Structural Geotechnical Report

Bridge Replacement
Francis Road over I-80
Contract Number: 62U39
Proposed Bridge SN: 099-8336
Will County, Illinois

Prepared for

Illinois Department of Transportation
IDOT PTB 202-016
Work Order #16

Project Design Engineer Team
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Structural Geotechnical Report
Francis Road over I-80
Proposed Bridge SN: 099-8336
IDOT PTB 202-016

Dear Mr. Paolicchi:

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 bridge for Bridge SN: 099-8336. The site investigation included advancing three (3) soil borings to depths ranging from 42 to 81 feet for the bridge, including a 15-foot rock core, four (4) borings to depths of 25 to 40 feet for potential bridge wingwalls and four (4) borings to 10 feet each for the subgrade roadway improvements.

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

Sincerely,

Brook Geletu, E.I.T.
Project Engineer

Dawn Edgell, P.E.
Geotechnical Department Manager

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1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the design of the proposed replacement of the Francis Road Bridge (SN:099-8336) over I-80 in the Village of New Lenox, Will County, Illinois. The purpose of this investigation was to explore the subsurface conditions, to determine engineering properties of the subsurface soil, and to develop design and construction recommendations for the bridge. The general project limits are shown in **Exhibit 1**.

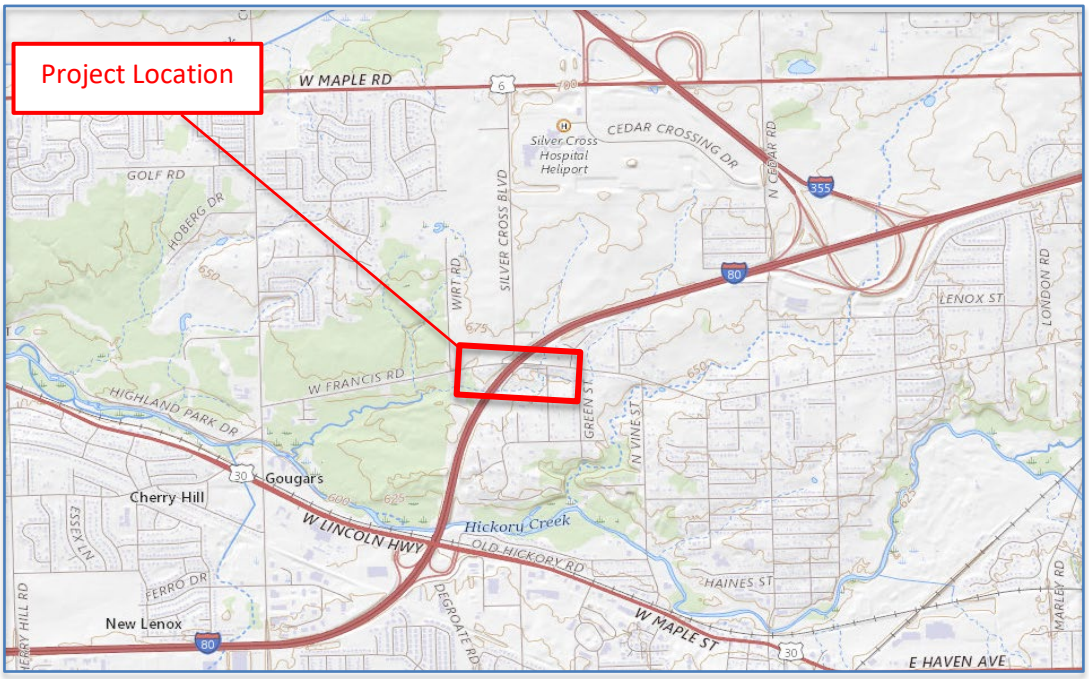


Exhibit 1 – Project Location Map
(Source: USGS Topographic Maps, usgs.gov)

1.1 Existing Bridge Information

The existing Francis Road bridge (SN: 099-0205) over I-80 was originally constructed in 1965 and repairs were performed in 1998. The existing structure is a four curved span steel plate girders superstructure carrying Francis Road over I-80 and supported by pile supported concrete stub abutments and open column piers on spread footings. The length of the bridge from back-to-

back of abutments is 314’-0 ½” skewed 45 degrees 28 minutes left. The out-to-out deck width of the bridge is 31’-8”. **Exhibits 2a and 2b** show the existing conditions of Francis Road Bridge.

Exhibit 2a – Existing Site Conditions at Proposed Bridge Location Looking South

Exhibit 2b – Existing Site Conditions at Proposed Bridge Location Looking North

1.2 Proposed Bridge Information

Based on the design information provided by ABNA Engineering, Inc. (dated July 3, 2024) **(Appendix A),** the proposed improvement will include the complete removal of the existing structure (SN: 099-0205) and replaced with a new two span structure (SN: 099-8336) supported on integral abutments and a reinforced concrete center pier. It is anticipated that the new abutments and center pier will be supported on driven steel pile foundations. Below the abutments, the slopes will be graded at a 1V:2H slope in lieu of retaining walls. The bridge will have a total back-to-back abutment length of 209’-1¾” and out to out width of 36’-10”. The vertical clearance of the bridge will be raised to 16’-10” over I-80.

2.0 SITE SUBSURFACE CONDITIONS

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The proposed locations and depths of the soil borings were selected in accordance with IDOT requirements. The borings were completed in the field based on field conditions and accessibility.

2.1 Subsurface Exploration Program

The subsurface exploration program for the borings was conducted between December 3 and 8, 2023, and March 28 through April 1, 2024, and included advancing a total of eleven (11) standard penetration test (SPT) borings. Three (3) borings were completed at the proposed abutments and pier locations and four (4) borings on each side for the approach slab and roadway. Four (4) borings were completed on the shoulders of I-80 for potential retaining walls. The borings were completed per IDOT requirements, to meet 500 kips capacity or the top of bedrock/auger refusal. A fifteen (15) foot rock core was collected at one of the abutment BSB boring locations.

The coordinates and existing ground surface elevations shown on the soil boring logs were obtained by GSG's field crew using GPS surveying equipment. 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. Copies of the Soil Boring Logs are provided in **Appendix C**.

Table 1 – Summary of Subsurface Exploration Borings

Structure	Boring ID	Location	Station	Offset (ft	Depth (ft)	Surface Elevation (ft)
Bridge	BSB-01	West Abutment	52+00.12	9.38	80.8[1]	672.25
	BSB-02	Center Pier	54+02.24	-18.95	42.0**	650.72
	BSB-03	East Abutment	55+45.29	1.83	58.0**	674.24
Retaining Walls	RWB-01	West MSE Wall	743+13.26	-68.79	40.0	651.39
	RWB-02	West MSE Wall	741+87.06	-68.16	40.0	651.83
	RWB-03	East MSE Wall	744+51.9	66.94	25.0**	653.03
	RWB-04	East MSE Wall	743+31.74	68.5	40.0	650.83
Roadway	SGB-01	West Roadway	49+59.6	16.7	10.0	N/A
	SGB-02	West Approach Slab	51+08.82	8.66	10.0	671.27
	SGB-03	East Approach Slab	56+06.12	14.59	10.0	673.48
	SGB-04	East Roadway	58+20.51	1.04	10.0	671.38

1 – includes a 15-foot rock core

*Based on Francis Road centerline

**terminated upon encountering practical auger refusal

The soil borings were drilled using B-57 Mobile (hammer efficiency 89.0%), and Geoprobe (hammer efficiency 102%) drill rigs, each equipped with 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 depths of either 10 or 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.

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.

GSG also collected rock core runs from one (1) bridge boring location with the use of a ten-foot and/or a five-foot, diamond bit, NX-5 split core barrel during the investigation. The bedrock cores were evaluated in the field for texture, physical condition, recovery percentage, and Rock Quality Designation (RQD). The extracted samples were visually inspected and classified, and the Rock Quality Designation (RQD) was determined according to ASTM D 6032, "Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core" by totaling all sections with a length in excess of four (4) inches and dividing it by the total length of the core run. The RQD is given a classification based upon the numeric value as indicated in **Table 2**.

Table 2 – Rock Quality Designation Summary

Rock Quality Designation	Descriptions
< 25%	Very Poor
25 – 50%	Poor
51 – 75%	Fair
76 – 90%	Good
91 – 100%	Excellent

2.2 Laboratory Testing Program

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. 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-92
- Moisture Content and Unit Weight ASTM D7263 / AASHTO T-19
- Organic and Ash Content ASTM D2974/AASHTO T-194
- Unconfined Compressive Strength on Rock

The laboratory tests were performed in accordance with test procedures outlined in the most current IDOT Geotechnical Manual, 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 Laboratory Test Results **(Appendix D)** and are also shown along with the field test results in the Soil Boring Logs **(Appendix C)**.

