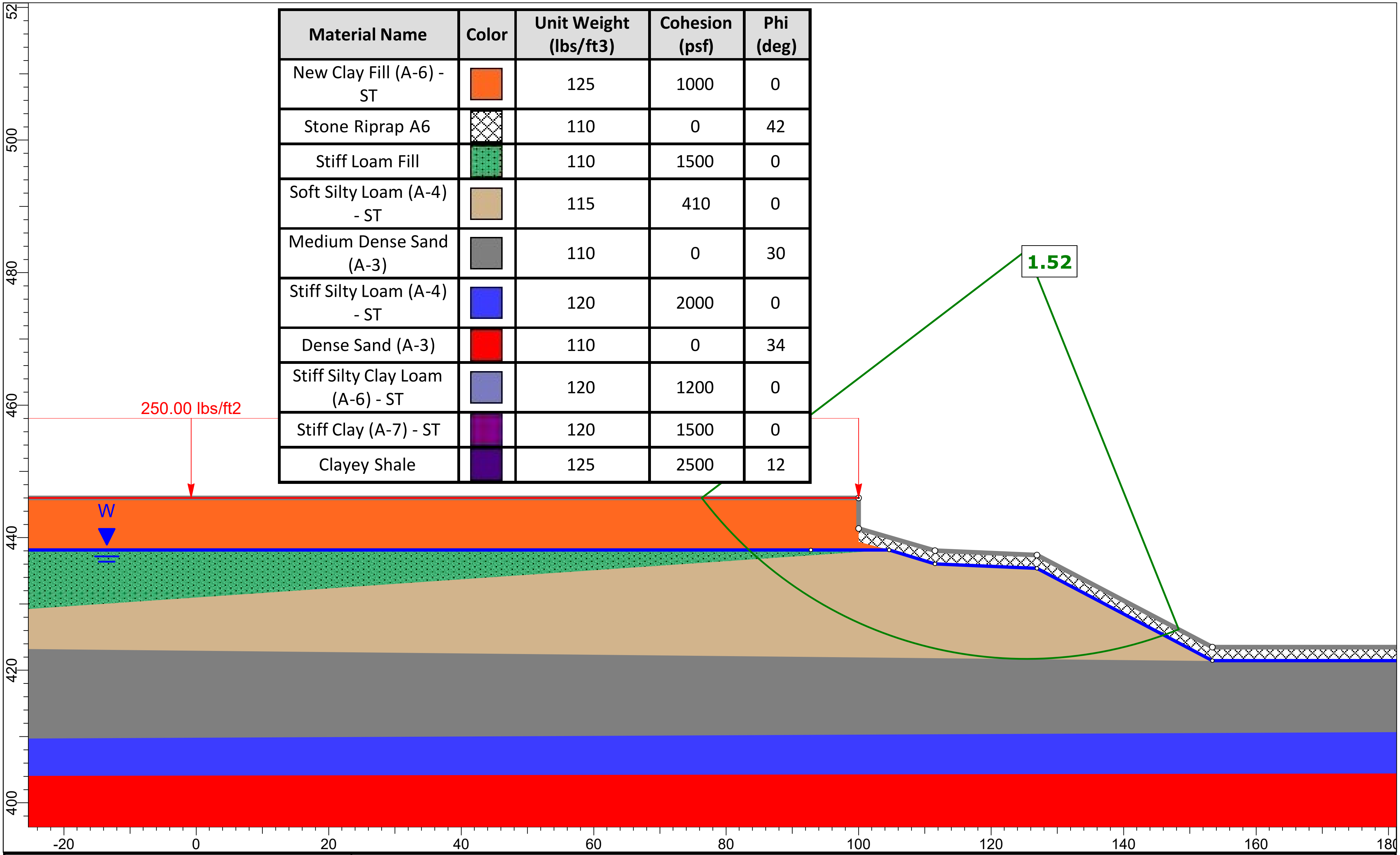
File Name Slope Stability Analysis.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
New Clay Fill (A-6)- Seismic	🟧	125	800	10
Stone Riprap A6	▨	110	0	42
Stiff Loam Fill	🟩	110	1500	0
Soft Silty Loam (A-4) - Seismic	🟫	115	320	5
Medium Dense Sand (A-3)	⬛	110	0	30
Stiff Silty Loam (A-4) - Seismic	🟦	120	1600	0
Dense Sand (A-3)	🟥	110	0	34
Stiff Silty Clay Loam (A-6) - Seismic	▨	120	960	0
Stiff Clay (A-7) - Seismic	🟪	120	1200	0
Clayey Shale	🟪	125	2500	12

