Structural Geotechnical Report

Existing Bridge SN: 016-0827
Proposed Bridge SN: 016-8301
Oakton Street Bridge over I-94
IDOT PTB 195-019
Cook County, Illinois

Prepared for

Illinois Department of Transportation (IDOT)
Contract Number: P-91-467-16

Project Design Engineer Team
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October 25, 2021

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Dear Mr. Amini:

Attached is a copy of the Structural Geotechnical Report for the above referenced project. This report provides a brief description of the site investigation, site conditions, and foundation and construction recommendations for the above referenced project. The site investigation included advancing three (3) soil borings to depths between 91 and 124 feet. The foundation recommendations for the bridge include supporting the proposed abutments, approach slabs, and center pier on driven piles.

Should you have any questions or require additional information, please call us at 630-994-2600.

Sincerely,

Thomas E. Kasang, P.E.
Project Engineer

Ala E Sassila, Ph.D., P.E.
Principal

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1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the design of the proposed Oakton Street Bridge over I-94 near the Villages of Skokie and Morton Grove in Cook County, Illinois. The purpose of the investigation was to explore the subsurface conditions, to determine engineering properties of the subsurface soil, and to develop design and construction recommendations for the project. The general project limits are shown in **Exhibit 1**.

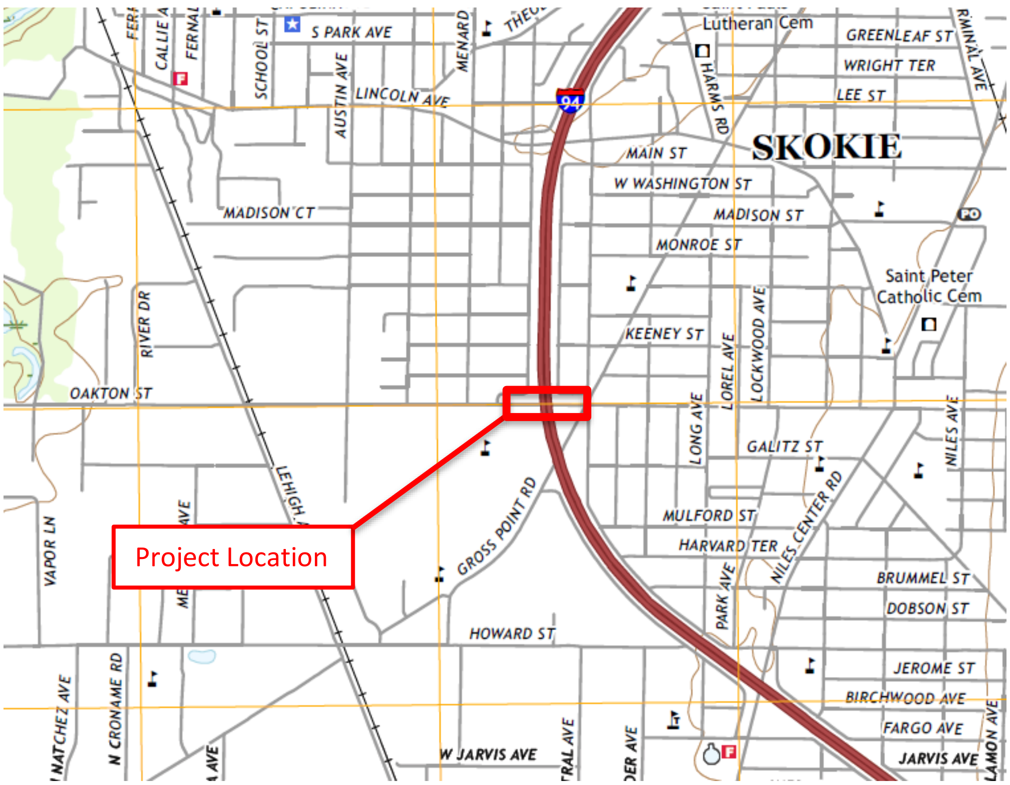


Exhibit 1 – Project Location Map
(Source: USGS Topographic Maps, usgs.gov)

1.1 Existing Bridge Information

The existing Oakton Street Bridge over I-94 (SN: 016-0827) was originally constructed in 1950, and repairs were performed in 1982 and 2007. The existing structure is a four-span steel girder bridge supported on reinforced concrete piers and concrete pile supported stub abutments. The length of the bridge from back to back of the abutments is 226’-6”. The out-to-out deck width of the bridge is 64’-0”, and the bridge is skewed 7° 36’ (right). **Exhibit 2** shows the existing conditions of the Oakton Street Bridge.

Exhibit 2 – Oakton Street Bridge Looking North on I-94

1.2 Proposed Bridge Information

Based on the design information and drawings provided by Atlas Engineering Group, Ltd. (Atlas) (dated March and December 2019) (**Appendix A**), the existing structure will be removed and replaced with a new two-span continuous galvanized steel structure (SN: 016-8301) supported on integral abutments and a reinforced concrete center pier. It is anticipated that the new abutments, approach slabs, and center pier will be supported on driven steel pile foundations. The bridge will have a total back-to-back abutment length of 213’-4 3/8’’ and out-to-out width of 84’-4”. The vertical clearance of the bridge will be raised to a height of 15’-9”, which will require approximately 3 feet of new fill at the bridge abutments and approaches. It is anticipated that the proposed improvements will also include modifying the slopes at the existing bridge abutments.

2.0 SUBSURFACE EXPLORATION PROGRAM

This section describes the subsurface exploration program and laboratory testing program completed. The proposed locations and depths of the soil borings were selected in accordance with IDOT requirements and were coordinated with Atlas based on available design information at the time of the field activities. The borings were completed in the field based on field conditions and accessibility. The subsurface exploration program was performed in accordance with the IDOT geotechnical manual and procedures.

2.1 Subsurface Exploration Program

The subsurface exploration program was conducted between August 26 and 30, 2021, and included advancing three (3) standard penetration test (SPT) borings at the proposed bridge location. The coordinates and existing ground surface elevations shown on the soil boring logs were obtained by GSG using handheld surveying equipment. The surface elevation of boring BSB-02 was estimated based on the proposed bridge drawings provided by Atlas. The as-drilled locations of the soil borings are shown on the Soil Boring Location Map and Subsurface Profile (**Appendix B**). **Table 1** presents a list of the borings completed.

Table 1 – Summary of Subsurface Exploration Borings

Boring ID	Location	Station*	Offset (ft)/ Direction*	Depth (ft)	Surface Elevation (ft)	Top of Bedrock Elevation (ft)
BSB-01	West Abutment	23+40	20.6 LT	112.0**	634.1	534.1
BSB-02	Center Pier	24+83	34.0 RT	91.0	618.5***	529.5
BSB-03	East Abutment	26+41	19.9 RT	124.0**	634.3	527.3

* Existing Oakton Street Stationing
** Boring B-01 blind drilled between 85.0 and 112.0 feet.
** Boring B-03 blind drilled between 110.0 and 124.0 feet
*** Estimated from proposed bridge drawings provided by Atlas (dated 12/04/2019)

GSG's soil borings were drilled using truck-mounted Diedrich D-50 drill rig using 3¼-inch I.D. hollow stem augers and an automatic hammer. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5-foot intervals to a depth of 30 feet below existing grade, and at 5-foot intervals thereafter until reaching auger refusal. Water level measurements were made in each boring when evidence of free groundwater was detected on the drill rods or in the samples. The boreholes were also checked for free water immediately after auger removal, and before filling the open boreholes with soil cuttings and surface patching with asphalt. Between depths of 85 and 112 feet in boring BSB-01 and 110 and 124 feet in BSB-03, blind drilling was performed due to the holes caving in, and samples were not taken.

GSG's field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities, and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester and a calibrated hand penetrometer in accordance with IDOT procedures and requirements. Representative soil samples collected from each sample interval, were placed in jars and returned to the laboratory for further testing and evaluation.

2.2 Laboratory Testing Program

For the borings performed by GSG, all samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed bridge. The following laboratory tests were performed on representative soil samples:

- Moisture content ASTM D2216 / AASHTO T-265
- Atterberg Limits ASTM D4318 / AASHTO T-89 / AASHTO T-90

The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (2020), and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO and the Illinois Division of Highways (IDH) classification systems. The results of the laboratory testing program are included in the **Appendix D-Laboratory Test Results** and are also shown along with the field test results in **Appendix C-Soil Boring Logs**.

2.3 Subsurface Soil Conditions

This section provides a brief description of the soils encountered in the borings performed in the vicinity of the proposed bridge. Detailed descriptions of the subsurface soils are provided in the Soil Boring Logs (**Appendix C**). The soil boring logs provide specific conditions encountered at each boring location, including soil descriptions, stratifications, penetration resistance, elevations, location of the samples, water levels (when encountered), and laboratory test data.

Variations in the general subsurface soil profile were noted during the drilling activities. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

Borings BSB-01 and BSB-03 were drilled through the existing pavement on the Oakton Street bridge approaches over I-94. Boring BSB-02 was through the existing pavement on the southbound median shoulder of I-94. Borings BSB-01 and BSB-03 initially noted 3 inches of asphalt over 8 inches of concrete. Boring BSB-02 initially encountered 18 inches of asphalt. The surface elevations of the borings ranged between 624.0 and 634.3 feet.

Beneath the pavement layers, the borings noted existing fill soils extending to elevations between 615.0 and 623.3 feet for the center pier and abutments, respectively. The existing fill soils were primarily granular in nature, with layers of clay fill soils noted in borings BSB-01 and BSB-03. Beneath the existing fill soils, very loose to medium dense brown sand and sandy clay loam was encountered to elevations between 610.0 and 618.3 feet. Beneath these soils, stiff to hard gray silty clay and silty clay loam soils were noted to elevations between 527.3 and 534.1 feet, at which point highly weathered bedrock was encountered. Within the gray silty clay soils, cohesionless soil layers (sand, sand clay loam, and silt) were noted at various depths between elevations 600.0 and 615.0 feet. Gravel seams were noted in borings BSB-02 and BSB-03 within the gray silty clay soils between elevations 580.0 and 590.0 feet.

Borings BSB-01 and BSB-03 were advanced through the weathered bedrock to elevations 511.8 and 524.11 feet, respectively, where moderately weathered limestone was encountered and the borings were terminated. Boring BSB-02, was terminated within the highly weathered limestone at elevation 527.5 feet.

The brown sand and sandy clay loam had SPT blow count ‘N’ values between 3 and 29 blows per foot (bpf). The gray silty clay had unconfined compressive strength values ranging between 1.0 and 5.83 tsf. The granular soils (sand, sandy clay loam, and silt) encountered within the gray silty clay soils had SPT blow count (N) values ranging from 3 to 21 bpf. The silty clay loam immediately above the weathered bedrock surface had SPT values of greater than 50 blows per 2 inches.

2.4 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. Mud rotary drilling techniques were utilized in the borings beginning at depths of 10 feet below grade in borings BSB-01 and BSB-03, and at 40 feet below grade in boring BSB-02. Groundwater was not encountered prior to beginning mud rotary drilling, and was obscured below these depths. The borings were not left open for delayed readings and were backfilled upon completion. Based on the color change from brown and gray to gray, it is anticipated that the long-term groundwater level could range between elevations 610 and 618 feet. Water level readings were made in the boreholes at times and under conditions shown on the boring logs and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

3.0 GEOTECHNICAL ANALYSES

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed bridge based on the results of the field exploration, laboratory testing, and geotechnical analysis. Subsurface conditions in unexplored locations may vary from those encountered at the boring locations. If structure locations, loadings, or elevations are changed, we request that GSG be contacted so that we may re-evaluate our recommendations.

3.1 Slope Stability

The bridge will be supported on a deep foundation system that will be designed to support the substructure against lateral and slope failure. Therefore, there are no slope stability concerns anticipated for the bridge structure. It is anticipated that new fill added to construct the new bridge abutments will be minimal. The existing abutment slopes under the existing Oakton Street bridge will be modified as part of the proposed reconstruction. For this report, a 2.5H:1V slope has been assumed. The overall stability of the proposed slopes was evaluated, considering a short-term and a long-term (potential five year) construction period.

Slide2 is a comprehensive slope stability analysis software used to evaluate the proposed side slopes for the project based on the limit equilibrium method. The slopes were analyzed based on the soils encountered at the site. Circular failure analyses were evaluated using the simplified Bishops analyses methods for the proposed slope geometries. A circular failure analyses was evaluated for both a short term (undrained) and long term (drained) condition based on the proposed geometry for the proposed slopes. The results of the analyses are shown in **Table 2**.

Table 2 – Global Slope Stability Analyses Results

Analysis Exhibit	Abutment Slope 2.5H:1V	Analysis Type	Factor of Safety	Minimum Factor of Safety
Exhibit 1	West Abutment	Circular – Short Term	2.2	1.5
Exhibit 2		Circular – Long Term	1.6	1.5
Exhibit 3	East Abutment	Circular – Short Term	2.0	1.5
Exhibit 4		Circular – Long Term	1.6	1.5

Based on general soils profiles for both abutments, the proposed slopes can maintain a stable slope of 2.5H:1V for the proposed bridge. Copies of the slope stability analyses exhibits are included in **Appendix F**.

3.2 Seismic Parameters

The seismic hazard for the site was analyzed per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRFD Bridge Design Specifications.

The Seismic Soil Site Class was determined per the requirements of “All Geotechnical Manual Users” (AGMU) Memo 9.1, Design Guide for Seismic Site Class Determination, and the “Seismic Site Class Determination” Excel spreadsheet provided by IDOT. A global Site Class Definition was determined for this project, and was found to be Soil Site Class D. The Seismic Performance Zone (SPZ) was determined using Figure 2.3.10-2 in the IDOT Bridge Manual and was found to be Seismic Performance Zone 1.