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.

The abutment and roadway improvement borings were drilled in the vicinity of the existing Francis Road Bridge. The retaining wall and the center pier borings were drilled in the shoulder of I-80 and on mainline I-80 adjacent to the existing center pier location, respectively. The surface elevations of the borings ranged from 674.2 to 650.7 feet. The borings initially encountered 12 to 14 inches of asphalt/concrete pavement followed by silty clay to silty sand fill materials, with the exception of boring RWB-03, which initially encountered 3 inches of topsoil. Below the fill materials, the borings encountered stiff to hard native silty clay layers. Beneath silty clay layers, the borings encountered layers of medium dense to dense sand and gravel layers to the termination depths/auger refusals. Boring BSB-02 noted sandy loam soils interbedded with very stiff to hard silty clay soils.

The silty clay fill soils had unconfined compressive strengths ranging from 1.87 to 8.3 tsf, with an average strength of 4.0 tsf. The silty clay soils had an unconfined compressive strength ranging from 1.04 to 7.71 tsf, with an average strength of 3.7 tsf. The sand and gravel layers had an SPT blow count (N) values ranging from 4 to 80 bpf with an average of 27 bpf.

Rock core samples were collected in one (1) of the boring locations (BSB-01). The bedrock cores have general characteristics of light gray, cherty, moderately weathered and slightly to moderately fractured limestone. **Table 3** provides the RQD values of the rock cores extracted during the site investigation. Photographs of the cores are included with boring log in **Appendix C**.

Table 3 – Rock Core Summary and Classification

Boring Number	Core Run / Length (ft)	Core Depth (feet)	Recovery (%)	RQD (%)	Compressive Strength (psi) / Depth (ft)	RQD Description	Type of Rock
BSB-01	1 / 10	65.8 – 75.8	100	32.5	6,053/70.8	Poor	Limestone
	2 / 5	75.8 – 80.8	100	70	13,627/77.8	Fair	Limestone

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. Groundwater was encountered while drilling within granular layers in borings BSB-01, BSB-02, and all four retaining wall borings. Groundwater was not encountered in the remaining borings. 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 of the native soils, it is anticipated that the long-term groundwater level could range between elevations 640.4 to 630.4 feet. Perched water may be present within the existing fill materials or any confined granular layers. 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 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 Scour

The bridge structure carrying the proposed Francis Road over I-80 has no waterways in the vicinity; therefore, scour will not be a concern for this project.

3.2 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. Slope stability evaluation of the retaining walls is discussed in Section 5.3.

3.3 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 4**. Given the site location and materials encountered, the potential for liquefaction is minimal.

Table 4 – Seismic Parameters

Building Code Reference	PGA	S_{DS}	S_{D1}
2020 AASHTO Guide for LRFD Seismic Bridge Design	0.048g	0.165g	0.095g

3.4 Integral Abutment Feasibility

Integral abutment feasibility was checked for the bridge in accordance with IDOT Bridge Manual (2023) and the IDOT Integral Abutment Feasibility Analysis spreadsheet. A total bridge structure back-to-back abutment length of 286.25 feet with each span of 143.125 feet and a 44˚33'46" skew from I-80 used for analysis. Based on the TS&L dated 7/3/2024, the abutment foundations will be constructed from the existing ground surface and extend through the existing embankment. Based on borings BSB-01 and BSB-03, stiff to hard silty clay was encountered below the proposed abutment bent elevations. The feasibility analysis showed that it is not feasible to use integral abutments without mitigation measures. It is recommended to precore the top 10 feet of existing embankment soil and fill the voids between the pile and the holes with bentonite in order to use integral abutment. With precore, the following pile sizes could be considered for use with integral abutments: MS 14, MS 16, HP 10x42, HP 12x53, HP 10x57, HP 12x63, HP 12x74, HP 14x73, HP 12x84, HP 14x89, HP 14x102 and HP 14x117.

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 preliminary service and factored loads provided by ABNA are shown in **Table 5**.

Table 5 - Preliminary Substructure Loads

		West Abutment	Center Pier	East Abutment
Dead Load (kips)	Service	468	1,525	468
	Factored	602	1,965	602
Live Load (kips)	Service	199	347	199
	Factored	348	607	348
Total Load (kips)	Service	667	1,872	667
	Factored	950	2,572	950

4.1 Bridge Foundation Recommendations

GSG evaluated potential foundation systems for the proposed bridge. GSG's evaluation included shallow spread footings, drilled shafts and driven piles. The results of the evaluation are presented below.

4.1.1 Shallow Foundations

Based on 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 encroach upon the adjacent roadway, and therefore will not be a feasible option and are not discussed further in the report.

4.1.2 Drilled Shafts

Drilled shafts are not considered economical options due to the presence of dense gravel and sandy load, which would require using protective casing, and therefore not considered as a design option in this project. 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 and H-piles are a feasible option for the construction of the abutments and center pier for the proposed bridge structure. Design recommendations for driven piles are provided in *Section 4.2* of this report.

4.2 Driven Pile Foundation Design Recommendation

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. The geotechnical losses due to downdrag or liquefaction were not included in the axial pile resistance calculations.

Tables 6a through 6c 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 **Tables 6a through 6c** and in **Appendix E** are based on the assumed pile cut off elevations 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 (2023), 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.

Tables 6a through 6c summarize estimated pile lengths for select metal shell pile 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 (RF) and nominal required bearing (RN), are included in **Appendix E.**

Table 6a – West Abutment Pile Design (BSB-01)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
Metal Shell 14'' Φ w/0.312'' walls (Max. R_N = 570 Kips)	323	178	31
	355	195	34
	383	210	36
Metal Shell 16'' Φ w/0.312'' walls (Max. R_N = 654 Kips)	399	220	31
	435	239	34
	467	257	36
HP10x42 (Max. R_N = 335 Kips)	220	121	56
	278	153	58
	335	184	59
HP12x53 (Max. R_N = 418 Kips)	277	152	56
	333	183	58
	418	230	59
HP14x73 (Max. R_N = 578 Kips)	344	189	56
	406	223	58
	578	318	59

***NOTES**: Pile cut off elevation = 664.15 feet*
Ground surface elevation against pile during driving = 663.15 feet

Table 6b – East Abutment Pile Design (BSB-03)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
MS 14"ϕw/.312" (Max. R_N = 570 Kips)	503	276	40
	540	297	43
	562	309	44
Metal Shell 16'' Φ w/0.312'' walls (Max. RN = 654 Kips)	494	272	35
	525	289	38
	607	334	40
	650	357	43
HP10x42 (Max. RN = 335 Kips)	236	130	45
	273	150	46
	335	184	47
HP12x53 (Max. RN = 418 Kips)	302	166	45
	327	180	46
	418	230	47
HP14x73 (Max. RN = 578 Kips	365	201	45
	397	219	46
	578	318	48

***NOTES**: Pile cut off elevation = 665.4 feet*
Ground surface elevation against pile during driving = 664.4 feet

Table 6c – Center Pier Pile Design (BSB-02)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
MS 14"ϕw/.312" (Max. R_N = 570 Kips)	88	48	6
	175	96	13
	181	100	14
	393	216	18
Metal Shell 16'' Φ w/0.312'' walls (Max. RN = 654 Kips)	106	58	6
	203	112	13
	211	116	14
HP10x42 (Max. RN = 335 Kips)	168	93	38
	212	117	39
	335	184	41
HP12x53 (Max. RN = 418 Kips)	212	117	38
	254	140	39
	418	230	41
HP14x73 (Max. RN = 578 Kips	264	145	38
	311	171	39
	578	318	41

***NOTES**: Pile cut off elevation = 647.5 feet*
Ground surface elevation against pile during driving = 646.5 feet

4.3 Pile Driving Considerations

The soil borings were completed within 30 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), should be considered due to the presence of gravel, boulders and cobbles observed in all of the borings and the proximity to bedrock. For metal shell piles, a wall thickness of 0.25" or greater is recommended to minimize potential damage during driving with a conical tip welded to the pile to avoid abrupt overstress.

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 2023 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 proposed loadings. **Tables F-1 and F-2** in **Appendix F** provide generalized soil parameters for the site and include 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.