SLIDEINTERPRET 9.020

Project	PTB 195 Item 57 IL-162 over Judy's Branch (SN 060-0241)		
Analysis Description	End Slope East Abut (Seismic)	Location	Madison County, Illinois
Drawn By PP	*Reviewed By:* TJC *Scale* 1:175	*Company*	SCI Engineering, Inc.
Date 5/16/2022	*Project #* 2020-0531.10	*File Name*	Slope Stability Analysis.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
New Clay Fill (A-6) - ST	🟧	125	1000	0
Stone Riprap A6	▨	110	0	42
Stiff Loam Fill	🟩	110	1500	0
Soft Silty Loam (A-4) - ST	🟫	115	410	0
Medium Dense Sand (A-3)	◼	110	0	30
Stiff Silty Loam (A-4) - ST	🟦	120	2000	0
Dense Sand (A-3)	🟥	110	0	34
Stiff Silty Clay Loam (A-6) - ST	🟪	120	1200	0
Stiff Clay (A-7) - ST	🟪	120	1500	0
Clayey Shale	🟪	125	2500	12

SLIDEINTERPRET 9.020

Project PTB 195 Item 57 IL-162 over Judy's Branch (SN 060-0241)

Analysis Description End Slope West Abut (Short Term)

Location Madison County, Illinois

Drawn By PP

Reviewed By: TJC

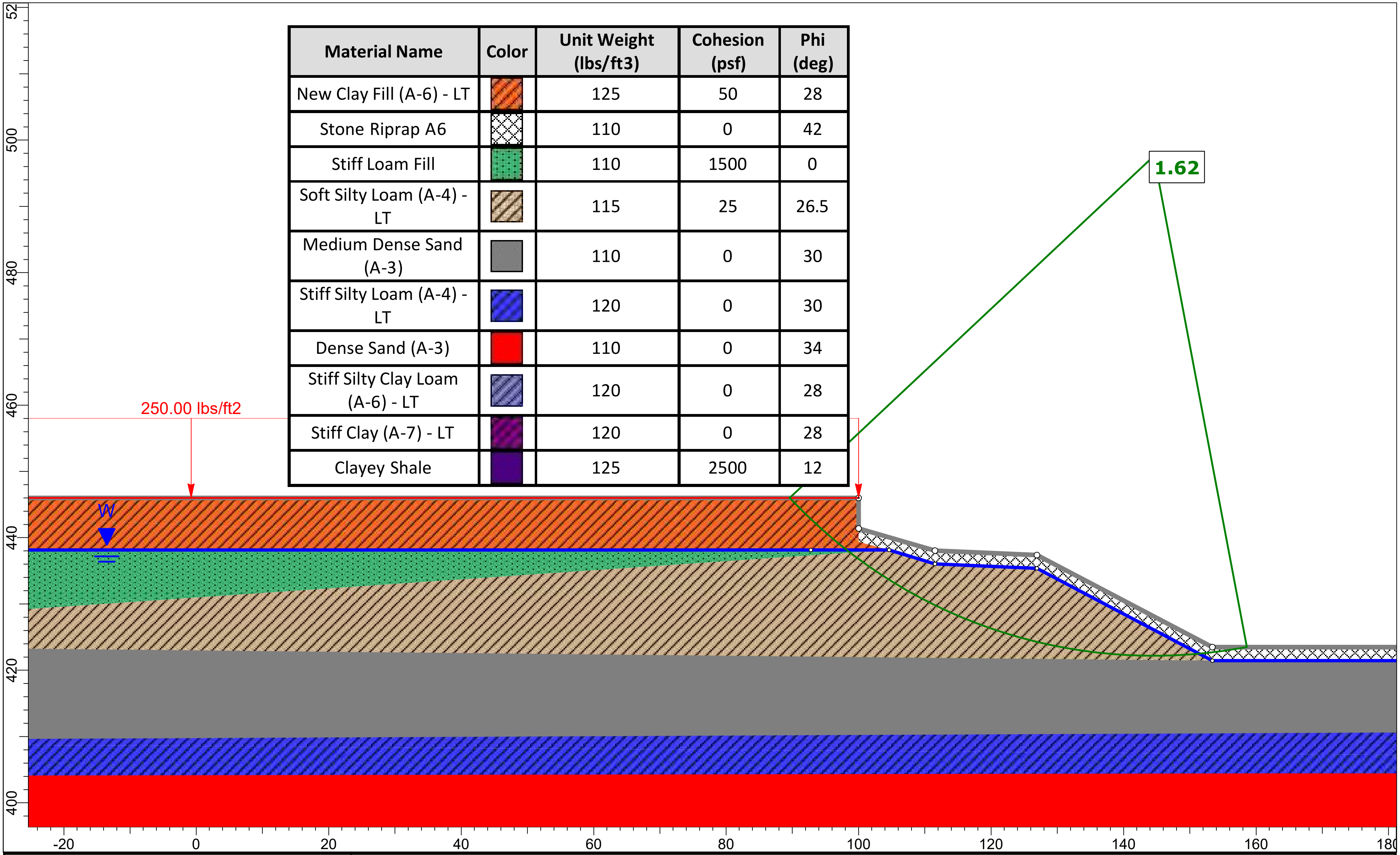
Scale 1:240

Company SCI Engineering, Inc.

Date 5/16/2022

Project # 2020-0531.10

File Name Slope Stability Analysis.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
New Clay Fill (A-6) - LT	🟧	125	50	28
Stone Riprap A6	▦	110	0	42
Stiff Loam Fill	🟩	110	1500	0
Soft Silty Loam (A-4) - LT	🟫	115	25	26.5
Medium Dense Sand (A-3)	◼	110	0	30
Stiff Silty Loam (A-4) - LT	🟦	120	0	30
Dense Sand (A-3)	🟥	110	0	34
Stiff Silty Clay Loam (A-6) - LT	▨	120	0	28
Stiff Clay (A-7) - LT	🟪	120	0	28
Clayey Shale	🟪	125	2500	12

SLIDEINTERPRET 9.020

Project PTB 195 Item 57 IL-162 over Judy's Branch (SN 060-0241)

Analysis Description End Slope West Abut (Long Term)