The AASHTO Seismic Design Parameters program was used to determine the peak ground acceleration coefficient (PGA), and the short (S_{DS}) and long (S_{D1}) period design spectral acceleration coefficients for each of the proposed structures. For this section of the project, the S_{DS} and the S_{D1} were determined using 2020 AASHTO Guide Specifications as shown in **Table 3**. Given the site location and materials encountered, the potential for liquefaction is minimal.

Table 3 – Seismic Parameters

Building Code Reference	PGA	S_{DS}	S_{D1}
2020 AASHTO Guide for LRFD Seismic Bridge Design	0.041g	0.14g	0.083g

3.3 Scour

The bridge structure carrying proposed Oakton Street over I-94 has no waterways in the vicinity; therefore, scour will not be a concern for this project.

3.4 Integral Abutment Feasibility

Integral abutment feasibility was checked for the bridge in accordance with ABD 12.3 and the IDOT Integral Abutment Feasibility Analysis spreadsheet. A total bridge structure back-to-back abutment length of 213.4 feet with the longest span of 106.7 feet and a 7˚36’0” skew from I-94 was used for analysis. Soil boring data was used from BSB-01 and BSB-03 to calculate the weighted average Qu for the soil profiles 10 feet below the estimated abutment invert elevations. The average Qu values were greater than 1.5 tsf, therefore the controlling expansion length was adjusted using a pile stiffness modifier of 1.57 to give an effective expansion length (EEL) of 186.99 feet from the east abutment. Based on the analyses, the following piles are suitable for the proposed integral abutment design: HP10x57, HP12x63, HP12x74, HP14x73, HP12x84, HP14x89, HP14x102, and HP14x117. The following pile types are unsuitable for integral abutment design: 12" and 14" diameter shell piles, HP8x36, HP10x42, and HP12x53.

4.0 GEOTECHNICAL BRIDGE DESIGN RECOMMENDATIONS

The foundations for the proposed bridge must provide sufficient support to resist dead and live loads, as well as seismic loading. The foundation design recommendations presented within this section were completed per the AASHTO LRFD 9th Edition (2020). The anticipated factored loads were unavailable at the time of this submittal.

4.1 Bridge Foundation Recommendations

GSG evaluated shallow and deep foundation system for the proposed bridge. Based on the design information and drawings provided to GSG, it is anticipated that the new abutments, approach slabs, and center pier will be supported on drive steel pile foundations. The results of the evaluation are presented below.

4.1.1 Shallow Foundations

Based on the soils encountered, the new span length and the anticipated loads, shallow foundations are not anticipated to be a feasible option for the proposed substructure of the bridge. We anticipate that shallow foundations will undergo excessive settlement, or the size of the footings will be very large, and therefore will not be a feasible option and are not discussed further in the report.

4.1.2 Drilled Shaft Foundations

Based on the soils encountered and the anticipated depth to a suitable bearing layer, drilled shaft foundations are not anticipated to be a feasible option for the proposed substructure of the bridge. It is anticipated that drilled shafts would extend to depths in excess of 75 to 80 feet for suitable bearing on the very stiff to hard clay soils. Drilled shaft foundations are not compatible with integral abutments that are proposed for the bridge structure. Based on the design drawings, drilled shafts are not anticipated for this structure and were therefore not considered as a design option in this report. If the design changes, GSG can provide recommendations at that time.

4.1.3 Driven Pile Foundations

Piles considered for this site include metal shell piles, concrete piles, and H-piles. Concrete piles are not recommended for this site because the pile lengths cannot be readily adjusted to accommodate variability in soil conditions. Metal shell piles are not a feasible option for the construction of the integral abutments of the proposed bridge structure. As specified previously

H-piles do meet

in *Section 3.4*, select steel H-piles do ~~not~~ meet the requirements for use in integral abutments. Design recommendations for driven piles are provided in *Section 4.2* of this report.

4.2 Driven Pile Foundation Design Recommendation

According to AASHTO Section 3.11.8-Downdrag, the pile should be designed to resist the downdrag if the ground settlement is 0.4 inches or greater. The nominal geotechnical resistance available to resist the structure load plus the downdrag load is estimated by considering only the positive side resistance and tip resistance below the lowest layer contributing to the downdrag. Based on the proposed fill heights at the bridge abutments, it is anticipated that settlement will be less than 0.4 inches; therefore, downdrag will not be discussed further in this report.

The Modified IDOT static method-excel spreadsheet was used to estimate the pile lengths at various axial geotechnical resistances for driven piles per IDOT AGMU Memo 10.2. The factored resistance includes a reduction of 0.55 for the geotechnical resistance for the pile installation. No geotechnical losses due to down drag or liquefaction were included in the axial pile resistance calculations.

Tables 4a thru 4e summarize the estimated maximum pile lengths for representative pile sections along with the factored resistance available for the piles that are feasible for the proposed substructures. The complete IDOT Pile Design Tables, including factored resistance available (RF) and nominal required bearing (R_N), are included in **Appendix E**.

The estimated pile lengths shown in **Table 4a thru 4e** and in **Appendix E** are based on the pile cut off elevations estimated from the preliminary plans and noted below each table. The actual pile length and resistance should be evaluated based on test piles installed in accordance with the specifications provided in Section 512.15 of IDOT Standard Specifications for Road and Bridge Construction. Per section 3.10.1.11 of the IDOT Bridge Manual (2012), the minimum pile spacing should be 3 pile diameters, and the maximum pile spacing should not be more than 3.5 times the effective footing thickness plus one foot, not to exceed a total of 8 feet.

Based on design criteria and assumptions provided in the IDOT "All Bridge Designers" Memorandum (ABD) 12.3, the following H-Pile sizes are suitable for the proposed integral abutments: HP10x57, HP12x63, HP12x74, HP14x73, HP12x84, HP14x89, HP14x102, and HP14x117. **Tables 4a thru 4e** summarize estimated pile lengths for select pile selections with the factored resistance available that are feasible for the proposed substructures. The complete IDOT Pile Design Tables for each substructure, including factored resistance available (R_F) and nominal required bearing (R_N), are included in **Appendix E**.

Table 4a – West Approach Slab Pile Design (BSB-01)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)	Pile End Bearing Stratum
HP12x63 (Max. R_N = 497 Kips)	429	236	74	Hard Gray Silty Clay
	444	244	76	Hard Gray Silty Clay
	497*	273*	80*	Hard Gray Silty Clay
HP14x73 (Max. R_N = 578 Kips)	517	285	74	Hard Gray Silty Clay
	534	294	76	Hard Gray Silty Clay
	578*	317*	80*	Hard Gray Silty Clay
HP14x89 (Max. R_N = 705 Kips)	587	323	86	Stiff to Very Stiff Gray Silty Clay
	599	330	89	Stiff to Very Stiff Gray Silty Clay
	705*	387*	92*	Hard Gray Silty Clay

NOTES:
Pile cut off elevation = 635.5 feet (preliminary TS&L)
Ground surface elevation against pile during driving = 634.5 feet (preliminary TS&L)
*Estimated based on maximum nominal required bearing of pile. Not included in Appendix E.

Table 4b – West Abutment Pile Design (BSB-01)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)	Pile End Bearing Stratum
HP12x63 (Max. R_N = 497 Kips)	422	232	67	Hard Gray Silty Clay
	437	240	70	Hard Gray Silty Clay
	497*	273*	73*	Hard Gray Silty Clay
HP14x73 (Max. R_N = 578 Kips)	509	280	67	Hard Gray Silty Clay
	526	289	70	Hard Gray Silty Clay
	578*	317*	73*	Hard Gray Silty Clay
HP14x89 (Max. R_N = 705 Kips)	579	318	80	Stiff to Very Stiff Gray Silty Clay
	591	325	82	Stiff to Very Stiff Gray Silty Clay
	705*	387*	86*	Hard Gray Silty Clay

NOTES:
Pile cut off elevation = 629.0 feet (preliminary TS&L)
Ground surface elevation against pile during driving = 628.0 feet (preliminary TS&L)
*Estimated based on maximum nominal required bearing of pile. Not included in Appendix E.

Table 4c – Center Pier Pile Design (BSB-02)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)	Pile End Bearing Stratum
HP12x63 (Max. R_N = 497 Kips)	482	265	74	Hard Gray Silty Clay
	488	268	76	Hard Gray Silty Clay
	497*	273*	80*	Hard Gray Silty Clay
HP14x73 (Max. R_N = 578 Kips)	473	260	69	Very Stiff Gray Silty Clay
	489	269	71	Very Stiff Gray Silty Clay
	578*	317*	74*	Hard Gray Silty Clay
HP14x89 (Max. R_N = 705 Kips)	608	334	79	Hard Gray Silty Clay
	623	343	84	Hard Gray Silty Clay
	705	388	88	Highly Weathered Limestone

NOTES:
Pile cut off elevation = 617.0 feet (preliminary TS&L)
Ground surface elevation against pile during driving = 616.0 feet (preliminary TS&L)
*Estimated based on maximum nominal required bearing of pile. Not included in Appendix E.

Table 4d – East Approach Slab Pile Design (BSB-03)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)	Pile End Bearing Stratum
HP12x63 (Max. R_N = 497 Kips)	456	251	81	Very Stiff Gray Silty Clay
	463	255	86	Stiff Gray Silty Clay
	497*	273*	90*	Stiff Gray Silty Clay
HP14x73 (Max. R_N = 578 Kips)	547	301	81	Very Stiff Gray Silty Clay
	549	302	86	Stiff Gray Silty Clay
	578*	317*	90*	Stiff Gray Silty Clay
HP14x89 (Max. R_N = 705 Kips)	567	312	89	Stiff Gray Silty Clay
	665	366	91	Hard Gray Silty Clay
	705*	387*	97*	Very Stiff Gray Silty Clay Loam

NOTES:
Pile cut off elevation = 635.5 feet (preliminary TS&L)
Ground surface elevation against pile during driving = 634.5 feet (preliminary TS&L)
*Estimated based on maximum nominal required bearing of pile. Not included in Appendix E.

Table 4e – East Abutment Pile Design (BSB-03)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)	Pile End Bearing Stratum
HP12x63 (Max. R_N = 497 Kips)	446	245	75	Very Stiff Gray Silty Clay
	453	249	80	Stiff Gray Silty Clay
	497*	273*	83*	Stiff Gray Silty Clay
HP14x73 (Max. R_N = 578 Kips)	535	294	75	Very Stiff Gray Silty Clay
	537	295	80	Stiff Gray Silty Clay
	578*	317*	83*	Stiff Gray Silty Clay
HP14x89 (Max. R_N = 705 Kips)	660	363	87	Very Stiff Gray Silty Clay Loam
	679	374	90	Very Stiff Gray Silty Clay Loam
	705*	387*	96*	Very Stiff Gray Silty Clay Loam

NOTES:
Pile cut off elevation = 629.0 feet (preliminary TS&L)
Ground surface elevation against pile during driving = 628.0 feet (preliminary TS&L)
*Estimated based on maximum nominal required bearing of pile. Not included in Appendix E.

4.3 Pile Driving Considerations

The subsurface conditions appear to be consistent throughout the soil boring locations. The soil borings were completed within 50 feet of the proposed substructure locations. The subsurface condition between borings indicated variable soil conditions. Therefore, it is recommended to complete test piles at each substructure location.

Driving shoes for the piles, in accordance with Section 1006.05 (e) of the IDOT Standard Specifications for Road and Bridge Construction (SSRBC), are recommended if the estimated driving depth is below elevation 565 feet to guard against damage in the hard clays or if the pile are extended to the top of the weathered bedrock.

Pile setup is a consideration that can contribute to an increase to long-term pile resistance of displacement piles (i.e. driven pile). This increase in resistance is referred to as pile setup which is the gain in pile resistance over time that occurs mainly due to dissipation of pore water pressures and healing of the distorted and remolded soils immediately surrounding the pile. The magnitude of soil setup is function of pile type as well as soil type and consistency. A greater magnitude of soil setup is generally expected for soft clays, dense granular deposits, and displacement type piles than for stiff clays, loose granular deposits, and non-displacement type piles. However, pile setup consideration should not be included in the pile resistance during the design phase of the project, but this may be considered during the construction phase if a pile does not achieve the required bearing during installation. Based on the subsurface soil conditions, we do not anticipate any setup for the driven piles.

4.4 Lateral Load Resistance

Lateral loadings applied to pile foundations are typically resisted by battering selected piles, the soil/structure interaction, pile flexure, or a combination of these factors. Section 3.10.1.10 of the 2012 IDOT Bridge Manual requires performing detailed structure interaction analysis if the factored lateral loading per pile exceeds 3 kips. The analysis shall determine actual pile moment and deflection to determine the selected pile adequacy for the existing loadings. **Table 5** provides generalized soil parameters for the entire site and includes recommended lateral soil modulus and soil strain parameters that can be used for laterally loaded pile analysis via the p-y curve method based on the encountered subsurface conditions.