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 (2022). 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

Based on the existing site conditions, significant utilities may exist along the project corridor that may interfere with construction of the proposed bridge. Before proceeding with construction, all existing utility lines that will interfere with construction should be completely relocated from 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

utilities 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

The contractor will be responsible for providing 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 Furnished Excavation" of the current IDOT Construction Manual. The fill material should be free of organic matter and debris. Earth-moving operations should be avoided during excessively cold or wet weather to avoid freezing of softening subgrade soils.

5.5 Pile Installation

IDOT standard practice requires driving one (1) test pile for each substructure element. The test-piles are installed based on the preliminary driving criteria in order to evaluate site conditions and are inspected in accordance with the IDOT Standard for Road and Bridge Construction. All pile installation should be completed in accordance with the IDOT SSRBC Section 512.15.

5.6 Groundwater Management

Based on the color change from brown and gray to gray of the native soils, it is anticipated that the long-term groundwater level could range between elevations 657.2 to 643.7 feet. GSG does not anticipate any significant groundwater related issues occur during construction activity,

however perched water may be encountered within the existing fill materials. If rainwater run-off or groundwater is accumulated at the base of excavations, 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 the removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

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

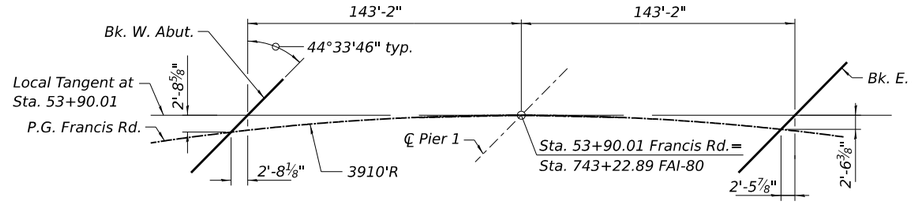
Benchmark: Cut square on NW headwall Station 53+08.17, 35.92' Lt. Elevation 650.53

Existing structure: SN 099-0205 Built in 1965 under FAI 80, Section 99-5HB and reconstructed in 1998. A protective shield was added in 2011 and temporary cribbing installed in 2017 under Girders 1 and 2 at pier 1 and Girder 1 at pier 3. Structure is a four (4) curved span steel plate girders (63, 95-95, 61), 314'-0 ½"back to back of concrete stub abutments on piles, piers are open concrete on spread footings. Skewed 45 degrees 28 minutes left advanced. The concrete deck is 7"with 2 3/8"latex overlay, 31'-8"out to out of deck over 4-48"plate girders non composite spans 1 & 4 and composite in spans 2 & 3. Structure to be removed and replaced under road closure.

Traffic Control: Francis Road Closed

Salvage: None

Notes: All structural steel shall be metalized.



OFFSET SKETCH

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 Sec. (SD1) = 0.095g
Design Spectral Acceleration at 0.2 Sec. (SDS) = 0.165g
Soil Site Class = D

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition with Interims

LOADING HL-93

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

DESIGN STRESSES

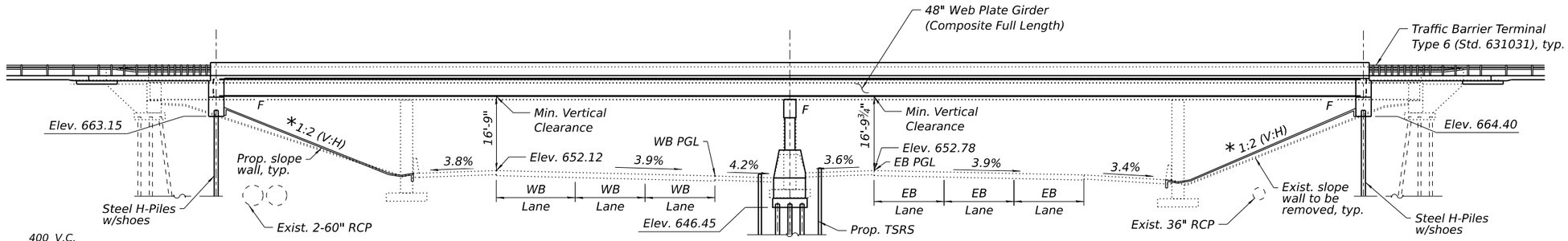
(FIELD UNITS)

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

HIGHWAY CLASSIFICATION

Francis Road
Functional Class: Major Collector
ADT: 3,950 (2021); 6,700(2050)
ADTT: 170 (2021); 290 (2050)
DHV: 400 (2021)
Design Speed: 35 m.p.h.
Posted Speed: 30 m.p.h.
Two-way Traffic distribution: 50:50

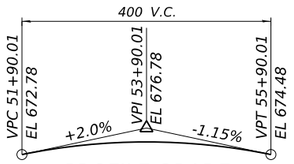
Interstate I-80
Functional Class: Interstate
ADT: 78,900 (2021); 114,300 (2050)
ADTT: 25,910 (2021); 37,540 (2050)
DHV: 7,900(2021)
Design Speed: 70 m.p.h.
Posted Speed: 65 m.p.h.
Two-way Traffic distribution: 50:50



∗ *At right ∠'s*

ELEVATION

(Looking North)



PROFILE GRADE

(Along ℄ Francis Road)

PLAN

LOCATION SKETCH

LEGEND

1963 Plans - Boring locations
New Boring locations

GENERAL PLAN & ELEVATION
FRANCIS ROAD OVER I-80
F.A.I. RTE. 80 - SECTION 22 FRANCIS BR
STATION 743+22.89
WILL COUNTY
STRUCTURE NO. 099-8336

ABNA DESIGN FIRM REG. 184.002117

USER NAME =	DESIGNED - SEA	REVISED -	
	CHECKED - FH	REVISED -	
PLOT SCALE =	DRAWN - MBJ	REVISED -	
PLOT DATE =	CHECKED - SEA	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
80	22 FRANCIS BR	WILL	3	1
		CONTRACT NO. 62U39		
	ILLINOIS	FED. AID PROJECT		

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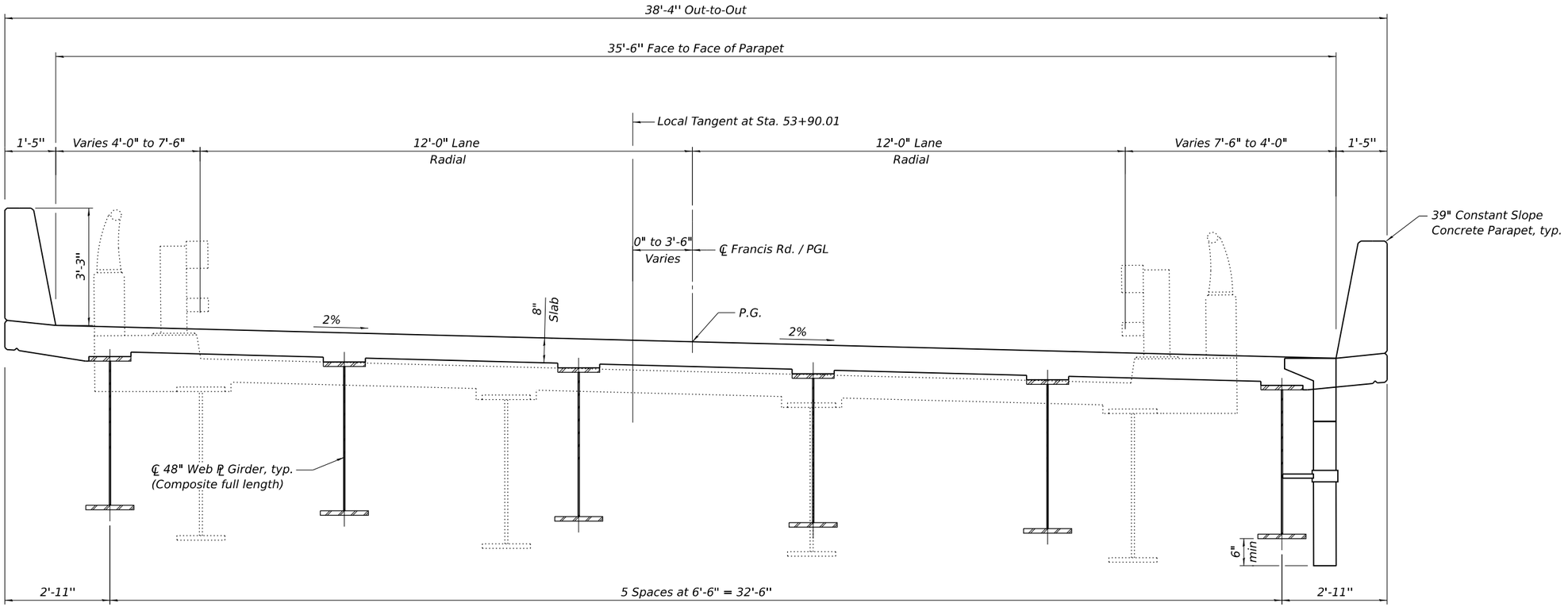
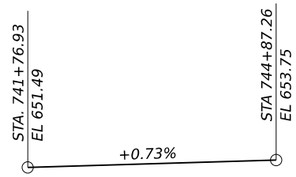