Location Madison County, Illinois

Drawn By PP

Reviewed By: TJC

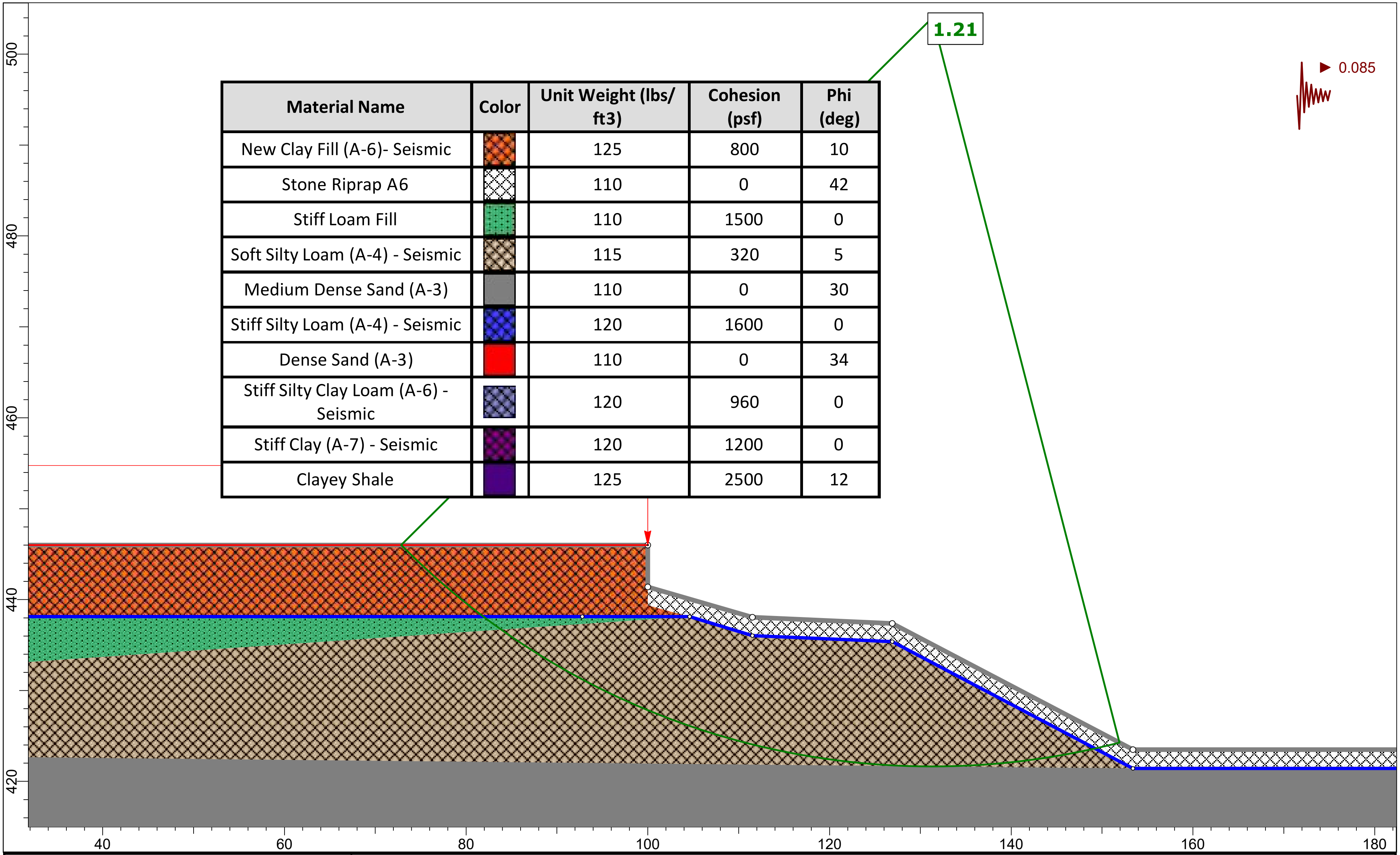
Scale 1:240

Company SCI Engineering, Inc.

Date 5/16/2022

Project # 2020-0531.10

File Name Slope Stability Analysis.slmd



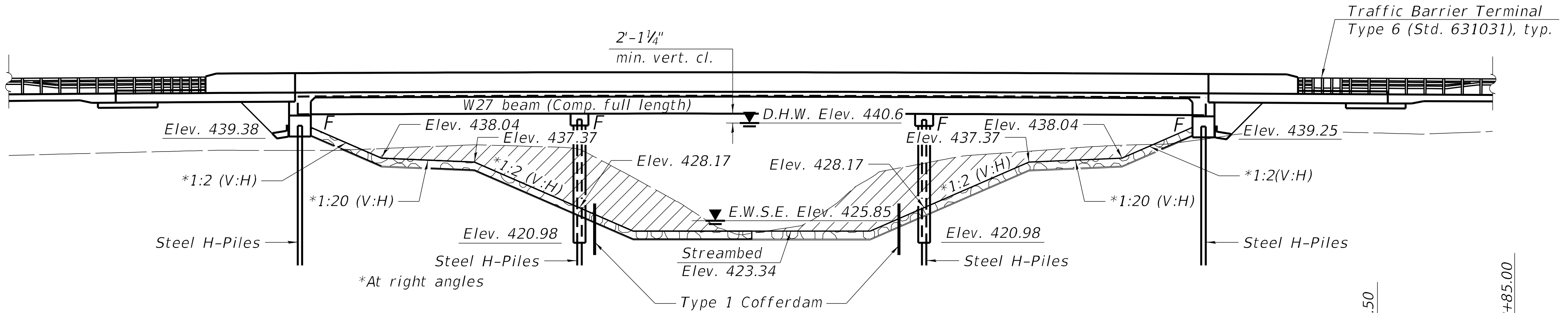
Material Name	Color	Unit Weight (lbs/ ft3)	Cohesion (psf)	Phi (deg)
New Clay Fill (A-6)- Seismic	🟧	125	800	10
Stone Riprap A6	▨	110	0	42
Stiff Loam Fill	🟩	110	1500	0
Soft Silty Loam (A-4) - Seismic	🟫	115	320	5
Medium Dense Sand (A-3)	■	110	0	30
Stiff Silty Loam (A-4) - Seismic	🟦	120	1600	0
Dense Sand (A-3)	🟥	110	0	34
Stiff Silty Clay Loam (A-6) - Seismic	▩	120	960	0
Stiff Clay (A-7) - Seismic	🟪	120	1200	0
Clayey Shale	🟪	125	2500	12