Table 5 –Lateral Load Resistance Soil Parameters
(BSB-01, BSB-02, & BSB-03)

Elevation Range (feet)	Soil Description	Lateral Earth Pressure Coefficient			L-Pile Soil Parameters		
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)	L-Pile Soil Type	Constant for Lateral Modulus of Subgrade Reaction k_{py} (pci)*	Soil Strain (ε_{50})
	New Engineered Clay Fill	0.39	2.56	0.56	Stiff Clay w/o Free Water (Reese)	1,000	0.005
	New Engineered Granular Fill	0.33	3.00	0.50	Sand (Reese)	90	N/A
1.0 to 8.5 (618.0 to 610.0)	Very Loose to Medium Dense Brown Sand / Sandy Clay Loam	0.31	3.25	0.47	Sand (Reese)	90	N/A
8.5 to 13.5 (610.0 to 605.0)	Very Loose to Medium Dense Gray Sandy Clay Loam / Sand / Silt	0.31	3.25	0.47	Sand (Reese)	60	N/A
13.5 to 53.5 (605.0 to 565.0)	Stiff to Very Stiff Gray Silty Clay	0.36	2.77	0.53	Stiff Clay w/o Free Water (Reese)	1,000	0.005
53.5 to 88.5 (565.0 to 530.0)	Very Stiff to Hard Gray Silty Clay	0.36	2.77	0.53	Stiff Clay w/o Free Water (Reese)	1,000	0.005
1.0 to 8.5 (633.0 to 625.5) *BSB-01 & BSB-03 only*	FILL Brown Sand	0.33	3.00	0.50	Sand (Reese)	60	N/A
8.5 to 13.5 (625.5 to 620.5) *BSB-01 & BSB-03 only*	FILL Gray and Black Clay Loam	0.39	2.56	0.56	Stiff Clay w/o Free Water (Reese)	1,000	0.005
16.0 to 28.5 (618.0 to 605.5) *BSB-01 & BSB-03 only*	Very Stiff to Hard Gray Silty Clay	0.36	2.77	0.53	Stiff Clay w/o Free Water (Reese)	1,000	0.005

*The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * z$, where k_{py} is the constant given in the table and z is the distance from the surface to the center point of the layer in inches

5.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (SSRBC, 2016). Any deviation from the requirements in the manuals above should be approved by the design engineer.

5.1 Site Preparation

Based on the existing site conditions, all pavement, vegetation, landscaping, and surface topsoil should be cleared and removed from the vicinity of the proposed construction. Where possible, the engineer may require proof-rolling of the subgrade with a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proof-rolling is to locate soft, weak, or excessively wet soils present at the time of construction. Proof-rolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. Any unsuitable materials observed during the evaluation and proof-rolling operations should be undercut and replaced with compacted structural fill and/or stabilized in-place. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer at the time of construction. Once the site has been properly prepared, at grade construction may proceed.

Foundation aggregate fill should not be placed upon wet or frozen subgrade soils. If the subgrade or structural fill becomes frozen, desiccated, wet, disturbed, softened, or loose, the affected materials should be scarified, dried and moisture conditioned, and compacted to the full depth of the affected area or the soils should be removed. Rainfall and runoff can soften soils and affect the load bearing capacity of the soils. All water entering foundation excavation should be removed prior to placement backfill materials above the wall bottom.

5.2 Existing Utilities

Before proceeding with construction, any existing utility lines that will interfere with construction should be completely relocated from beneath the proposed construction areas. Where possible, existing utility lines that are to be abandoned in place should be removed and/or plugged with a minimum of 2 feet of cement grout. All excavations resulting from underground utility removal activities should be cleaned of loose and disturbed materials, including all previously placed backfill, and backfilled with suitable fill materials in accordance with the requirements of this section. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

5.3 Site Excavation

Site excavations are expected to encounter various types of soils as described in the Subsurface Exploration section of this report. The contractor will be responsible to provide a safe excavation during the construction activities of the project. All excavations should be conducted in accordance with applicable federal, state, and local safety regulations, including, but not limited to the Occupational Safety and Health Administration (OSHA) excavation safety standards. Excavation stability and soil pressures on temporary shoring are dependent on soil conditions, depth of excavations, installation procedures, and the magnitude of any surcharge loads on the ground surface adjacent to the excavation. Excavation near existing structures and underground utilities should be performed with extreme care to avoid undermining existing structures. Excavations should not extend below the level of adjacent existing foundations or utilities unless underpinning or other support is installed. It is the responsibility of the contractor for field determinations of applicable conditions and providing adequate shoring for all excavation activities.

5.4 Borrow Material and Compaction Requirements

If borrow material is to be used for onsite construction, it should conform to Section 204 “Borrow and Furnish Excavations” of the latest IDOT Construction Manual.

The fill material should be free of organic matter and debris and should be placed and compacted in accordance with Section 205, Embankment, of the IDOT SSRBC (2016). Fill should be placed in lifts and compacted according to Section 205, Embankment (IDOT, 2016).

5.5 Temporary Soil Retention System

If staged construction is used for the proposed improvement, a temporary soil retention system (TSRS) will be required. Based on the soil profile, a cantilevered sheet pile system could be used. The sheet pile retaining system should be designed in accordance with the IDOT Bridge Design Manual, Section 3.13.1, Temporary Sheet Piling Design, Temporary Soil Retention Systems. The design of the TSRS is the responsibility of the contractor. The contractor should submit the TSRS plans to the structural design team for review prior to commencing construction of the TSRS.

5.6 Groundwater Management

It is anticipated that the long-term water table could range between elevations 610 and 618 feet. GSG does not anticipate groundwater related issues during construction activity; however, water may be perched in the fill material encountered near the existing ground surface or the confined granular layers. If rainwater run-off or perched water is accumulated at the base of excavation, the contractor should remove accumulated water using conventional sump pit and pump procedures and maintain a dry and stable excavation. The location of the sump should be determined by the contractor based on field conditions. During earthmoving activities at the site, grading should be performed to ensure that drainage is maintained throughout the construction period. Water should not be allowed to accumulate in the foundation area either during or after construction. Undercut and excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

If water seepage occurs during excavations or where wet conditions are encountered such that the water cannot be removed with conventional sumping, we recommend placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation below the water table. The CA-7 stone should be placed to 12 inches above the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable.

6.0 LIMITATIONS

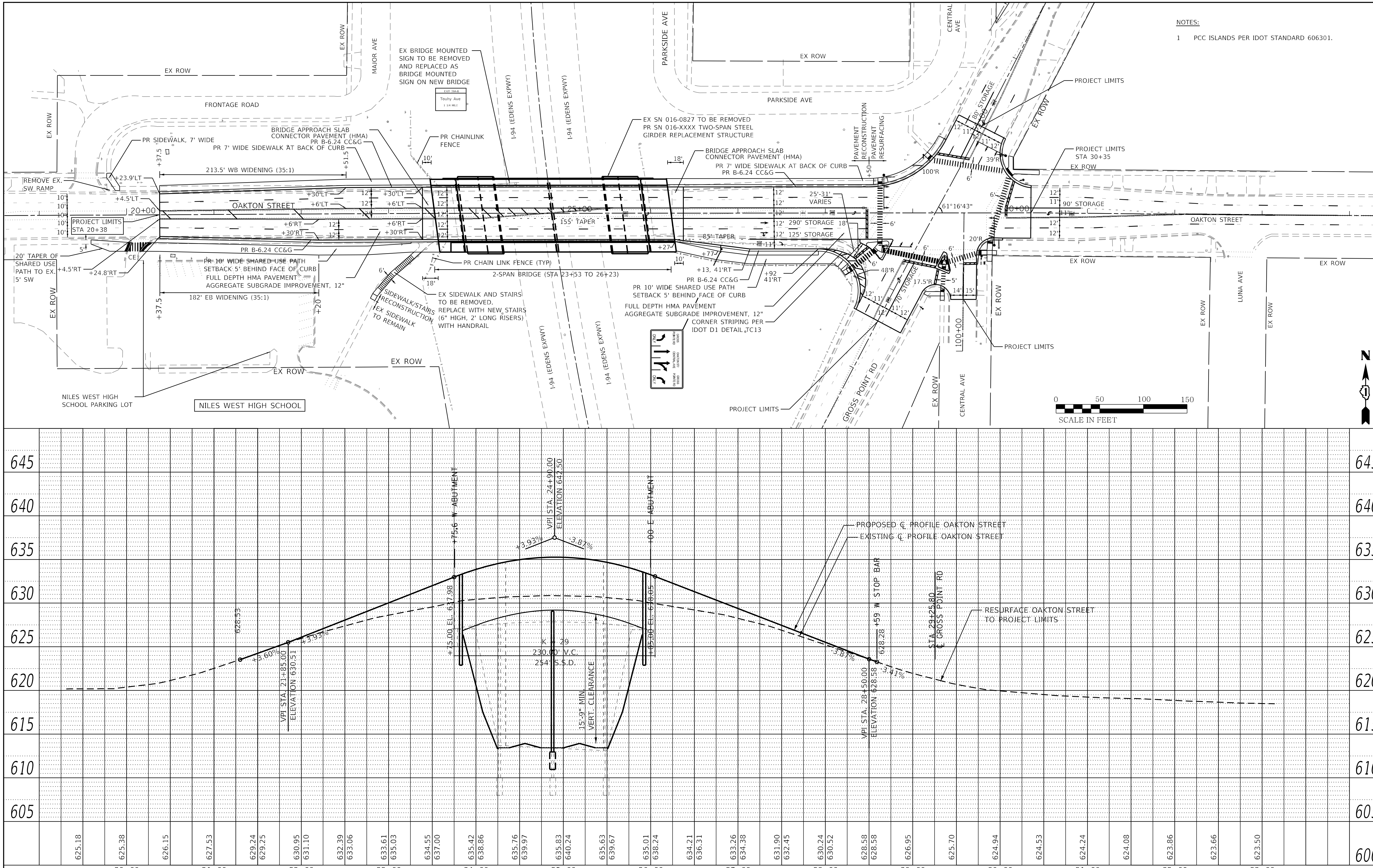
This report has been prepared for the exclusive use of the Illinois Department of Transportation (IDOT) and its Design Section Engineer consultant. The recommendations provided in the report are specific to the project described herein and are based on the information obtained at the soil boring locations. The analyses have been performed, and the recommendations have been provided based on subsurface conditions determined at the location of the borings. This report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

APPENDIX A

GENERAL PLAN & ELEVATON

NOTES:

1 PCC ISLANDS PER IDOT STANDARD 606301.



Hampton, Lenzini and Renwick, Inc. Civil Engineers • Structural Engineers Land Surveyors • Environmental Services 380 SHEPARD DRIVE ELGIN, ILLINOIS 60123 847.697.6700 www.hlrengineering.com	USER NAME = $USER$	DESIGNED – DSS	REVISED –
		DRAWN – DSS	REVISED –
	PLOT SCALE = $SCALE$	CHECKED – ARM	REVISED –
	PLOT DATE = $DATE$	DATE – 12/4/19	REVISED –

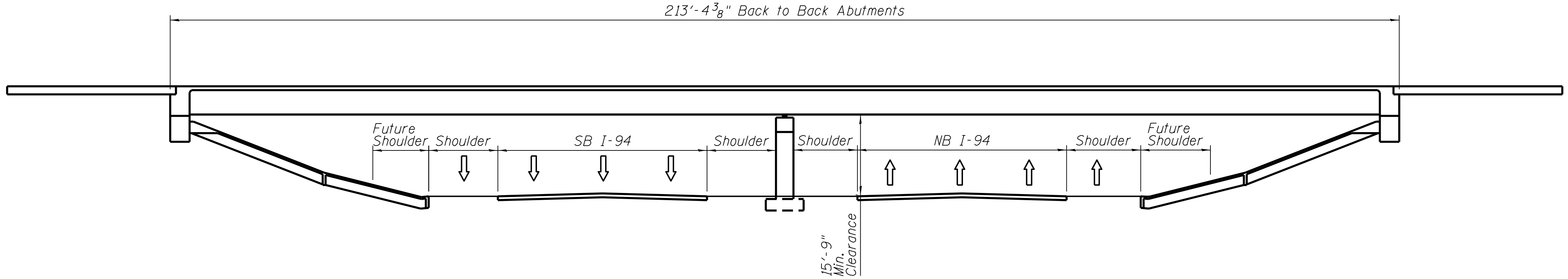
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I-94 (EDENS EXPWY) AT OAKTON STREET
PLAN AND PROFILE

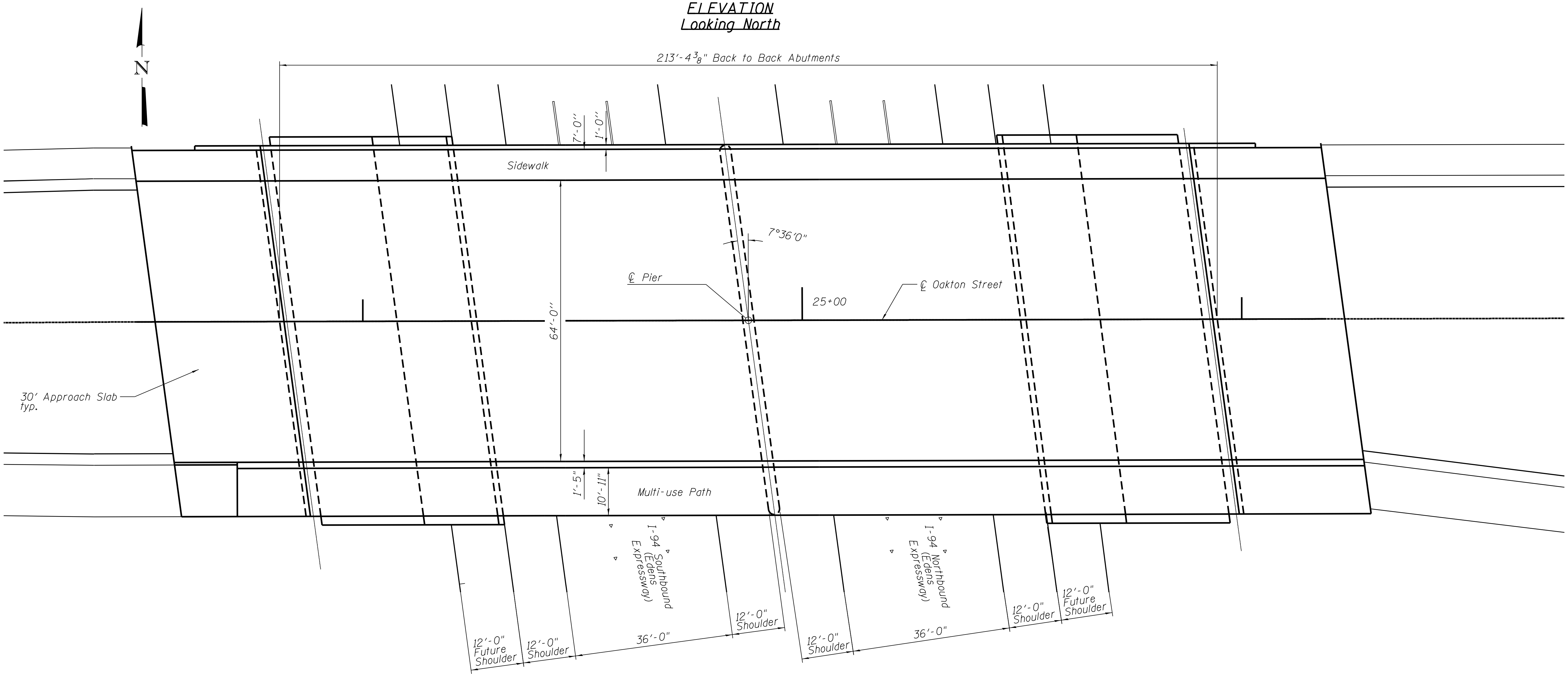
E-5.1.1

SCALE: 1"=50' | SHEET OF SHEETS | STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	1	1
		CONTRACT NO.		
		ILLINOIS FED. AID PROJECT		