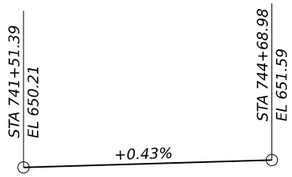
CROSS SECTION
(Looking Upstation)

CURVE DATA
FRANCIS ROAD
PI STA = 53+02.15
Δ = 09°18'03" (RT)
D = 01°27'55"
R = 3,910.00'
T = 318.05'
L = 634.71'
E = 12.91'
e = 2.0%
PC STA = 49+84.10
PT STA = 56+18.80

CURVE DATA
EXIST. F.A.I. - 80
PI STA = 743+04.54
Δ = 16°06'36" (RT)
D = 01°15'33"
R = 4,550.27'
T = 643.95'
L = 1279.41'
E = 45.34'
e = 3.9%
PC STA = 736+60.59
PT STA = 749+40.00



PROFILE GRADE
(EASTBOUND F.A.I. - 80)
(Along inside edge of pavement)



PROFILE GRADE
(WESTBOUND F.A.I. - 80)
(Along inside edge of pavement)

CROSS SECTION
FRANCIS ROAD OVER I-80
F.A.I. RTE. 80 - SECTION 22 FRANCIS BR
STATION 743+22.89
WILL COUNTY
STRUCTURE NO. 099-8336

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ABNA DESIGN FIRM REG. 184.002117

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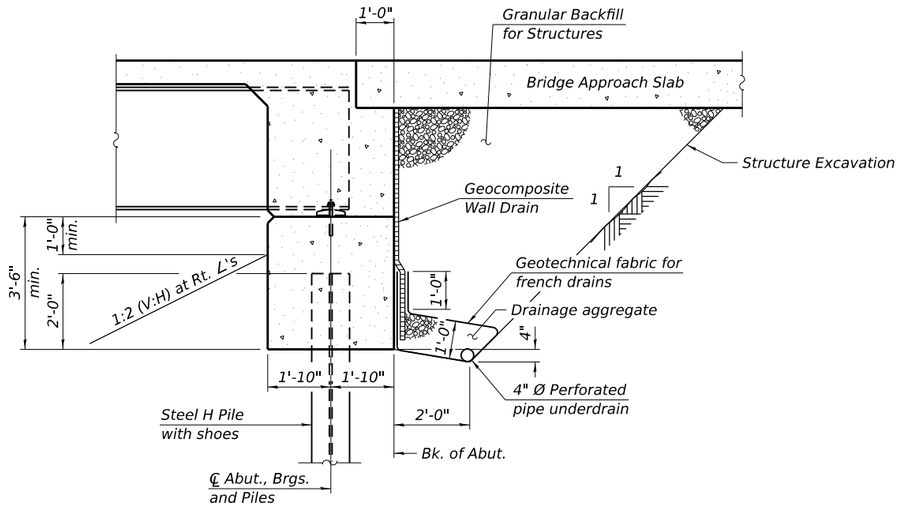
	CHECKED - FH	REVISED -
PLOT SCALE =	DRAWN - MBJ	REVISED -
PLOT DATE =	CHECKED - SEA	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

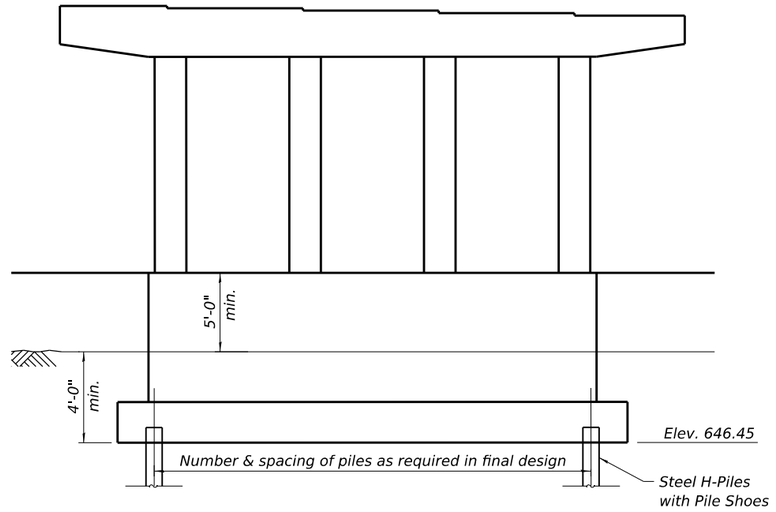
SHEET 2 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
80	22 FRANCIS BR	WILL	3	2
		CONTRACT NO. 62U39		
	ILLINOIS	FED. AID PROJECT		



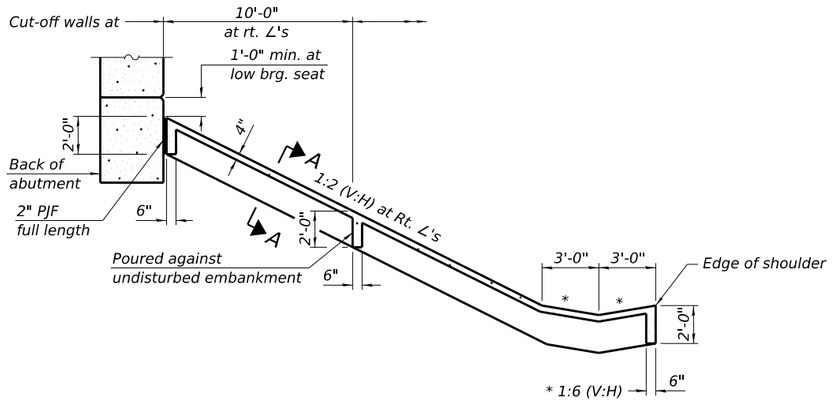
SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. at Rt. ∠'s)

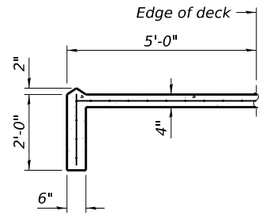


PIER SKETCH

(Pier 1 - Looking Upstation)



SECTION THRU CONCRETE SLOPEWALL



SECTION A-A

DETAILS
FRANCIS ROAD OVER I-80
F.A.I. RTE. 80 - SECTION 22 FRANCIS BR
STATION 743+22.89
WILL COUNTY
STRUCTURE NO. 099-8336

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PLOT DATE =	CHECKED - SEA	REVISED -