SLIDEINTERPRET 9.020

Project	PTB 195 Item 57 IL-162 over Judy's Branch (SN 060-0241)		
Analysis Description	End Slope West Abut (Seismic)	Location	Madison County, Illinois
Drawn By PP	*Reviewed By:* TJC	*Scale* 1:175	*Company* SCI Engineering, Inc.
Date 5/16/2022	*Project #* 2020-0531.10		*File Name* Slope Stability Analysis.slmd

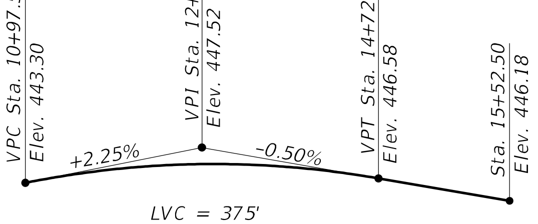
Appendix F

Benchmark: Found cut square (with +) on top parapet wall northwest corner of SN 060-0087. Elev. 449.226
Existing Structure: None



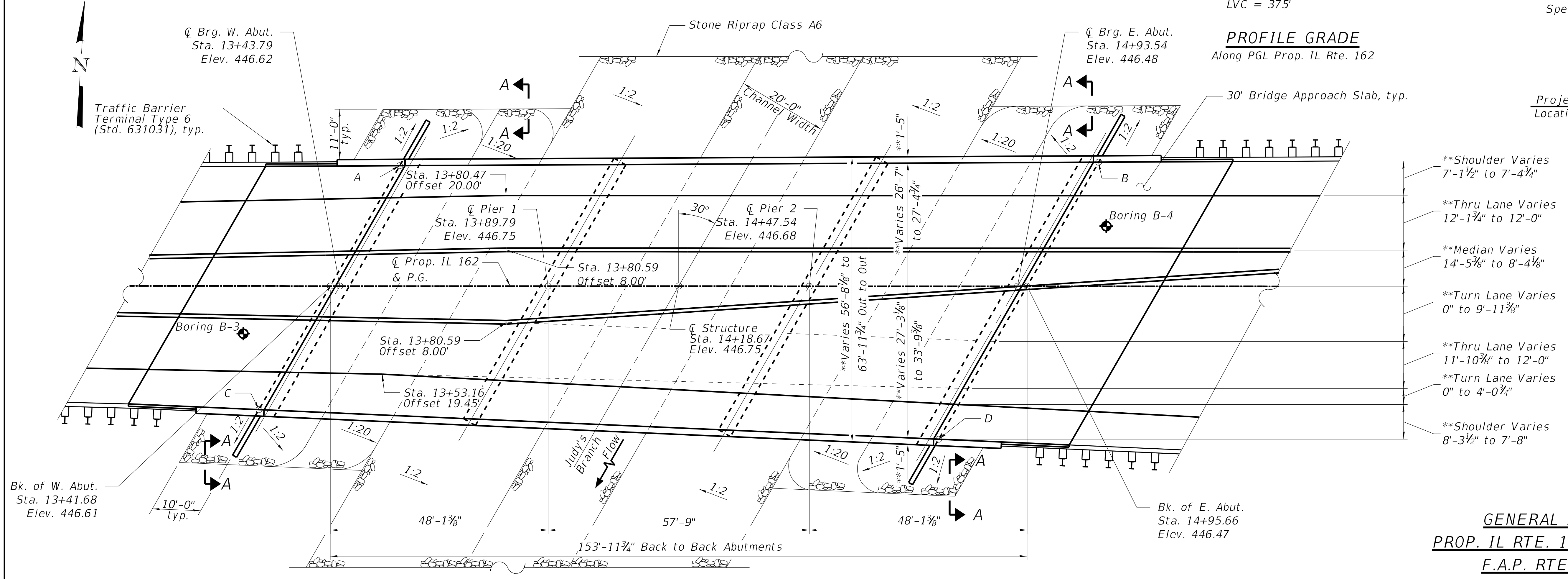
Notes:
Hatched areas indicate limits of channel excavation. See roadway plans.