ELEVATION
Looking North



PLAN

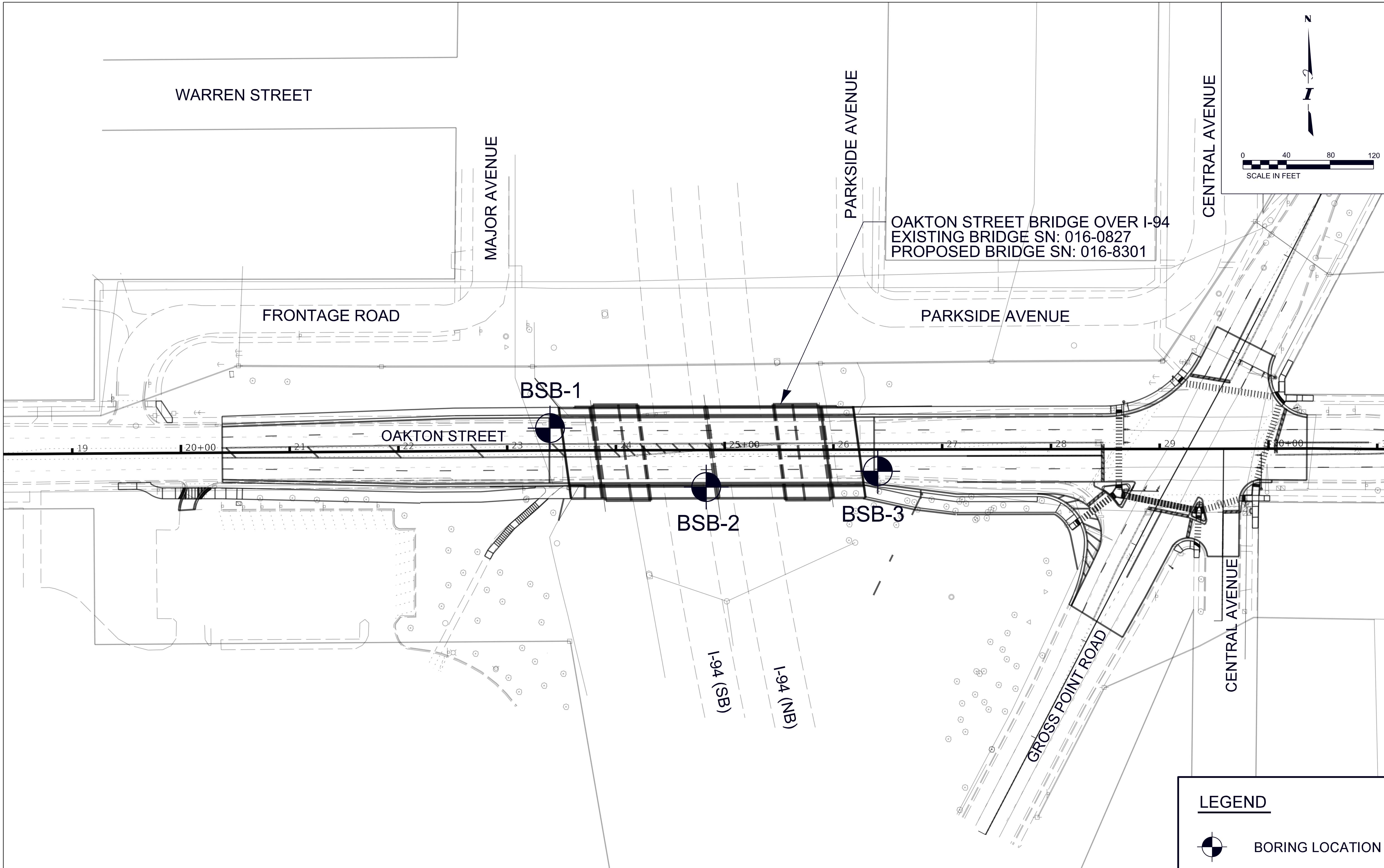
PROPOSED BRIDGE PLAN AND ELEVATION
FULL REPLACEMENT
OAKTON STREET OVER
I-94 (EDENS EXP.)
COOK COUNTY
STRUCTURE NO. 016-0827

E-7.1

PROJECT NUMBER: 17.0262.120	DRAWN: J.L.A.	DATE: 03/2019

APPENDIX B

SOIL BORING LOCATION PLAN AND SUBSURFACE PROFILE



GSG CONSULTANTS, INC. 735 E. REMINGTON RD, SCHAUMBURG, IL 60173 TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM	USER NAME =	DESIGNED - TK		
	SHEET SIZE = 1 41667 0 916667	DRAWN - JS		
	PLOT SCALE = 960 0000 /	CHECKED - DE		
	PLOT DATE = 10/13/2021	DATE - 10/06/2021		

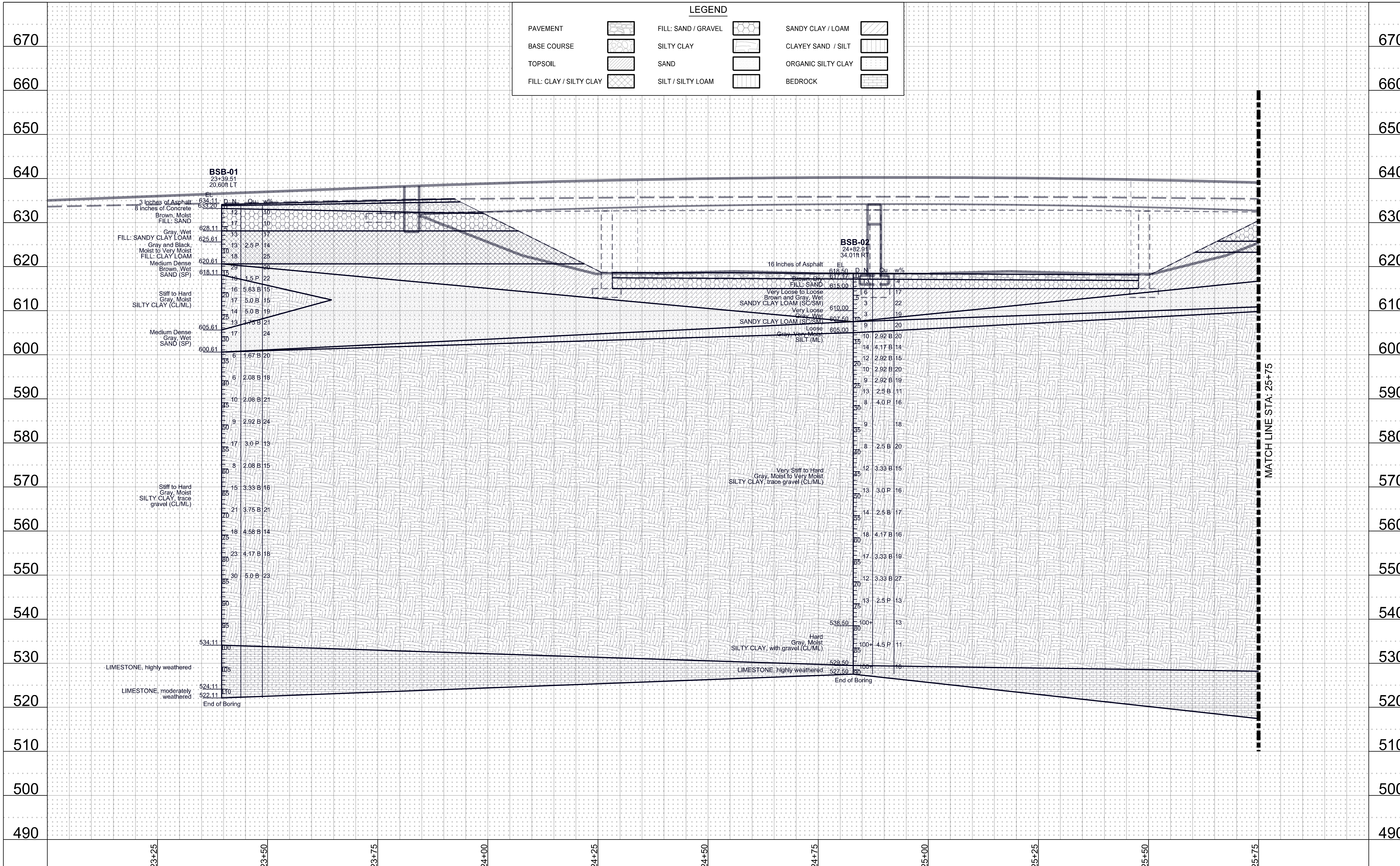
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PTB 195-019
OAKTON STREET BRIDGE OVER I-94
BORING LOCATION PLAN

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	3	1
		CONTRACT NO. P-91-467-16		

ILLINOIS | FED. AID PROJECT



GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME =		DESIGNED -	TK
SHEET SIZE =	1 41667 0 916667	DRAWN -	JS
PLOT SCALE =	1200 0000 /	CHECKED -	DE
PLOT DATE =	10/13/2021	DATE -	10/06/2021

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PTB 195-019

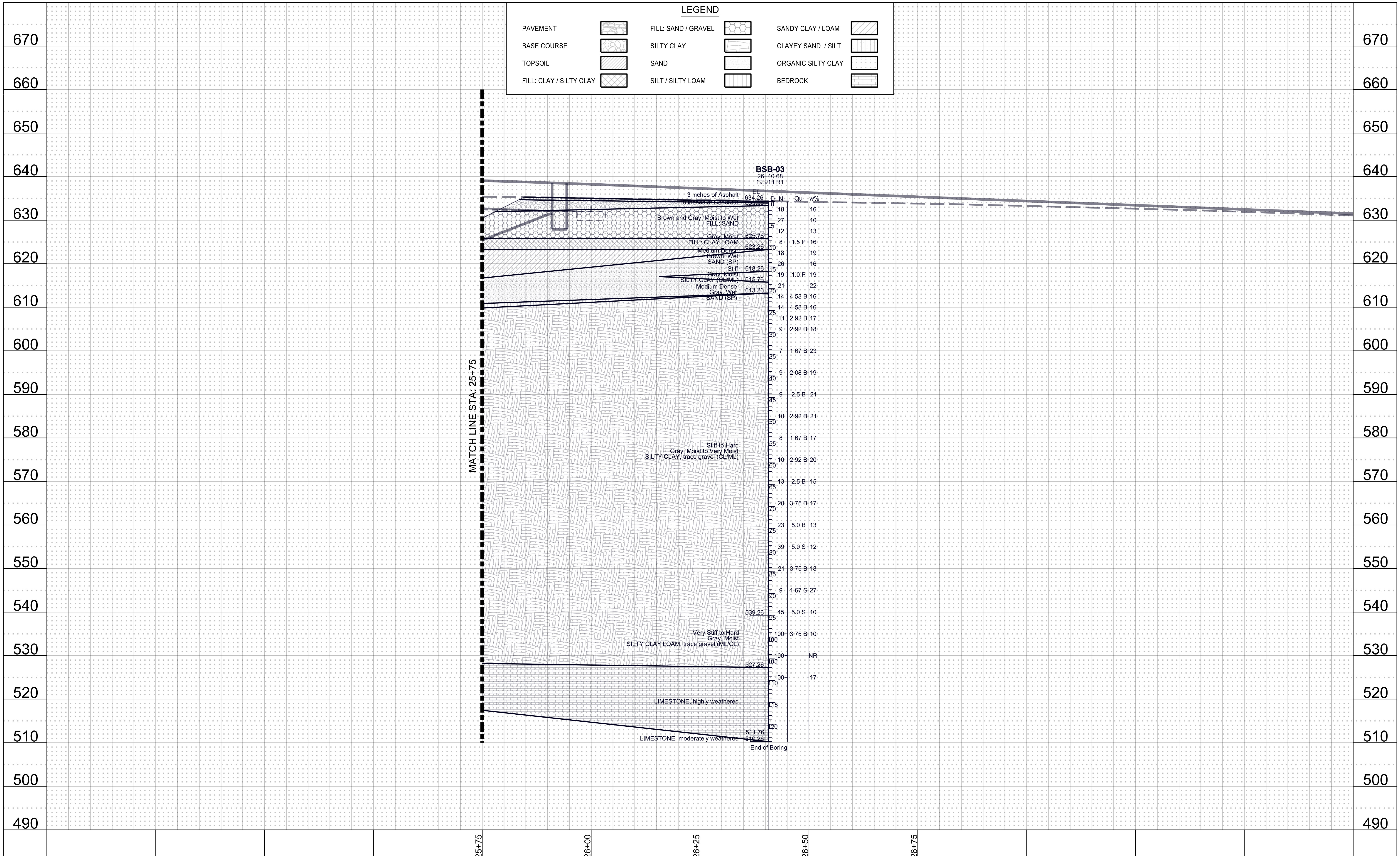
OAKTON STREET BRIDGE OVER I-94
BORING LOCATION PROFILE

SCALE: AS NOTED | SHEET 1 OF 2 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	3	2