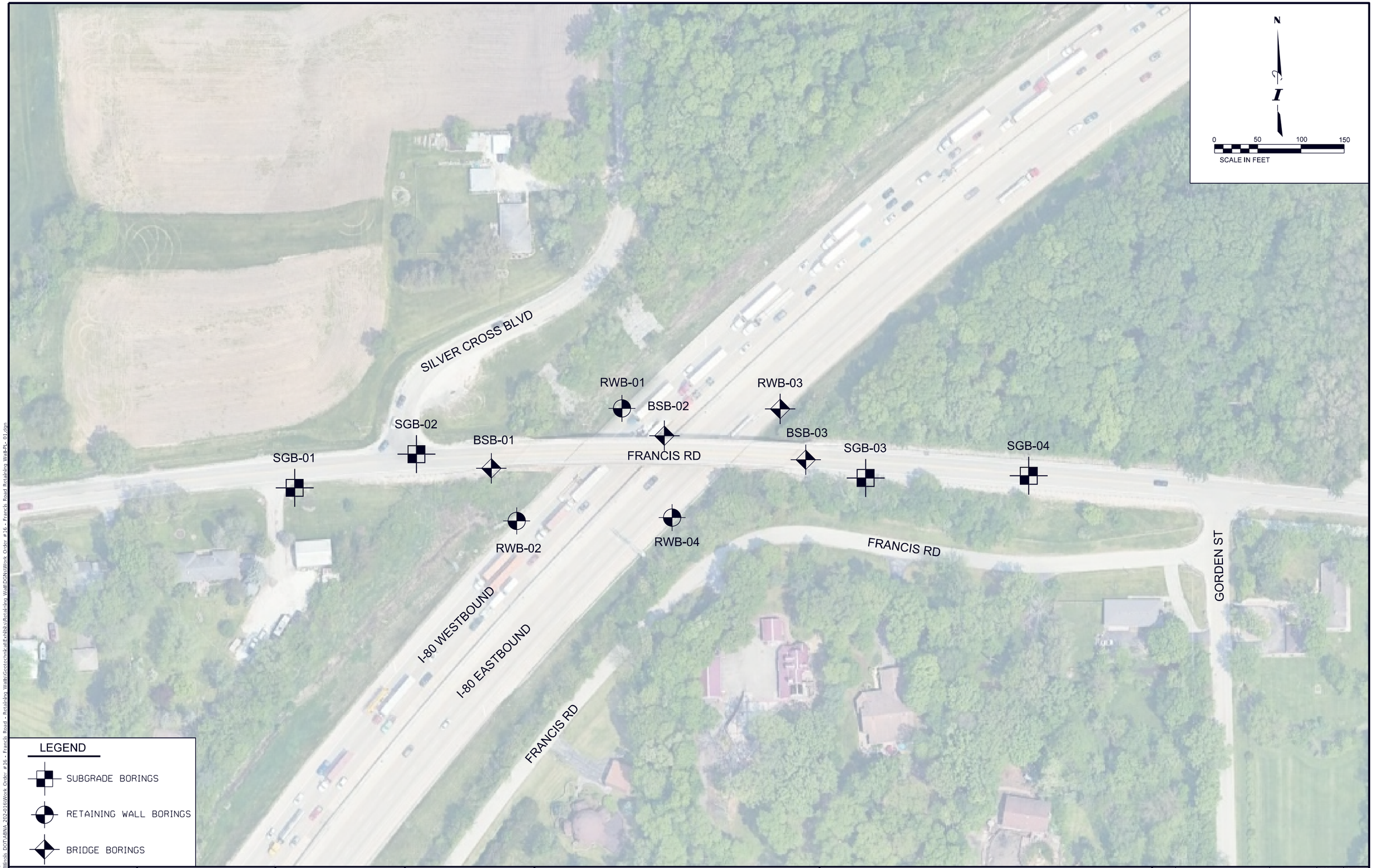
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 3 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
80	22 FRANCIS BR	WILL	3	3
		CONTRACT NO. 62U39		
	ILLINOIS	FED. AID PROJECT		

APPENDIX B

SOIL BORING LOCATION PLAN AND SUBSURFACE PROFILE



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

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	DRAWN - NN	REVISED -
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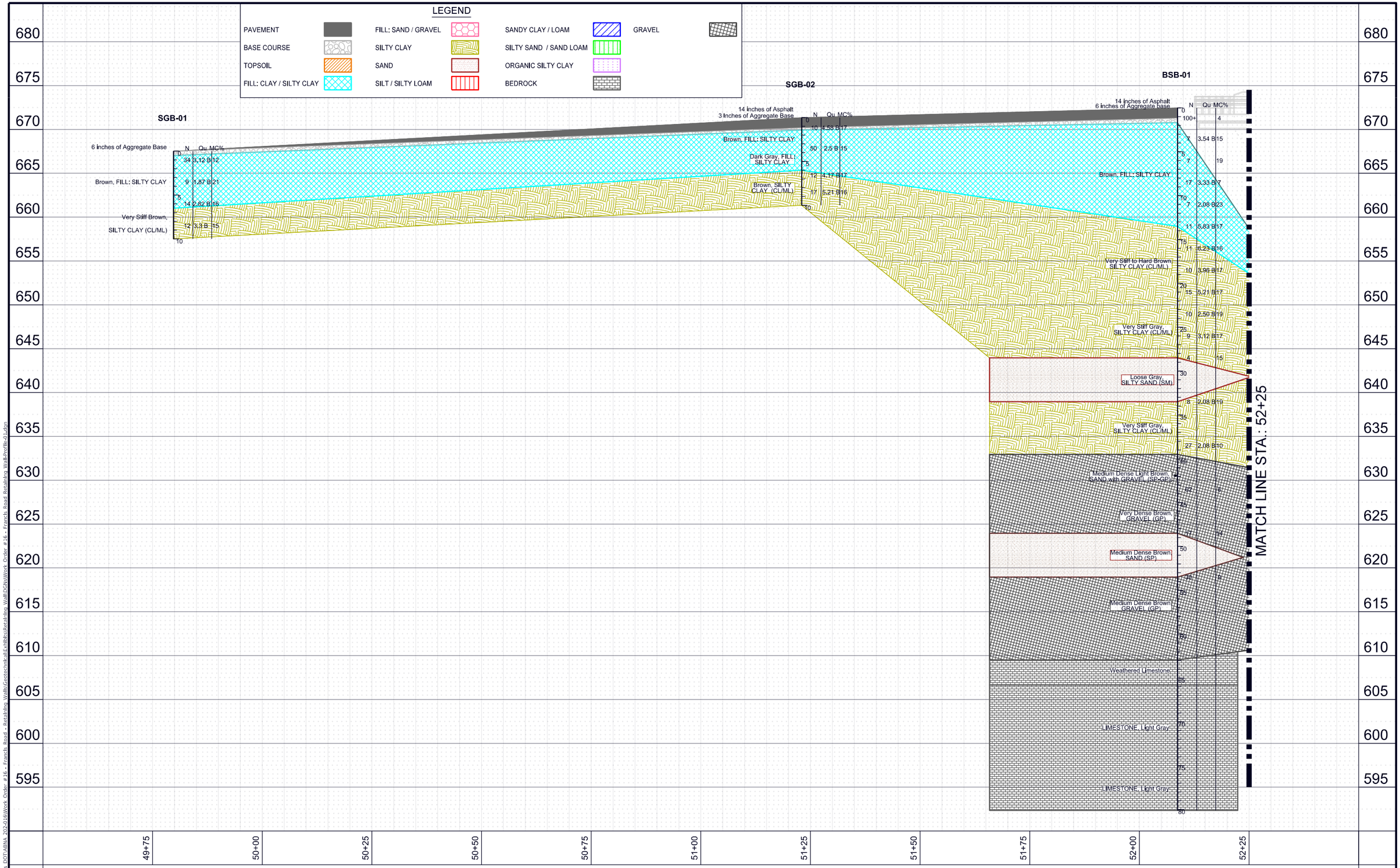
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT ANBA 202-016
I-80 AT FRANCIS ROAD
BORING LOCATION PLAN

SCALE: 1:50 | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	5	1
		CONTRACT NO. 202-016		
	ILLINOIS	FED. AID PROJECT		