ELEVATION



PROFILE GRADE

Along PGL Prop. IL Rte. 162



PLAN

**At right angles to ℄ Roadway.
From Bk. Abut. to Bk. Abut.

LOADING HL-93

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

SEISMIC DATA

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.23g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.53g
Soil Site Class = D

HIGHWAY CLASSIFICATION

F.A.P. Rte. 586 - Prop. IL Rte. 162
Functional Class: Other Principal Arterial
ADT: 5650 (2021); 7400 (2044)
ADTT: 316 (2021); 414 (2044)
DHV: 770
Design Speed: 50 m.p.h.
Posted Speed: 45 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

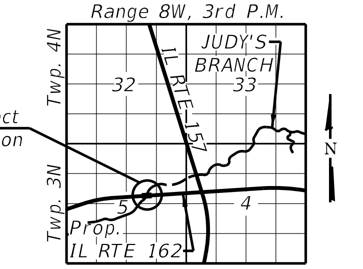
DESIGN STRESSES

FIELD UNITS

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

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design
Specifications, 9th Edition



LOCATION SKETCH

BACK OF ABUTMENT STATIONS AND OFFSETS

Point	Station	Offset
A	13+57.02	26.58' Lt.
B	15+11.48	27.40' Lt.
C	13+25.92	27.30' Rt.
D	14+76.15	33.78' Rt.

GENERAL PLAN & ELEVATION
PROP. IL RTE. 162 OVER JUDY'S BRANCH
F.A.P. RTE. 586 - SEC. 51-1R
MADISON COUNTY
STATION 14+18.67
STRUCTURE NO. 060-0241

X:\Production\Files\2020\420\0018\CAD\Bridge\060024\00\GPE.dgn

LOCHMUELLER GROUP
1928 SR Bradley R. Smith Drive
Troy, IL 62294
PHONE: 618.667.1400

USER NAME =	DESIGNED - ACS	REVISED -	
	CHECKED - REB	REVISED -	
PLOT SCALE =	DRAWN - VCH	REVISED -	
PLOT DATE =	CHECKED - ACS	REVISED -	