CONTRACT NO. P-91-467-16

ILLINOIS | FED. AID PROJECT



GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME =		DESIGNED -	TK
SHEET SIZE =	1 41667 0 916667	DRAWN -	JS
PLOT SCALE =	1200 0000 /	CHECKED -	DE
PLOT DATE =	10/13/2021	DATE -	10/06/2021

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PTB 195-019
OAKTON STREET BRIDGE OVER I-94
BORING LOCATION PROFILE

SCALE: AS NOTED | SHEET 2 OF 2 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	3	3

CONTRACT NO. P-91-467-16
ILLINOIS | FED. AID PROJECT

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation

Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/27/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0264864, **Longitude** -87.7692392

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-01
Station 23+40
Offset 20.60ft LT
Ground Surface Elev. 634.11 ft

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

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

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
3 inches of Asphalt 8 inches of Concrete	633.20				
Brown, Moist FILL: SAND			4 5 7		10
		-5	4 8 9		10
Gray, Wet FILL: SANDY CLAY LOAM	628.11		4 6 7		17
Gray and Black, Moist to Very Moist FILL: CLAY LOAM	625.61	-10	6 7 6	2.5 P	14
			4 8 10		25
Medium Dense Brown, Wet SAND (SP)	620.61	-15	10 13 16		20
Stiff to Hard Gray, Moist SILTY CLAY (CL/ML) Sand seam at 17 feet	618.11		5 8 10	1.5 P	22
		-20	9 7 9	5.8 B	15
Stiff to Hard Gray, Moist SILTY CLAY (CL/ML) *(continued)*			5 7 10	5.0 B	15
		-25	4 5 9	5.0 B	19
			4 6 7	3.8 B	21
Medium Dense Gray, Wet SAND (SP)	605.61	-30	6 10 7		24
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML)	600.61	-35	2 2 4	1.7 B	20
		-40	2 3 3	2.1 B	18

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/27/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0264864, **Longitude** -87.7692392

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-01
Station 23+40
Offset 20.60ft LT
Ground Surface Elev. 634.11 ft

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

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

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
	-45	3 5 5	2.1 B	21
	-50	3 4 5	2.9 B	24
	-55	12 6 11	3.0 P	13
	-60	3 3 5	2.1 B	15

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
	-65	5 6 9	3.3 B	16
	-70	6 8 13	3.8 B	21
	-75	6 8 10	4.6 B	14
	-80	6 10 13	4.2 B	18

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/27/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0264864, **Longitude** -87.7692392

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-01
Station 23+40
Offset 20.60ft LT
Ground Surface Elev. 634.11 ft

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

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

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
550.61				
Hard Gray, Moist SILTY CLAY LOAM, trace gravel (ML/CL)		5 12 18	5.0 B	23
	-85			
	-90			
Hole cave-in at 45 feet. Blind drill after 85 feet to boring termination depth.				
	-95			
534.11	-100			

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
LIMESTONE, highly weathered				
	-105			
524.11	-110			
LIMESTONE, moderately weathered				
Auger refusal at 112 feet				
522.11				
End of Boring				
	-115			
	-120			

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/30/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263350, **Longitude** -87.7687120

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-02
Station 24+83
Offset 34.00ft RT
Ground Surface Elev. 618.50 ft

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

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

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
16 inches of Asphalt	617.17				
Brown, Dry FILL: SAND			8 6 7		4
	615.00				
Very Loose to Loose Brown and Gray, Wet SANDY CLAY LOAM (SC/SM)		-5	3 3 3		17
			3 1 2		22
	610.00				
Very Loose Gray, Wet SANDY CLAY LOAM (SC/SM)		-10	1 1 2		19
	607.50				
Loose Gray, Very Moist SILT (ML)			3 5 4		20
	605.00				
Very Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)		-15	3 5 5	2.9 B	20
			4 6 8	4.2 B	14
		-20	5 5 7	2.9 B	15

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*		3 4 6	2.9 B	20
	-25	4 4 5	2.9 B	19
		7 6 7	2.5 B	11
	-30	4 4 4	4.0 P	16
Gravel seams between 30 and 45 feet				
	-35	3 3 6		18
	-40	3 3 5	2.5 B	20

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/30/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263350, **Longitude** -87.7687120

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-02
Station 24+83
Offset 34.00ft RT
Ground Surface Elev. 618.50 ft

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

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

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
	-45	6 5 7	3.3 B	15
	-50	4 6 7	3.0 P	16
	-55	5 6 8	2.5 B	17
	-60	4 8 10	4.2 B	16

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
	-65	5 8 9	3.3 B	19
	-70	4 5 7	3.3 B	27
	-75	7 6 7	2.5 P	13
538.50	-80	50/5"		13

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/30/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263350, **Longitude** -87.7687120

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-02
Station 24+83
Offset 34.00ft RT
Ground Surface Elev. 618.50 ft

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

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

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Hard Gray, Moist SILTY CLAY, with gravel (CL/ML)			41 50/6"	4.5 P	11
		-85			
	529.50		50/2"		
LIMESTONE, highly weathered					18
		-90			
Auger refusal at 91 feet	527.50				
End of Boring					
		-95			
		-100			

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/26/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263719, **Longitude** -87.7681311

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-03
Station 26+41
Offset 19.90ft RT
Ground Surface Elev. 634.26 ft

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

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

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
3 inches of Asphalt 8 inches of Concrete	633.35				
Brown and Gray, Moist to Wet FILL: SAND			8 6 12		16
		-5	5 11 16		10
	625.76		4 6 6		13
Gray, Moist FILL: CLAY LOAM	623.26	-10	4 4 4	1.5 P	16
Medium Dense Brown, Wet SAND (SP)			3 8 10		19
	618.26	-15	8 12 14		16
Stiff Gray, Moist SILTY CLAY (CL/ML)	615.76		6 5 14	1.0 P	19
Medium Dense Gray, Wet SAND (SP)		-20	11 12 9		22

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	613.26				
Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)			6 6 8	4.6 B	16
		-25	5 6 8	4.6 B	16
			4 5 6	2.9 B	17
		-30	3 5 4	2.9 B	18
		-35	3 3 4	1.7 B	23
		-40	3 4 5	2.1 B	19

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/26/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263719, **Longitude** -87.7681311

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-03
Station 26+41
Offset 19.90ft RT
Ground Surface Elev. 634.26 ft

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

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

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
	-45	3 3 6	2.5 B	21
	-50	3 4 6	2.9 B	21
Sand and gravel seam at 50 feet				
	-55	4 4 4	1.7 B	17
	-60	4 5 5	2.9 B	20

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
	-65	4 6 7	2.5 B	15
	-70	6 8 12	3.8 B	17
	-75	7 9 14	5.0 B	13
	-80	18 17 22	5.0 S	12

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/26/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263719, **Longitude** -87.7681311

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-03
Station 26+41
Offset 19.90ft RT
Ground Surface Elev. 634.26 ft

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

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

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)* Sand and gravel seam at 80 feet				
		8		
		9	3.8	18
	-85	12	B	
		4		
		4	1.7	27
	-90	5	S	
		12		
		19	5.0	10
539.26	-95	26	S	
Very Stiff to Hard Gray, Moist SILTY CLAY LOAM, trace gravel (ML/CL)				
		50/5"		
			3.8	10
	-100		B	

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff to Hard Gray, Moist SILTY CLAY LOAM, trace gravel (ML/CL) *(continued)*				
		50/1"		
				NR
	-105			
527.26				
LIMESTONE, highly weathered				
		50/2"		
				17
	-110			
Blind drill after 110 feet				
	-115			
	-120			

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

Illinois Department of Transportation
Division of Highways
GSG Consultanrts, Inc.

SOIL BORING LOG

Date 8/26/21

ROUTE Oakton Street **DESCRIPTION** Bridge Boring **LOGGED BY** EH

SECTION Oakton Street at I-94 **LOCATION** Skokie and Morton Grove, IL, **SEC.** , **TWP.** Niles, **RNG.** ,
Latitude 42.0263719, **Longitude** -87.7681311

COUNTY COOK **DRILLING RIG** Diedrich D-50 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 96

STRUCT. NO. SN 016-8301
Station N/A

BORING NO. BSB-03
Station 26+41
Offset 19.90ft RT
Ground Surface Elev. 634.26 ft

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

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

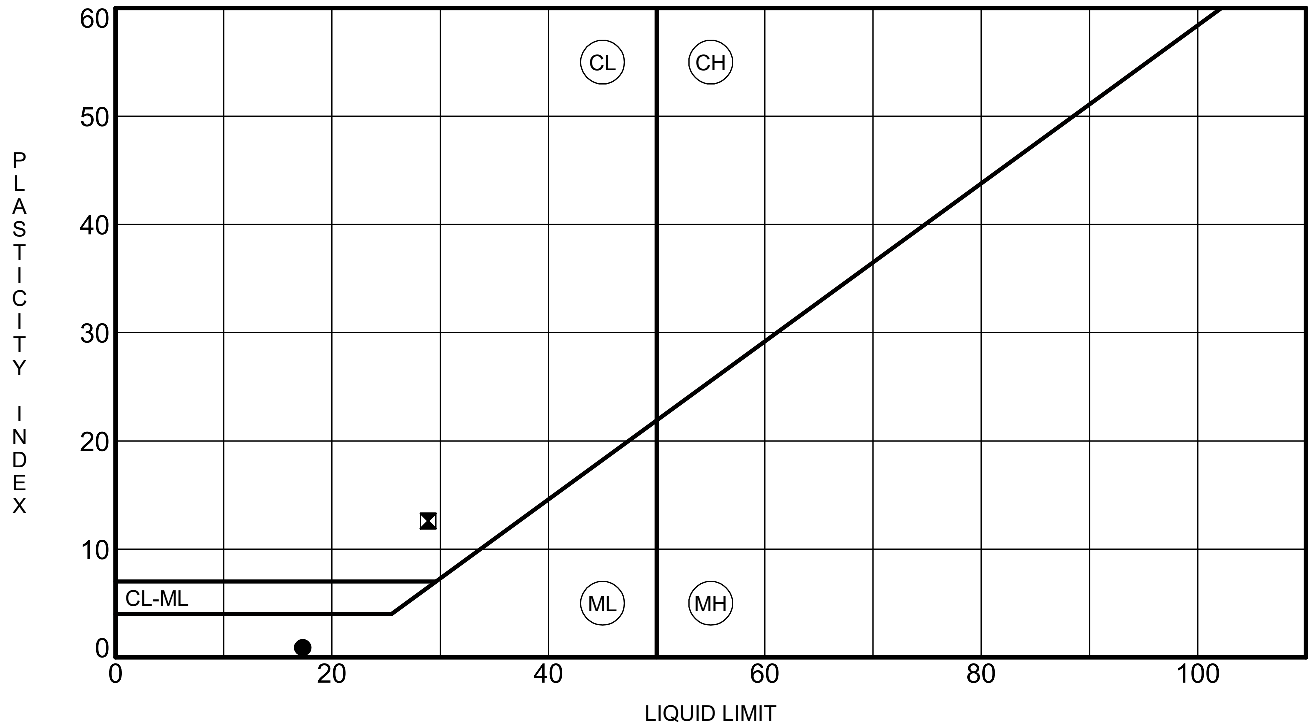
Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
LIMESTONE, highly weathered *(continued)*	511.76				
LIMESTONE, moderately weathered					
Auger refusal at 124 feet	510.26				
End of Boring		-125			
		-130			
		-135			
		-140			

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

BBS, form 137 (Rev. 8-99)

APPENDIX D

LABORATORY TEST RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BSB-01**	**83.50**	**17.3**	**16.4**	**0.9**		
⊠	**BSB-03**	**33.50**	**28.9**	**16.3**	**12.6**		

Illinois Department of Transportation

Division of Highways
GSG Consultants, Inc.