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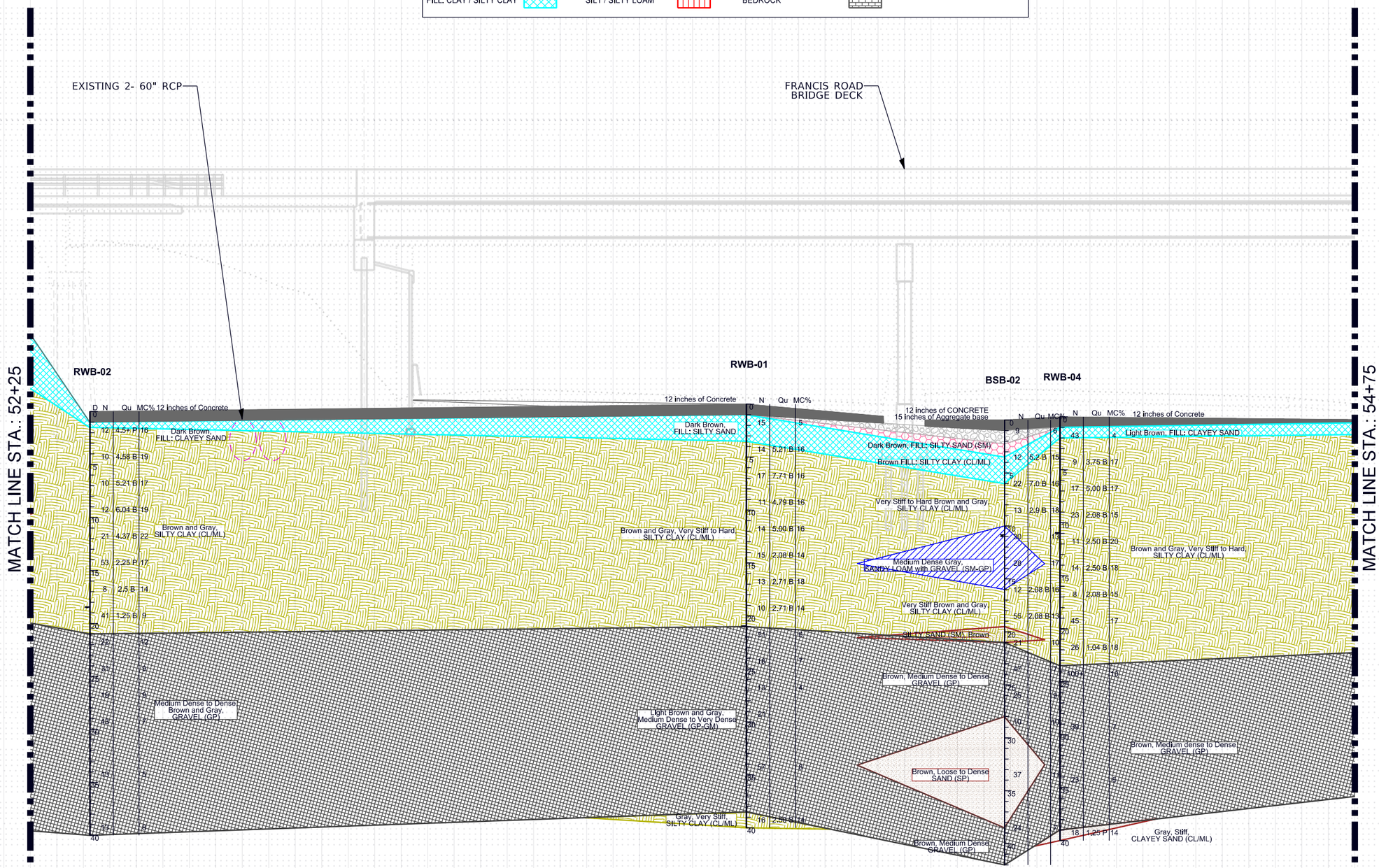
GSG CONSULTANTS, INC. 735 E. REMINGTON RD, SCHAUMBURG, IL 60173 TEL: +630.994.2600 | WWW.GSG-CONSULTANTS.COM	USER NAME = nnano	DESIGNED - BG	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	IDOT PTB 202–016 I–80 AT FRANCIS ROAD BORING PROFILE
		DRAWN - NN	REVISED -		
	PLOT SCALE = 240.0000 ' / ft.	CHECKED - DE	REVISED -		SCALE: AS NOTED | SHEET 1 OF 4 SHEETS | STA. 49+50 TO STA. 52+25
	PLOT DATE = 6/4/2024	DATE - 04/11/2024	REVISED -		

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	5	2
		CONTRACT NO. PTB 202-016		
	ILLINOIS	FED. AID PROJECT		

LEGEND

PAVEMENT	FILL: SAND / GRAVEL	SANDY CLAY / LOAM	GRAVEL
BASE COURSE	SILTY CLAY	SILTY SAND / SAND LOAM	
TOPSOIL	SAND	ORGANIC SILTY CLAY	
FILL: CLAY / SILTY CLAY	SILT / SILTY LOAM	BEDROCK	



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GSG CONSULTANTS, INC. 735 E. REMINGTON RD, SCHAUMBURG, IL 60173 TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM			
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	DRAWN - NN	REVISED -	
PLOT SCALE = 240.0000 ' / ft.	CHECKED - DE	REVISED -	
PLOT DATE = 4/17/2024	DATE - 04/11/2024	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PTB 202-016
I-80 AT FRANCIS ROAD
BORING PROFILE

SCALE: AS NOTED | SHEET 2 OF 4 SHEETS | STA. 52+25 | TO STA. 54+75

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	5	3
		CONTRACT NO. PTB 202-016		
	ILLINOIS FED. AID PROJECT			

LEGEND

PAVEMENT		FILL: SAND / GRAVEL		SANDY CLAY / LOAM		GRAVEL	
BASE COURSE		SILTY CLAY		SILTY SAND / SAND LOAM			
TOPSOIL		SAND		ORGANIC SILTY CLAY			
FILL: CLAY / SILTY CLAY		SILT / SILTY LOAM		BEDROCK			

EXISTING - 60" RCP

MATCH LINE STA.: 54+75

MATCH LINE STA.: 57+25

BSB-03

14 inches of Asphalt
6 inches of Aggregate base

N Qu MC%
0
5 4.5+ P 8
8 2.71 B18
5
8 4.17 B19
10 3.54 B16
10
21 7.29 B17
17 4.17 B23
15
11 2.08 B21
13 4.5+ P21
20
18 5.21 S16
22 5.83 S17
25
14 4.17 B19
17 16
30
14 3.96 B19
35
11 1.87 B15
20
24 19
25
30 6
40
42 8
55

Brown to Gray, FILL: SILTY CLAY

Very Stiff to Hard Brown, SILTY CLAY (CL/ML)

Gray, Stiff SILTY CLAY (CL/ML)

Brown, Medium Dense SANDY GRAVEL (GPS)

Brown, Dense BOULDER and COBBLE

Weathered Limestone

RWB-03

3 Inches of Topsoil
Dark Brown FILL: SANDY CLAY

N Qu MC%
0
8 2.71 B 18
10 1.67 B 19
5
12 5.83 B 17
6 1.46 B 13
10
14 5.41 B 20
7 3.75 B 23
15
8 3.54 B 13
58 5.21 B 14
20
25 16
11
15
25

Brown and Gray, Stiff to Hard SILTY CLAY (CL/ML)

Medium Dense GRAVEL (GP-GM)

SGB-03

6 inches of Aggregate Base

N Qu MC%
0
11 4.37 B15
13 6.25 B14
5
11 5.62 B16
7 2.08 B19
10

Brown, FILL: SILTY CLAY

54+75 55+00 55+25 55+50 55+75 56+00 56+25 56+50 56+75 57+00 57+25

695 690 685 680 675 670 665 660 655 650 645 640 635 630 625 620 615 610

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GSG CONSULTANTS, INC.
735 E REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +630.994.2600 | WWW.GSG-CONSULTANTS.COM

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	DRAWN - NN	REVISED -
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PLOT DATE = 4/17/2024	DATE - 04/11/2024	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PTB 202–016
I–80 AT FRANCIS ROAD
BORING PROFILE

SCALE: AS NOTED | SHEET 3 OF 4 SHEETS | STA. 54+75 | TO STA. 57+25

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	5	4
		CONTRACT NO. PTB 202-016		
		ILLINOIS	FED. AID PROJECT	

LEGEND

PAVEMENT		FILL: SAND / GRAVEL		SANDY CLAY / LOAM		GRAVEL	
BASE COURSE		SILTY CLAY		SILTY SAND / SAND LOAM			
TOPSOIL		SAND		ORGANIC SILTY CLAY			
FILL: CLAY / SILTY CLAY		SILT / SILTY LOAM		BEDROCK			

695 690 685 680 675 670 665 660 655 650 645 640 635 630 625 620 615 610

MATCH LINE STA.: 57+25

SGB-04

	N	Qu	MC%	
0				10 inches of Asphalt
12	8.33	B	14	11 inches of Aggregate Base
11	3.96	B	16	
5				
10	3.75	B	17	Brown, FILL: SILTY CLAY
4				
10	4.58	B	18	
T0				

57+25 57+50 57+75 58+00 58+25 58+50 58+75 59+00 59+25 59+50 59+75

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

USER NAME = nnano	DESIGNED - BG	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	IDOT PTB 202–016 I–80 AT FRANCIS ROAD BORING PROFILE	
	DRAWN - NN	REVISED -			
PLOT SCALE = 240.0000 ' / ft.	CHECKED - DE	REVISED -			
PLOT DATE = 4/17/2024	DATE - 04/11/2024	REVISED -		SCALE: AS NOTED | SHEET 4 OF 4 SHEETS | STA. 57+25 TO STA. 59+75	