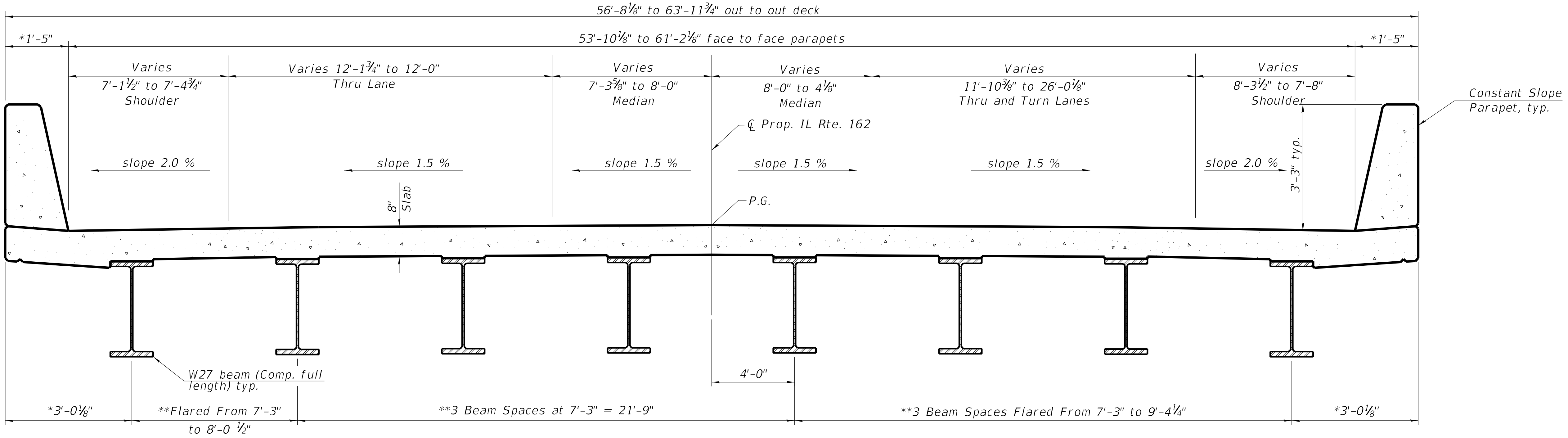
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
586	51-1R	MADISON		