ATTERBERG LIMITS' RESULTS

Route: Oakton Street

Section: Oakton Street Bridge over I-94

County: COOK

ATTERBERG LIMITS PTB 195-19.GPJ IL DOT.GDT 9/24/21

APPENDIX E

IDOT PILE DESIGN TABLES

Pile Design Table for Oakton Bridge West Approach Slab utilizing Boring #BSB-01

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls				**Steel HP 10 X 42**				**Steel HP 12 X 84**			
	147	81	20		157	87	41		149	82	25
	166	91	22		185	102	46		165	91	35
	191	105	25		211	116	51		177	97	36
	206	113	27		227	125	56		202	111	41
	233	128	35		259	142	61		238	131	46
	245	135	36		290	159	66		270	149	51
	274	151	41		328	180	71		288	158	56
	310	171	46	**Steel HP 10 X 57**					331	182	61
	348	191	51		161	88	41		371	204	66
	378	208	56		189	104	46		420	231	71
Metal Shell 14"Φ w/.25" walls					215	118	51		442	243	74
	117	64	17		232	128	56		457	251	76
	182	100	20		264	145	61		477	262	79
	202	111	22		296	163	66		503	277	86
	231	127	25		335	184	71		513	282	89
	247	136	27		352	194	74		588	323	91
	275	151	35		366	201	76		609	335	96
	289	159	36		382	210	79		664	365	101
	323	178	41		407	224	81	**Steel HP 14 X 73**			
	367	202	46		409	225	86		135	74	22
	411	226	51		418	230	89		171	94	25
	444	244	56	**Steel HP 12 X 53**					193	106	35
Metal Shell 14"Φ w/.312" walls					159	87	35		208	114	36
	117	64	17		170	94	36		236	130	41
	182	100	20		194	107	41		280	154	46
	202	111	22		229	126	46		317	174	51
	231	127	25		260	143	51		335	184	56
	247	136	27		278	153	56		388	213	61
	275	151	35		319	175	61		434	239	66
	289	159	36		357	196	66		493	271	71
	323	178	41		404	222	71		517	285	74
	367	202	46	**Steel HP 12 X 63**					534	294	76
	411	226	51		160	88	35		557	306	79
	444	244	56		172	95	36	**Steel HP 14 X 89**			
	493	271	61		196	108	41		138	76	22
	545	300	66		232	127	46		175	96	25
Metal Shell 16"Φ w/.312" walls					263	144	51		195	107	35
	137	75	17		280	154	56		211	116	36
	219	120	20		322	177	61		239	131	41
	240	132	22		361	198	66		284	156	46
	274	151	25		408	225	71		321	177	51
	289	159	27		429	236	74		339	187	56
	318	175	35		444	244	76		392	216	61
	334	184	36		464	255	79		440	242	66
	373	205	41	**Steel HP 12 X 74**					499	275	71
	425	234	46		147	81	25		524	288	74
	476	262	51		162	89	35		540	297	76
	512	281	56		175	96	36		564	310	79
	570	313	61		199	109	41		587	323	86
	630	347	66		235	129	46		599	330	89
Metal Shell 16"Φ w/.375" walls					266	147	51		697	383	91
	137	75	17		284	156	56	**Steel HP 14 X 102**			

	219	120	20
	240	132	22
	274	151	25
	289	159	27
	318	175	35
	334	184	36
	373	205	41
	425	234	46
	476	262	51
	512	281	56
	570	313	61
	630	347	66
	702	386	71
	736	405	74
	764	420	76
Steel HP 8 X 36			
	147	81	46
	168	92	51
	182	100	56
	207	114	61
	231	127	66
	261	144	71
	275	151	74

	326	180	61
	366	201	66
	414	228	71
	435	239	74
	450	248	76
	470	259	79
	496	273	86
	507	279	89
	579	319	91

	140	77	22
	177	97	25
	198	109	35
	213	117	36
	242	133	41
	288	158	46
	325	179	51
	343	189	56
	397	218	61
	445	245	66
	505	278	71
	530	292	74
	547	301	76
	571	314	79
	593	326	86
	606	333	89
	706	388	91
	732	403	96
	810	445	101
Steel HP 14 X 117			
	143	79	22
	180	99	25
	200	110	35
	216	119	36
	245	135	41
	291	160	46
	329	181	51
	347	191	56
	402	221	61
	451	248	66
	512	281	71
	537	295	74
	554	304	76
	577	318	79
	600	330	86
	613	337	89
	714	393	91
	741	408	96
	929	511	101
Precast 14"x 14"			
	110	61	12

Pile Design Table for Oakton Bridge West Abutment utilizing Boring #BSB-01

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	141	78	16
	167	92	18
	181	100	21
	209	115	28
	220	121	30
	249	137	35
	286	157	40
	323	178	45
	353	194	50
Metal Shell 14"Φ w/.25" walls			
	153	84	13
	173	95	16
	203	111	18
	218	120	21
	246	135	28
	260	143	30
	294	162	35
	338	186	40
	382	210	45
	415	228	50
Metal Shell 14"Φ w/.312" walls			
	153	84	13
	173	95	16
	203	111	18
	218	120	21
	246	135	28
	260	143	30
	294	162	35
	338	186	40
	382	210	45
	415	228	50
	464	255	55
	517	284	60
Metal Shell 16"Φ w/.312" walls			
	104	57	11
	186	102	13
	207	114	16
	241	133	18
	256	141	21
	285	157	28
	301	166	30
	340	187	35
	392	216	40
	443	243	45
	479	263	50
	537	295	55
	598	329	60
Metal Shell 16"Φ w/.375" walls			
	104	57	11
	186	102	13
	207	114	16
	241	133	18

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	152	83	35
	179	99	40
	205	113	45
	221	122	50
	253	139	55
	284	156	60
	322	177	65
Steel HP 10 X 57			
	155	85	35
	183	101	40
	209	115	45
	226	124	50
	259	142	55
	291	160	60
	329	181	65
	347	191	67
	360	198	70
	376	207	72
	401	221	75
	403	222	80
	412	227	82
Steel HP 12 X 53			
	152	83	28
	163	90	30
	187	103	35
	222	122	40
	253	139	45
	271	149	50
	312	171	55
	350	193	60
	398	219	65
	418	230	67
Steel HP 12 X 63			
	153	84	28
	165	91	30
	189	104	35
	225	124	40
	256	141	45
	273	150	50
	315	173	55
	354	195	60
	401	221	65
	422	232	67
	437	240	70
	457	251	72
Steel HP 12 X 74			
	155	85	28
	167	92	30
	192	105	35
	228	125	40
	259	143	45
	277	152	50

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	158	87	28
	170	93	30
	194	107	35
	231	127	40
	263	145	45
	281	155	50
	324	178	55
	364	200	60
	413	227	65
	434	239	67
	450	247	70
	470	258	72
	496	273	80
	506	278	82
	581	319	85
	601	331	90
	664	365	95
Steel HP 14 X 73			
	159	87	18
	185	102	28
	200	110	30
	228	125	35
	272	150	40
	309	170	45
	327	180	50
	379	209	55
	426	234	60
	485	267	65
	509	280	67
	526	289	70
	549	302	72
Steel HP 14 X 89			
	162	89	18
	187	103	28
	202	111	30
	231	127	35
	276	152	40
	313	172	45
	331	182	50
	384	211	55
	432	237	60
	491	270	65
	516	284	67
	532	293	70
	555	305	72
	579	318	80
	591	325	82
	689	379	85
Steel HP 14 X 102			
	128	70	16
	165	91	18
	189	104	28

	256	141	21
	285	157	28
	301	166	30
	340	187	35
	392	216	40
	443	243	45
	479	263	50
	537	295	55
	598	329	60
	669	368	65
	703	387	67
	731	402	70
	763	420	72
Steel HP 8 X 36			
	142	78	40
	163	90	45
	178	98	50
	202	111	55
	227	125	60
	256	141	65
	270	149	67
	282	155	70

	319	176	55
	359	197	60
	407	224	65
	428	236	67
	443	244	70
	463	255	72
	489	269	80
	500	275	82
	572	315	85

	205	113	30
	234	129	35
	279	154	40
	317	174	45
	335	184	50
	389	214	55
	437	240	60
	497	273	65
	522	287	67
	539	296	70
	562	309	72
	585	322	80
	598	329	82
	697	383	85
	724	398	90
	810	445	95
Steel HP 14 X 117			
	131	72	16
	168	92	18
	192	105	28
	208	114	30
	237	130	35
	283	156	40
	321	176	45
	339	186	50
	394	217	55
	442	243	60
	503	277	65
	528	291	67
	545	300	70
	569	313	72
	592	325	80
	604	332	82
	706	388	85
	733	403	90
	929	511	95
Precast 14"x 14"			
	73	40	6

Pile Design Table for Oakton Bridge Center Pier utilizing Boring #BSB-02

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	136	75	25
	165	91	27
	170	94	29
	203	112	34
	244	134	39
	281	155	44
	315	173	49
	362	199	54
	386	212	56
Metal Shell 14"Φ w/.25" walls			
	146	80	22
	163	90	25
	200	110	27
	203	112	29
	241	133	34
	290	159	39
	333	183	44
	371	204	49
	430	236	54
	458	252	56
Metal Shell 14"Φ w/.312" walls			
	146	80	22
	163	90	25
	200	110	27
	203	112	29
	241	133	34
	290	159	39
	333	183	44
	371	204	49
	430	236	54
	458	252	56
	476	262	59
	500	275	61
	523	288	64
	547	301	66
	561	308	69
Metal Shell 16"Φ w/.312" walls			
	148	81	20
	173	95	22
	191	105	25
	236	130	27
	238	131	29
	281	154	34
	338	186	39
	387	213	44
	429	236	49
	499	274	54
	531	292	56
	550	303	59
	577	317	61
	604	332	64
	631	347	66

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	138	76	34
	168	93	39
	192	106	44
	213	117	49
	251	138	54
	267	147	56
	275	151	59
	289	159	61
	303	166	64
	316	174	66
	322	177	69
	333	183	71
Steel HP 10 X 57			
	141	78	34
	172	95	39
	197	108	44
	218	120	49
	257	141	54
	273	150	56
	281	155	59
	295	162	61
	309	170	64
	323	178	66
	329	181	69
	340	187	71
	345	190	72
	349	192	73
	393	216	74
	398	219	76
	403	222	79
	414	228	84
	454	250	88
Steel HP 12 X 53			
	148	81	29
	172	95	34
	210	116	39
	238	131	44
	262	144	49
	311	171	54
	331	182	56
	339	186	59
	355	195	61
	371	204	64
	388	213	66
	393	216	69
	406	223	71
	411	226	72
	417	229	73
Steel HP 12 X 63			
	150	82	29
	174	96	34
	212	117	39

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	154	85	29
	179	98	34
	219	120	39
	248	136	44
	272	149	49
	324	178	54
	344	189	56
	352	193	59
	369	203	61
	386	212	64
	402	221	66
	407	224	69
	421	232	71
	426	235	72
	432	238	73
	496	273	74
	503	276	76
	509	280	79
	522	287	84
	664	365	88
Steel HP 14 X 73			
	147	81	25
	178	98	27
	184	101	29
	211	116	34
	259	142	39
	291	160	44
	318	175	49
	382	210	54
	405	222	56
	411	226	59
	431	237	61
	450	248	64
	469	258	66
	473	260	69
	489	269	71
	495	272	72
	501	276	73
Steel HP 14 X 89			
	149	82	25
	181	100	27
	187	103	29
	214	118	34
	262	144	39
	295	162	44
	321	177	49
	386	213	54
	410	225	56
	416	229	59
	436	240	61
	456	251	64
	475	261	66

	646	355	69
Metal Shell 16"Φ w/.375" walls			
	148	81	20
	173	95	22
	191	105	25
	236	130	27
	238	131	29
	281	154	34
	338	186	39
	387	213	44
	429	236	49
	499	274	54
	531	292	56
	550	303	59
	577	317	61
	604	332	64
	631	347	66
	646	355	69
	668	367	71
	677	372	72
	685	377	73
Steel HP 8 X 36			
	153	84	44
	170	94	49
	199	109	54
	212	117	56
	220	121	59
	231	127	61
	242	133	64
	253	139	66
	259	143	69
	268	148	71
	272	150	72
	276	152	73
	241	132	44
	264	145	49
	315	173	54
	334	184	56
	342	188	59
	358	197	61
	375	206	64
	391	215	66
	396	218	69
	410	225	71
	415	228	72
	421	231	73
	482	265	74
	488	268	76
	494	272	79
Steel HP 12 X 74			
	152	84	29
	176	97	34
	215	119	39
	244	134	44
	268	147	49
	319	176	54
	339	186	56
	347	191	59
	364	200	61
	380	209	64
	397	218	66
	402	221	69
	415	228	71
	421	231	72
	426	234	73
	489	269	74
	495	272	76
	502	276	79
	515	283	84
	589	324	88
	478	263	69
	494	272	71
	501	275	72
	507	279	73
	593	326	74
	600	330	76
	608	334	79
	623	343	84
	705	388	88
Steel HP 14 X 102			
	151	83	25
	183	101	27
	189	104	29
	217	119	34
	266	146	39
	299	164	44
	325	179	49
	391	215	54
	415	228	56
	421	232	59
	441	243	61
	461	254	64
	481	264	66
	484	266	69
	500	275	71
	507	279	72
	513	282	73
	600	330	74
	608	334	76
	616	339	79
	631	347	84
	800	440	88
	810	445	89
Steel HP 14 X 117			
	153	84	25
	186	103	27
	192	105	29
	220	121	34
	269	148	39
	303	166	44
	329	181	49
	396	218	54
	420	231	56
	427	235	59
	447	246	61
	467	257	64
	487	268	66
	490	269	69
	506	278	71
	512	282	72
	519	285	73
	608	334	74
	616	339	76
	623	343	79
	639	351	84
	814	448	88
	929	511	89
Precast 14"x 14"			

											159	87	20
											186	102	22
											207	114	25
											254	140	27
											259	142	29

Pile Design Table for Oakton Bridge East Approach Slab utilizing Boring #BSB-03

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	149	82	22
	174	96	25
	185	102	27
	204	112	30
	204	112	31
	233	128	36
	266	146	41
	303	167	46
	329	181	51
	365	201	56
Metal Shell 14"Φ w/.25" walls			
	112	62	17
	181	100	22
	211	116	25
	221	122	27
	241	133	31
	276	152	36
	315	173	41
	358	197	46
	387	213	51
	431	237	56
Metal Shell 14"Φ w/.312" walls			
	112	62	17
	181	100	22
	211	116	25
	221	122	27
	241	133	31
	276	152	36
	315	173	41
	358	197	46
	387	213	51
	431	237	56
	469	258	61
	522	287	66
Metal Shell 16"Φ w/.312" walls			
	130	72	17
	216	119	22
	250	137	25
	259	142	27
	279	153	31
	319	175	36
	364	200	41
	415	228	46
	445	245	51
	498	274	56
	541	298	61
	604	332	66
Metal Shell 16"Φ w/.375" walls			
	130	72	17
	216	119	22
	250	137	25
	259	142	27