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	5	5
		CONTRACT NO. PTB 202-016		
	ILLINOIS FED. AID PROJECT			

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG

SOIL BORING LOG

Date 12/6/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Bridge Replacement Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 8, **TWP.** 35 N, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53106902, **Longitude** -87.98628686

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. BSB-01
Station 52+00.12
Offset 9.38ft
Ground Surface Elev. 672.25 ft

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

Groundwater Elev.:
First Encounter 630.3 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
14 inches of Asphalt				
671.09				
6 inches of Aggregate base		10		
670.58		50/5"		4
FILL: SILTY CLAY, trace gravel, trace organics, Brown, Moist		5		
	-5	4 3	3.5 B	15
		3		
		3 4		19
		3		
	-10	11 6	3.3 B	7
		1		
		3 4	2.1 B	23
658.75				
SILTY CLAY (CL/ML), trace gravel, occasional sand seams, Brown, Very Stiff to Hard, Moist		1		
	-15	5 6	5.8 B	17
		1		
		5 6	6.2 B	16
		2		
	-20	5 5	4.0 B	17
SILTY CLAY (CL/ML), trace gravel, occasional sand seams, Brown, Very Stiff to Hard, Moist *(continued)*		3		
650.25				
SILTY CLAY (CL/ML), trace gravel, Gray, Very Stiff, Moist		5 10	5.2 B	17
		3		
	-25	5 5	2.5 B	19
		2		
		3 6	3.1 B	17
643.75				
SILTY SAND (SM), trace gravel, Gray, Loose, Saturated		1		
	-30	1 3		15
638.75				
SILTY CLAY (CL/ML), trace gravel, Gray, Very Stiff, Moist		1		
	-35	4 4	2.1 B	19
		2		
632.75				
	-40	7 20	2.1 B	10

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

SOIL BORING LOG

Date 12/6/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Bridge Replacement Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 8, **TWP.** 35 N, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53106902, **Longitude** -87.98628686

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. BSB-01
Station 52+00.12
Offset 9.38ft
Ground Surface Elev. 672.25 ft

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

Groundwater Elev.:
First Encounter 630.3 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND with GRAVEL (SP-GP), trace gravel, Light Brown, Medium Dense, Saturated *(continued)*				
▼		7		
		23		6
627.75 GRAVEL (GP), Brown, Very Dense, Saturated	-45	39		
623.75 SAND (SP), trace gravel, Brown, Medium Dense, Saturated		10		
		7		14
	-50	10		
618.75 GRAVEL (GP), Brown, Medium Dense, Saturated		6		
		10		9
	-55	20		
	-60			

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
GRAVEL (GP), Brown, Medium Dense, Saturated *(continued)*				
609.30 Auger refusal at 63.0 feet Weathered Limestone	-65			
606.45 LIMESTONE, Light Gray, moderately weathered, moderately to extremely fractured, cherty RUN 1: 65.8' - 75.8' Recovery: 100% RQD: 32.5% (Poor)	-70			
	-75			
596.45 LIMESTONE, Light Gray, moderately weathered, slightly to moderately fractured, cherty RUN 2: 75.8' - 80.8' Recovery: 100% RQD: 70.0% (Fair)				
592.25 End of Boring	-80			

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)

ABNA 202-016 Work Order 13 – Francis Road at I-80
Boring Number: BSB-01
New Lenox, IL

Boring No.	Run	Depth (ft)	Recovery (%)	RQD (%)	RQD Classification	Compressive Strength (psi)	Description
BSB-01	1	65.8’ – 75.8’	100.0	32.5	Poor	6,053	Light Gray Limestone Moderately Weathered, Extremely to Moderately Fractured, Hard, Cherty

ABNA 202-016 Work Order 13 – Francis Road at I-80
Boring Number: BSB-01
New Lenox, IL

Boring No.	Run	Depth (ft)	Recovery (%)	RQD (%)	RQD Classification	Compressive Strength (psi)	Description
BSB-01	2	75.8' – 80.8'	100.0	70.0	Fair	13,627	Light Gray Limestone Moderately Weathered, Moderately to Slightly Fractured, Hard, Cherty

Illinois Department of Transportation
Division of Highways
GSG

SOIL BORING LOG

Date 12/3/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Bridge Replacement Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.5311702, **Longitude** -87.98560166

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. BSB-02
Station 54+02.24
Offset -18.95ft
Ground Surface Elev. 650.72 ft

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

Groundwater Elev.:
First Encounter 639.7 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
12 inches of CONCRETE				
649.72				
15 inches of Aggregate base		16		
		10		6
648.47		9		
FILL: SILTY SAND (SM), trace gravel, Dark Brown, Moist				
647.22		3		
FILL: SILTY CLAY (CL/ML), trace gravel, Brown, Moist		5	5.2	15
	-5	7	B	
644.72				
SILTY CLAY (CL/ML), trace gravel, Brown and Gray, Very Stiff to Hard, Moist		5		
		7	7.0	16
		15	B	
		4		
		5	2.9	18
640.72	-10	8	B	
SANDY LOAM with GRAVEL (SM-GP), Gray, Medium Dense, Moist ▼		7		
		20		13
		10		
		12		
		13		17
	-15	15		
634.72				
SILTY CLAY (CL/ML), trace gravel, Brown and Gray, Very Stiff, Moist		3		
		5	2.1	16
		7	B	
		3		
631.22		15	2.1	13
	-20	40	B	

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY SAND (SM), with gravel, Brown, Moist *(continued)*				
629.72				
GRAVEL (GP), Brown, Medium Dense to Dense, Saturated		2		
		11		10
		10		
		10		
		35		7
	-25	12		
		4		
		5		9
		20		
622.72				
		3		
SAND (SP), trace gravel, Brown, Loose to Dense, Saturated		4		10
	-30	6		
		12		
		17		11
	-35	20		
612.22				
GRAVEL (GP), Brown, Medium Dense, Saturated		10		
		12		7
	-40	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
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SOIL BORING LOG

Date 12/3/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Bridge Replacement Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.5311702, **Longitude** -87.98560166

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. BSB-02
Station 54+02.24
Offset -18.95ft
Ground Surface Elev. 650.72 ft

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

Groundwater Elev.:
First Encounter 639.7 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
GRAVEL (GP), Brown, Medium Dense, Saturated *(continued)*				
Refusal at 42 feet 608.72				
End of Boring				

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
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SOIL BORING LOG

Date 12/5/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Bridge Replacement Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53112611, **Longitude** -87.98497604

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. BSB-03
Station 55+45.29
Offset 1.83ft
Ground Surface Elev. 674.24 ft

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

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				14 inches of Asphalt
				673.07
	3			6 inches of Aggregate base
				672.57
	3	4.5	8	FILL: SILTY CLAY, trace gravel,
	2	P		trace organics, Brown to Gray,
				Moist
	1			
-5	3	2.7	18	
	5	B		
	2			
	3	4.2	19	
	5	B		
	3			
-10	4	3.5	16	
	6	B		
	5			
	11	7.3	17	
	10	B		
	4			
-15	6	4.2	23	
	11	B		
	3			
	4	2.1	21	
	7	B		
	5			
-20	5	4.5	21	
	8	P		
				653.24
	5			SILTY CLAY (CL/ML), some
	8	5.2	16	gravel, Brown, Hard, Moist
	10	S		
	6			
-25	9	5.8	17	
	13	S		
	4			
	7	4.2	19	
	7	B		
	6			
-30	8		16	
	9			
	3			
-35	5	4.0	19	
	9	B		
				635.74
	5			SILTY CLAY (CL/ML), trace
-40	6	1.9	15	gravel, Gray, Stiff, Moist
	5	B		

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
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SOIL BORING LOG

Date 12/5/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Bridge Replacement Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53112611, **Longitude** -87.98497604

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. BSB-03
Station 55+45.29
Offset 1.83ft
Ground Surface Elev. 674.24 ft

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

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY (CL/ML), trace gravel, Gray, Stiff, Moist *(continued)*				
630.74				
SANDY GRAVEL (GPS), trace gravel, Brown, Medium Dense, Moist		13		
		15		10
	-45	9		
		11		
		15		9
	-50	15		
620.74				
BOULDER and COBBLE, with gravel, Brown, Dense, Saturated		40		
		19		8
619.24	-55	23		
Weathered Limestone				
616.24				
Auger Refusal at 58 feet				
End of Boring				
	-60			

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

Illinois Department of Transportation
Division of Highways
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SOIL BORING LOG