CONTRACT NO. 76A46

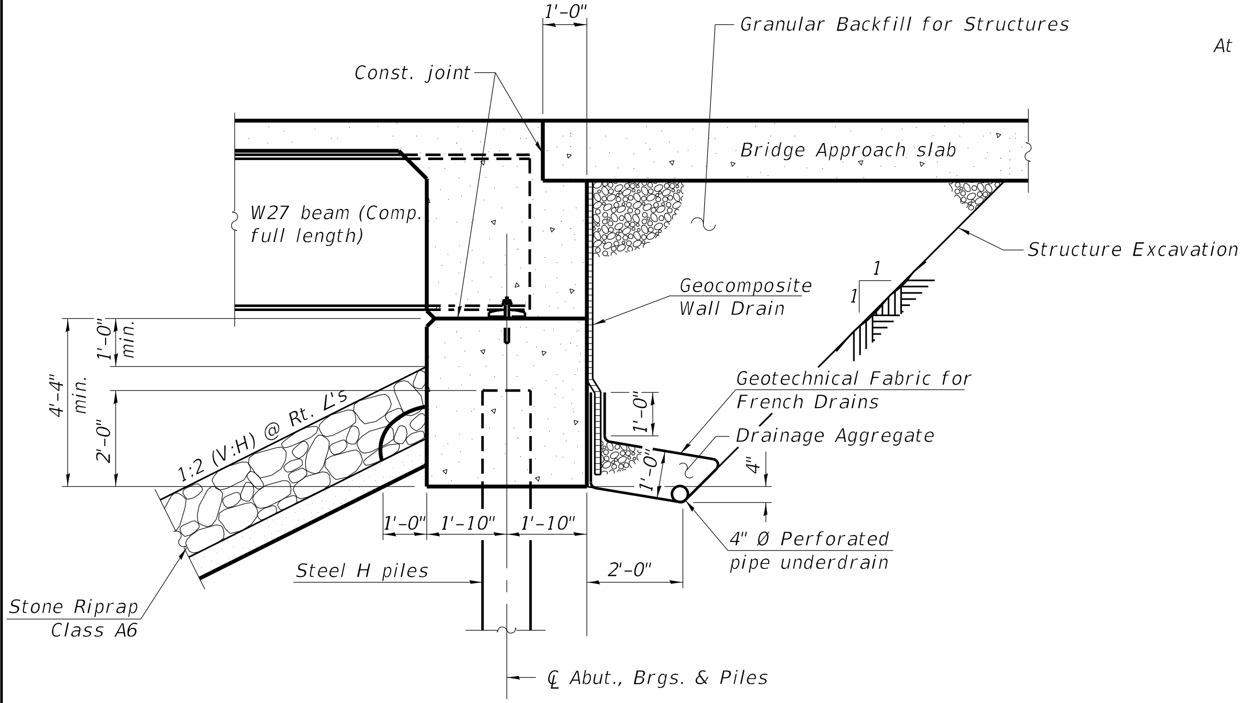
ILLINOIS FED. AID PROJECT



CROSS SECTION

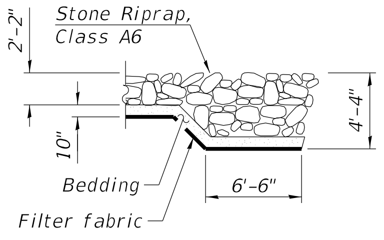
(Looking East)
At right angles to ℄ Roadway. From Bk. Abut. to Bk. Abut.

*Perpendicular to Edge of Deck.
**℄ Abut. Brg. to ℄ Abut. Brg.

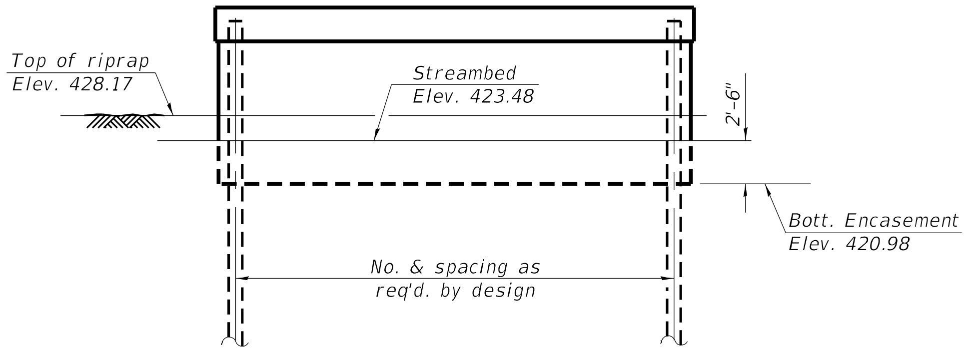


SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. ∠'s)



SECTION A-A



PIER SKETCH

WATERWAY INFORMATION

Drainage Area = 8.6 sq. mi.			Existing Overtopping Elev. = N/A Proposed Overtopping Elev. - 438.54*					at Sta. at Sta. 7+45.00	
Flood Event	Freq. Yr.	Discharge Ft³/S	Waterway Opening - Ft²		Natural H.W.E. - Ft.	Head - Ft.		Headwater Elevation - Ft.	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
Overtop Existing	<10	<3880	603	772					438.2*
Design	50	5750	783	885	440.3	-	0.3	-	440.6
Base	100	6590	866	927	440.7	-	0.5	-	441.2
Scour Design Check	200	7600	959	972	441.1	-	0.6	-	441.7
Overtop Proposed	N/A	-	-	-	-	-	-	-	-
Max. Calc.	500	8920	1067	1019	441.6	-	2.0	-	443.6

10 YEAR VELOCITY THROUGH EXISTING BRIDGE = N/A ft/s
10 YEAR VELOCITY THROUGH PROPOSED BRIDGE = 4.99 ft/s

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				
	W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	439.38	415.46	415.46	439.25	5
Q200	439.38	415.46	415.46	439.25	
Design	439.38	415.46	415.46	439.25	
Check	439.38	415.46	415.46	439.25	

DETAILS
PROP. IL RTE. 162 OVER JUDY'S BRANCH
F.A.P. RTE. 586 - SEC. 51-1R
MADISON COUNTY
STATION 14+18.67
STRUCTURE NO. 060-0241

LOCHMUELLER GROUP
1928 SrA Bradley R. Smith Drive
Troy, IL 62294
PHONE: 618.667.1400

USER NAME =	DESIGNED - ACS	REVISED -
	CHECKED - REB	REVISED -
PLOT SCALE =	DRAWN - VCH	REVISED -
PLOT DATE =	CHECKED - ACS	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
586	51-1R	MADISON		

CONTRACT NO. 76A46

ILLINOIS FED. AID PROJECT

Important Information about Your
Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

IIGER06085.0MRP