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	147	81	41
	174	95	46
	186	103	51
	215	118	56
	236	130	61
	270	149	66
	312	172	71
	329	181	74
Steel HP 10 X 57			
	151	83	41
	178	98	46
	190	105	51
	220	121	56
	241	133	61
	276	152	66
	319	176	71
	337	185	74
	354	195	76
	372	204	79
	377	207	81
	386	213	86
	395	217	89
	447	246	91
	451	248	94
Steel HP 12 X 53			
	153	84	36
	183	101	41
	215	118	46
	228	125	51
	266	146	56
	290	159	61
	334	183	66
	387	213	71
	407	224	74
Steel HP 12 X 63			
	155	85	36
	185	102	41
	218	120	46
	230	127	51
	268	148	56
	292	161	61
	337	185	66
	390	215	71
	411	226	74
	432	238	76
	453	249	79
	456	251	81
	463	255	86
	473	260	89
Steel HP 12 X 74			
	157	86	36
	187	103	41

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	160	88	36
	190	105	41
	224	123	46
	236	130	51
	276	152	56
	301	165	61
	347	191	66
	402	221	71
	423	233	74
	445	245	76
	466	256	79
	469	258	81
	475	261	86
	486	267	89
	560	308	91
	566	311	94
	581	320	96
	594	327	101
	607	334	106
	664	365	108
Steel HP 14 X 73			
	156	86	31
	188	103	36
	224	123	41
	264	145	46
	275	151	51
	324	178	56
	351	193	61
	406	224	66
	473	260	71
	497	274	74
	522	287	76
	546	300	79
	547	301	81
	549	302	86
	561	309	89
Steel HP 14 X 89			
	158	87	31
	190	105	36
	227	125	41
	267	147	46
	278	153	51
	328	180	56
	355	195	61
	412	226	66
	479	264	71
	504	277	74
	529	291	76
	553	304	79
	553	304	81
	555	305	86
	567	312	89

	279	153	31
	319	175	36
	364	200	41
	415	228	46
	445	245	51
	498	274	56
	541	298	61
	604	332	66
	683	375	71
	717	394	74
	751	413	76
Steel HP 8 X 36			
	150	82	51
	172	94	56
	189	104	61
	215	118	66
	248	136	71
	262	144	74
	276	152	76

	221	121	46
	233	128	51
	272	150	56
	296	163	61
	342	188	66
	396	218	71
	417	229	74
	438	241	76
	459	253	79
	462	254	81
	469	258	86
	480	264	89
	552	304	91
	558	307	94
	573	315	96
	586	322	101

	665	366	91
	672	369	94
	691	380	96
Steel HP 14 X 102			
	160	88	31
	193	106	36
	230	127	41
	271	149	46
	282	155	51
	332	182	56
	359	198	61
	417	229	66
	485	267	71
	510	281	74
	535	294	76
	560	308	81
	561	309	86
	574	315	89
	673	370	91
	680	374	94
	700	385	96
	715	393	101
	730	402	106
	810	445	108
Steel HP 14 X 117			
	162	89	31
	195	107	36
	233	128	41
	274	151	46
	285	157	51
	336	185	56
	364	200	61
	422	232	66
	491	270	71
	517	284	74
	542	298	76
	566	312	81
	567	312	86
	580	319	89
	682	375	91
	688	379	94
	709	390	96
	724	398	101
	739	407	106
	929	511	108
Precast 14"x 14"			
	88	49	10

Pile Design Table for Oakton Bridge East Abutment utilizing Boring #BSB-03

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls				**Steel HP 10 X 42**				**Steel HP 12 X 84**			
	148	82	21		139	77	35		150	82	30
	167	92	23		165	91	40		180	99	35
	167	92	25		178	98	45		214	118	40
	196	108	30		207	114	50		226	124	45
	229	126	35		228	125	55		266	146	50
	266	146	40		262	144	60		291	160	55
	292	161	45		304	167	65		337	185	60
	328	180	50		321	177	67		392	216	65
	361	199	55	**Steel HP 10 X 57**					413	227	67
Metal Shell 14"Φ w/.25" walls					142	78	35		435	239	70
	138	76	16		169	93	40		456	251	72
	168	92	18		182	100	45		459	252	75
	178	98	21		212	117	50		465	256	80
	198	109	25		233	128	55		476	262	82
	232	128	30		268	147	60		550	303	85
	271	149	35		311	171	65		556	306	87
	315	173	40		328	181	67		571	314	90
	343	189	45		346	190	70		584	321	95
	388	213	50		363	200	72		597	328	100
	426	234	55		368	203	75		664	365	102
Metal Shell 14"Φ w/.312" walls					378	208	80	**Steel HP 14 X 73**			
	138	76	16		387	213	82		144	79	25
	168	92	18		438	241	85		176	97	30
	178	98	21		443	244	87		213	117	35
	198	109	25	**Steel HP 12 X 53**					252	139	40
	232	128	30		144	79	30		264	145	45
	271	149	35		173	95	35		312	172	50
	315	173	40		206	113	40		339	187	55
	343	189	45		218	120	45		395	217	60
	388	213	50		256	141	50		461	254	65
	426	234	55		280	154	55		486	267	67
	479	263	60		324	178	60		510	281	70
	545	300	65		377	207	65		535	294	72
Metal Shell 16"Φ w/.312" walls					397	219	67		535	294	75
	81	44	11		418	230	70		537	295	80
	166	91	16	**Steel HP 12 X 63**					549	302	82
	200	110	18		145	80	30	**Steel HP 14 X 89**			
	209	115	21		175	96	35		146	80	25
	229	126	25		208	114	40		179	98	30
	269	148	30		220	121	45		215	118	35
	315	173	35		258	142	50		256	141	40
	366	201	40		283	155	55		267	147	45
	396	218	45		327	180	60		316	174	50
	449	247	50		381	209	65		343	189	55
	491	270	55		401	221	67		400	220	60
	555	305	60		422	232	70		467	257	65
	633	348	65		443	244	72		492	271	67
Metal Shell 16"Φ w/.375" walls					446	245	75		517	284	70
	81	44	11		453	249	80		542	298	72
	166	91	16		464	255	82		542	298	75
	200	110	18	**Steel HP 12 X 74**					543	299	80
	209	115	21		147	81	30		556	306	82

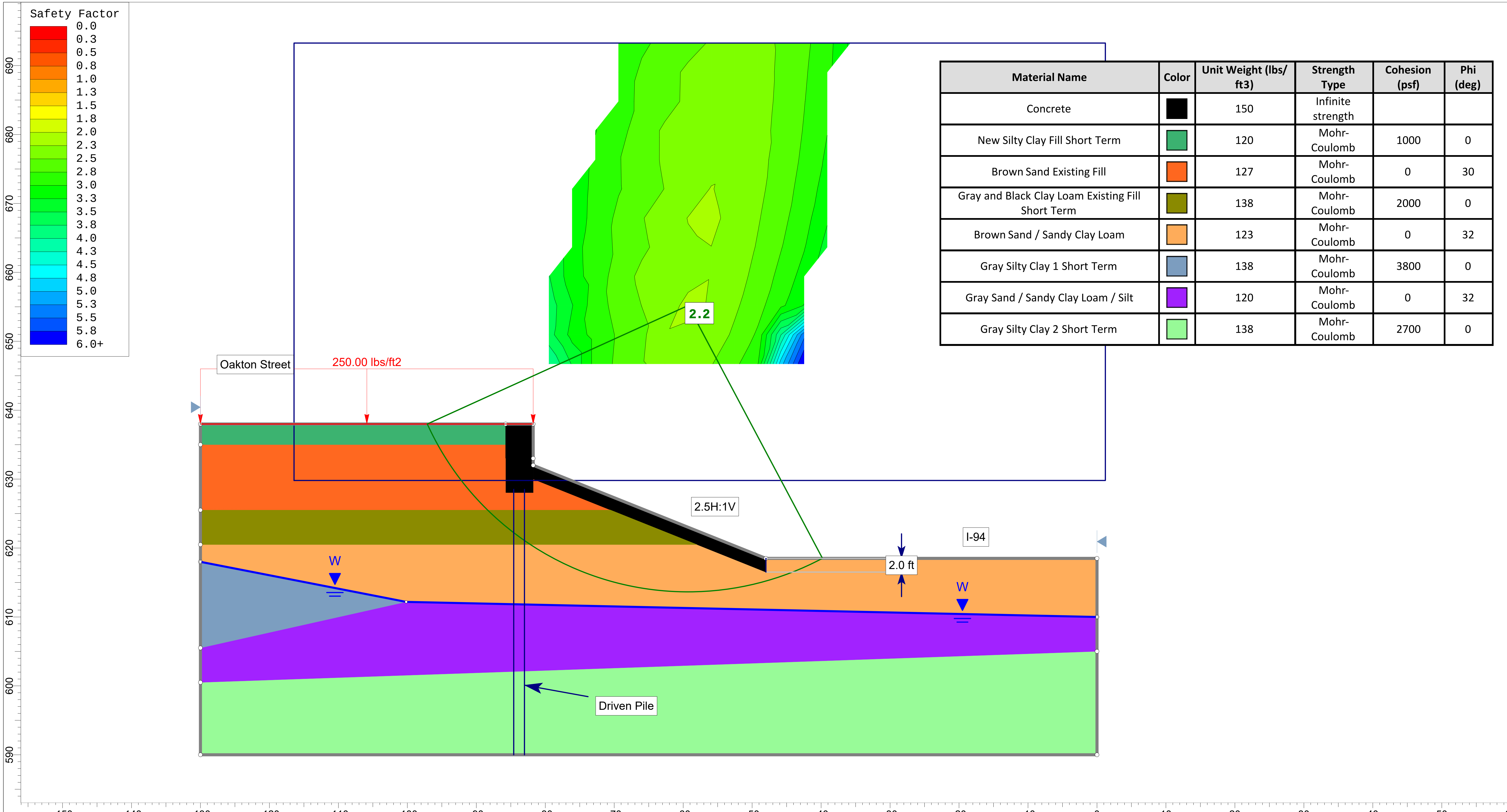
	229	126	25
	269	148	30
	315	173	35
	366	201	40
	396	218	45
	449	247	50
	491	270	55
	555	305	60
	633	348	65
	667	367	67
	701	386	70
	735	404	72
	750	413	75
	777	428	80
Steel HP 8 X 36			
	143	79	45
	165	91	50
	183	100	55
	209	115	60
	241	133	65
	255	140	67
	269	148	70
	283	156	72

	178	98	35
	211	116	40
	223	123	45
	262	144	50
	287	158	55
	332	182	60
	386	212	65
	407	224	67
	428	236	70
	449	247	72
	452	249	75
	459	253	80
	470	258	82
	542	298	85
	548	301	87
	563	310	90
	576	317	95
	589	324	100
	589	324	102

	653	359	85
	660	363	87
	679	374	90
	695	382	95
Steel HP 14 X 102			
	148	81	25
	181	100	30
	218	120	35
	259	142	40
	270	148	45
	320	176	50
	347	191	55
	405	223	60
	473	260	65
	498	274	67
	523	288	70
	548	301	75
	549	302	80
	562	309	82
	662	364	85
	668	367	87
	688	378	90
	703	387	95
	719	395	100
	810	445	102
Steel HP 14 X 117			
	150	82	25
	183	101	30
	221	122	35
	262	144	40
	273	150	45
	324	178	50
	352	193	55
	410	225	60
	479	264	65
	505	278	67
	530	291	70
	555	305	75
	555	306	80
	568	312	82
	670	368	85
	676	372	87
	697	383	90
	712	392	95
	727	400	100
	929	511	102
Precast 14"x 14"			
	88	48	11

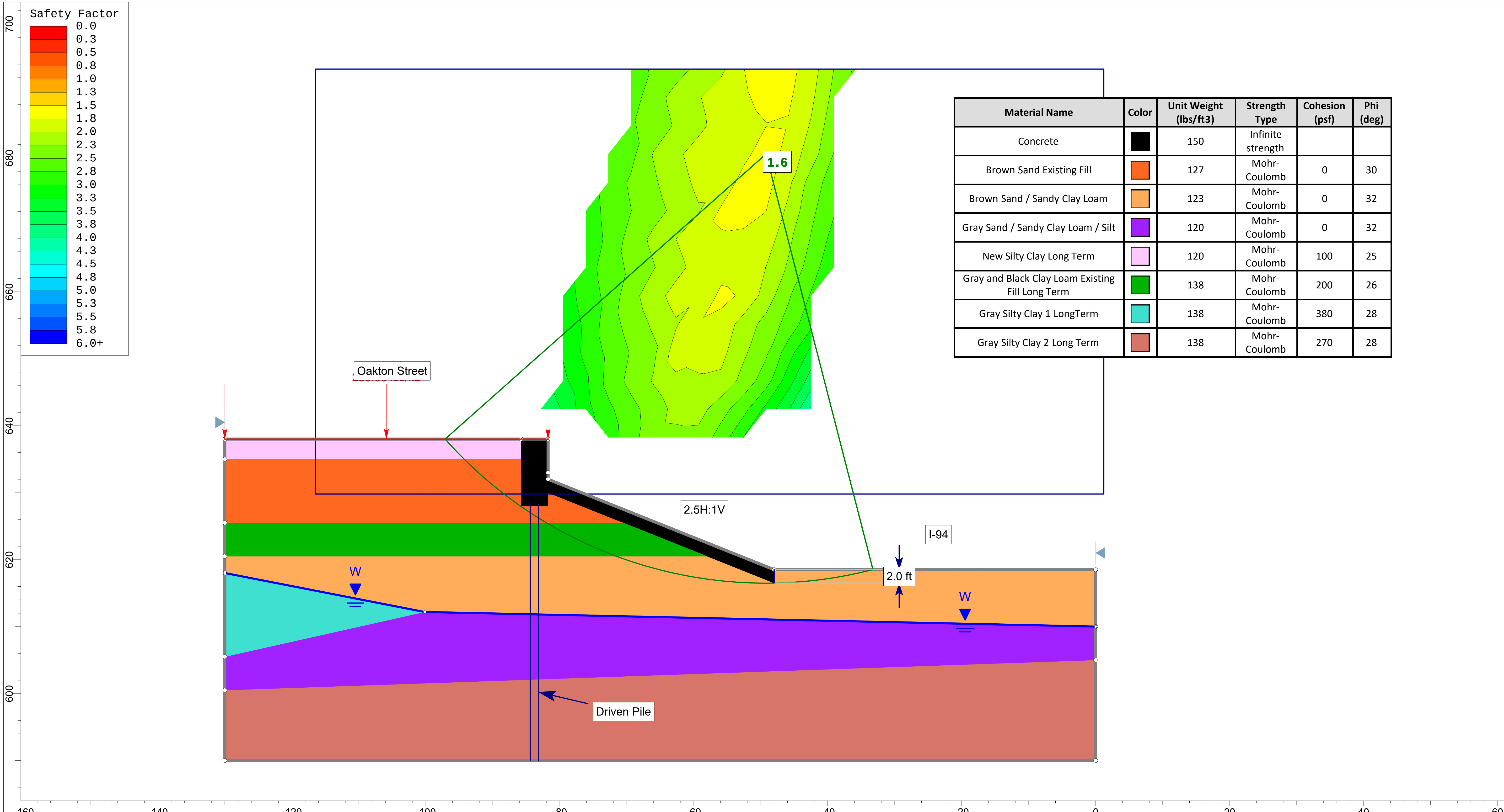
APPENDIX F

SLOPE STABILTY ANALYSES EXHIBITS



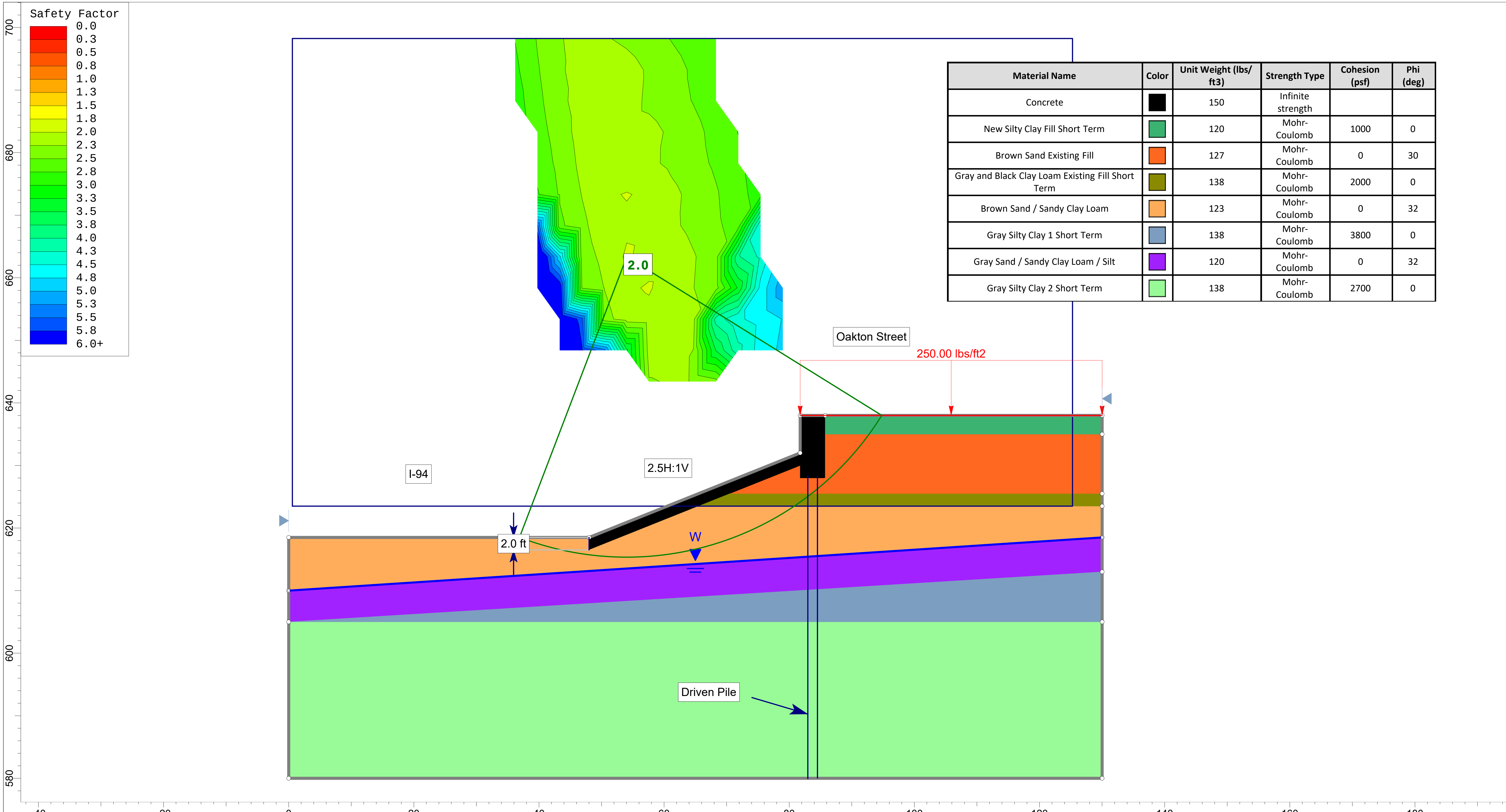
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Concrete		150	Infinite strength		
New Silty Clay Fill Short Term		120	Mohr-Coulomb	1000	0
Brown Sand Existing Fill		127	Mohr-Coulomb	0	30
Gray and Black Clay Loam Existing Fill Short Term		138	Mohr-Coulomb	2000	0
Brown Sand / Sandy Clay Loam		123	Mohr-Coulomb	0	32
Gray Silty Clay 1 Short Term		138	Mohr-Coulomb	3800	0
Gray Sand / Sandy Clay Loam / Silt		120	Mohr-Coulomb	0	32
Gray Silty Clay 2 Short Term		138	Mohr-Coulomb	2700	0

Project	IDOT PTB 195-019: Oakton Street Bridge over I-94		
Analysis Description	Exhibit 1 - West Abutment Slope - Slope Circular Failure Short Term		
Drawn By	TEK	*Company*	GSG Consultants, Inc.
Date	10/7/2021 11:23:40 AM	*File Name*	west abutment, 2.5H to 1V.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Concrete		150	Infinite strength		
Brown Sand Existing Fill		127	Mohr-Coulomb	0	30
Brown Sand / Sandy Clay Loam		123	Mohr-Coulomb	0	32
Gray Sand / Sandy Clay Loam / Silt		120	Mohr-Coulomb	0	32
New Silty Clay Long Term		120	Mohr-Coulomb	100	25
Gray and Black Clay Loam Existing Fill Long Term		138	Mohr-Coulomb	200	26
Gray Silty Clay 1 LongTerm		138	Mohr-Coulomb	380	28
Gray Silty Clay 2 Long Term		138	Mohr-Coulomb	270	28

Project	IDOT PTB 195-019: Oakton Street Bridge over I-94
Analysis Description	Exhibit 2 - West Abutment Slope - Slope Circular Failure Long Term
Drawn By	TEK
Company	GSG Consultants, Inc.
Date	10/7/2021 11:24:25 AM
File Name	west abutment, 2.5H to 1V.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Concrete		150	Infinite strength		
New Silty Clay Fill Short Term		120	Mohr-Coulomb	1000	0
Brown Sand Existing Fill		127	Mohr-Coulomb	0	30
Gray and Black Clay Loam Existing Fill Short Term		138	Mohr-Coulomb	2000	0
Brown Sand / Sandy Clay Loam		123	Mohr-Coulomb	0	32
Gray Silty Clay 1 Short Term		138	Mohr-Coulomb	3800	0
Gray Sand / Sandy Clay Loam / Silt		120	Mohr-Coulomb	0	32
Gray Silty Clay 2 Short Term		138	Mohr-Coulomb	2700	0

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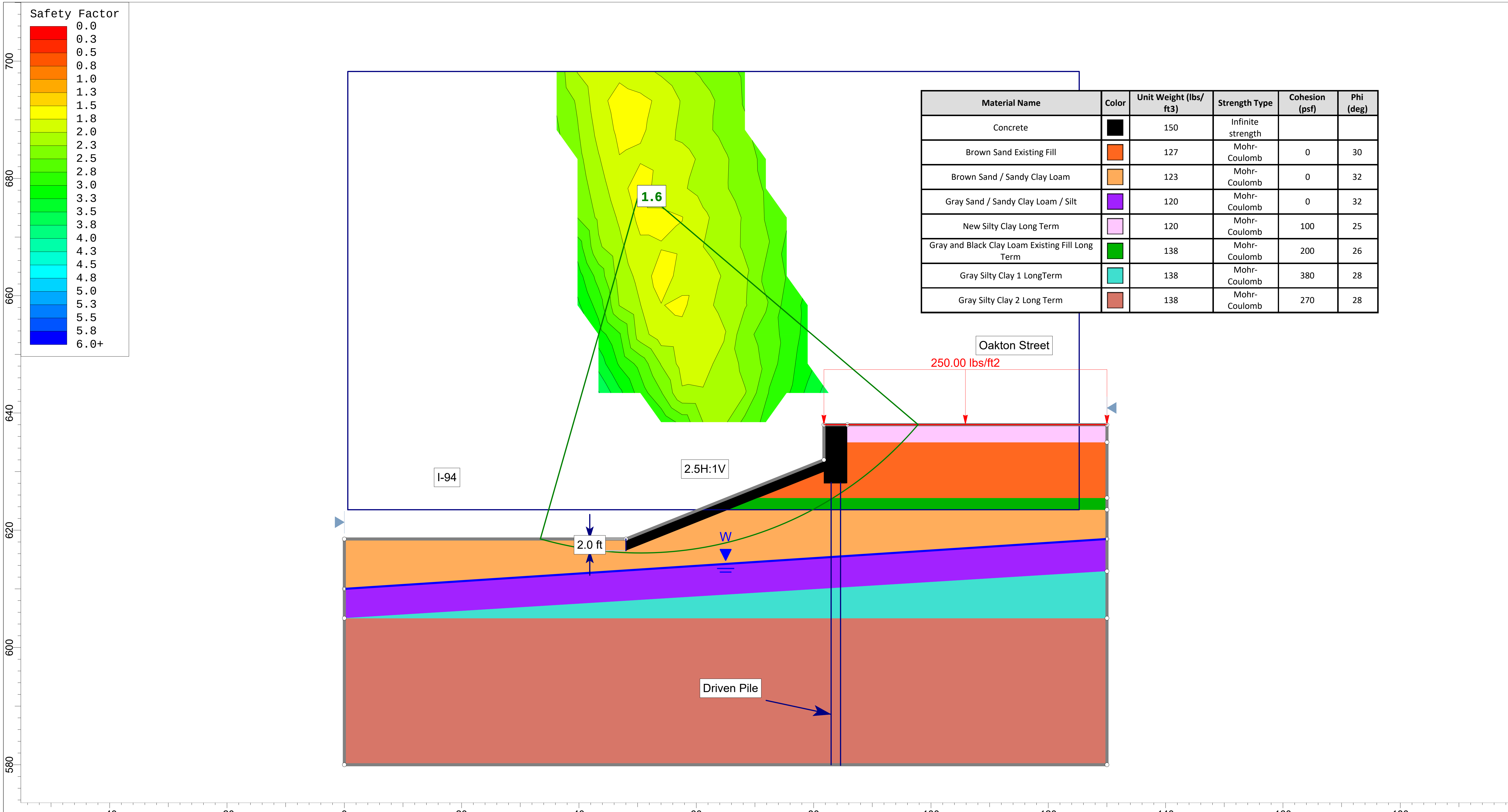
Project	IDOT PTB 195-019: Oakton Street Bridge over I-94
Analysis Description	Exhibit 3 - East Abutment Slope - Slope Circular Failure Short Term
Drawn By	TEK
Company	GSG Consultants, Inc.
Date	10/7/2021 11:25:29 AM
File Name	east abutment, 2.5H to 1V.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Concrete		150	Infinite strength		
Brown Sand Existing Fill		127	Mohr-Coulomb	0	30
Brown Sand / Sandy Clay Loam		123	Mohr-Coulomb	0	32
Gray Sand / Sandy Clay Loam / Silt		120	Mohr-Coulomb	0	32
New Silty Clay Long Term		120	Mohr-Coulomb	100	25
Gray and Black Clay Loam Existing Fill Long Term		138	Mohr-Coulomb	200	26
Gray Silty Clay 1 LongTerm		138	Mohr-Coulomb	380	28
Gray Silty Clay 2 Long Term		138	Mohr-Coulomb	270	28

Project	IDOT PTB 195-019: Oakton Street Bridge over I-94		
Analysis Description	Exhibit 4 - East Abutment Slope - Slope Circular Failure Long Term		
Drawn By	TEK	*Company*	GSG Consultants, Inc.
Date	10/7/2021 11:26:25 AM	*File Name*	east abutment, 2.5H to 1V.slmd