Date 3/28/24

ROUTE FAI 80 (I-80) **DESCRIPTION** Retaining Wall Borings **LOGGED BY** TS

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**,
Latitude 41.5312757900182, **Longitude** -87.98573732

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. RWB-01
Station 743+13.26
Offset -68.79ft
Ground Surface Elev. 651.39 ft

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

Groundwater Elev.:
First Encounter 630.4 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				12 inches of Concrete
650.39				
	8			FILL: SILTY SAND, with trace gravel, Dark Brown, Moist
	8 7		5	
647.89				
	5			SILTY CLAY (CL/ML), trace gravel and sand, Brown and Gray, Very Stiff to Hard, Moist
-5	7 7	5.2 B	16	
	5			
	6 11	7.7 B	16	
	2			
-10	5 6	4.8 B	16	
	2			
	4 10	5.0 B	16	
	3			
-15	8 7	2.1 B	14	
	1			
	4 9	2.7 B	18	
	2			
-20	3 7	2.7 B	14	
630.39 ▼				
	8			GRAVEL (GP-GM), with silt, Light Brown and Gray, Medium Dense to Very Dense, Moist to Wet
	23 28		6	
	9			
-25	9 9		7	
	3			
	7 6		4	
	6			
-30	7 14			
			8	
	2			
-35	13 44		8	
	5			
-40	6 10	2.5 S	14	
612.89				
				SILTY CLAY (CL/ML), trace sand and gravel, Gray, Very Stiff, Moist
611.39				

End of Boring

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
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SOIL BORING LOG

Date 4/1/24

ROUTE FAI 80 (I-80) **DESCRIPTION** Retaining Wall Borings **LOGGED BY** TS

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53091972, **Longitude** -87.98618432

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. RWB-02
Station 741+87.06
Offset -68.16ft
Ground Surface Elev. 651.83 ft

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

Groundwater Elev.:
First Encounter 633.3 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				12 inches of Concrete
650.83				
	16			FILL: CLAYEY SAND, with gravel, Dark Brown, Moist
650.33				
	8 4	4.5 P	16	SILTY CLAY (CL/ML), trace gravel, Brown and Gray, Stiff to Hard, Moist
	2			
-5	5 5	4.6 B	19	
	2			
	4 6	5.2 B	17	
	2			
-10	5 7	6.0 B	19	
	2			
	4 17	4.4 B	22	Pushed rock at 12 feet
	9			
-15	36 17	2.3 P	17	Pushed rock at 14 feet
	2			
	3 5	2.5 B	14	
▼	7			
-20	21 20	1.3 B	9	
630.83				
	3			GRAVEL (GP), with trace sand, Brown and Gray, Medium Dense to Dense, Moist to Wet
	8 14		12	
	3			
-25	14 17		9	
	2			
	5 14		9	
	4			
-30	12 31		7	
	10			
-35	8 5		5	
	4			
-40	7 6		8	Cobbles at 39 feet
611.83				End of Boring

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
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SOIL BORING LOG

Date 3/29/24

ROUTE FAI 80 (I-80) **DESCRIPTION** Retaining Wall Borings **LOGGED BY** TS

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53127212, **Longitude** -87.985068678

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. RWB-03
Station 744+51.9
Offset 66.94ft
Ground Surface Elev. 653.03 ft

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

Groundwater Elev.:
First Encounter 632.0 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
652.78				3 inches of Topsoil
	3			FILL: SANDY CLAY, with gravel, Dark Brown, Moist
651.53				
	4	2.7	18	SILTY CLAY (CL/ML), trace gravel and sand, Brown and Gray,
	4	B		Stiff to Hard, Moist
	2			
	5	1.7	19	
-5	5	B		
	2			
	5	5.8	17	
	7	B		
	2			
	3	1.5	13	
-10	3	B		
	3			
	6	5.4	20	
	8	B		
	2			
	3	3.8	23	
-15	4	B		
	1			
	3	3.5	13	Sand Seam at 16.5 feet
	5	B		
	3			Sand Seam at 17.5 feet
	25	5.2	14	
-20	33	B		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
632.03 ▼				
	18			GRAVEL (GP-GM), with silt, Gray,
	18		8	Medium Dense, Moist
	9			
	3			
	4		11	
628.03 -25	10			
				End of Boring

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
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SOIL BORING LOG

Date 3/29/24

ROUTE FAI 80 (I-80) **DESCRIPTION** Retaining Wall Borings **LOGGED BY** TS

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53092824, **Longitude** -87.98552722

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. RWB-04
Station 743+31.74
Offset 68.50ft
Ground Surface Elev. 650.83 ft

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

Groundwater Elev.:
First Encounter 639.8 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				12 inches of Concrete
				649.83
	12			FILL: CLAYEY SAND, with gravel, Light Brown, Moist
	17		4	648.83
	26			SILTY CLAY (CL/ML), trace gravel, trace sand, Brown and Gray, Very Stiff to Hard, Moist
	4			
-5	3 6	3.8 B	17	
	5			
	8 9	5.0 B	17	Pushed Rock at 6.5 feet
	2			
-10	9 14	2.1 B	15	
▼	4			
	4 7	2.5 B	20	
	3			
-15	6 8	2.5 B	18	
	3			
	4 4	2.1 B	15	
	4			
-20	18 27		17	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	12			SILTY CLAY (CL/ML), trace gravel, trace sand, Brown and Gray, Very Stiff to Hard, Moist *(continued)*
	15 11	1.0 B	18	Pushed Rock at 22 feet
				627.33
	11			GRAVEL (GP), with sand, Brown, Medium dense to Dense, Moist
-25	30 50/5		10	Pushed Rock at 24.5 feet
	11			
-30	24 15		7	
	2			
-35	8 15		6	
	10			
				611.83
-40	9 9	1.3 P	14	CLAYEY SAND (CL/ML), trace gravel, Gray, Stiff, Moist
				610.83

End of Boring

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

SOIL BORING LOG

Date 12/8/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Roadway Improvments Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 8, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53103016, **Longitude** -87.98712183

COUNTY Will **DRILLING RIG** Geoprobe **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. SGB-01
Station 49+59.6
Offset 16.70ft
Ground Surface Elev. 667.52 **ft**

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

Groundwater Elev.:
First Encounter None **ft**
Upon Completion N/A **ft**
After N/A **Hrs.** N/A **ft**

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Aggregate Base 667.02				
FILL: SILTY CLAY, trace gravel, Brown, Moist		3		
6 inches of recycled Asphalt at 1.5 feet		21 13	3.1 B	12
		2		
	-5	3 6	1.9 B	21
661.02		3		
SILTY CLAY (CL/ML), trace gravel, Brown, Very Stiff, Moist		6 8	2.8 B	16
		3		
657.52	-10	5 7	3.3 B	15
End of Boring				

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

SOIL BORING LOG

Date 12/8/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Roadway Improvments Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 8, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.5311416, **Longitude** -87.98661946

COUNTY Will **DRILLING RIG** Geoprobe **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. SGB-02
Station 51+08.82
Offset 8.66ft
Ground Surface Elev. 671.27 ft

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

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
14 inches of Asphalt				
670.11				
3 inches of Aggregate Base 669.85		4		
FILL: SILTY CLAY, trace gravel, Brown, Moist		4 6	4.6 B	17
667.77		3		
FILL: SILTY CLAY, trace gravel, trace organics, Dark Gray, Moist	-5	50	2.5 B	15
Asphalt at 4 feet and 4 inches				
665.27		4		
SILTY CLAY (CL/ML), trace gravel, Brown, Hard, Moist		5 7	4.2 B	17
		6		
		7 10	5.2 B	16
661.27	-10			
End of Boring				

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

SOIL BORING LOG

Date 12/8/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Roadway Improvments Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53103078, **Longitude** -87.98470443

COUNTY Will **DRILLING RIG** Geoprobe **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. SGB-03
Station 56+06.12
Offset 14.59ft
Ground Surface Elev. 673.48 ft

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

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Aggregate Base 672.98 FILL: SILTY CLAY, trace gravel, Brown, Moist		3		
		5 6	4.4 B	15
		3		
		5 8	6.3 B	14
	-5	2		
		5 6	5.6 B	18
		2		
		3 4	2.1 B	19
663.48	-10			
End of Boring				

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

SOIL BORING LOG

Date 12/5/23

ROUTE FAI 80 (I-80) **DESCRIPTION** Roadway Improvments Borings **LOGGED BY** DF

SECTION FAI 80 22 FRANCIS BR **LOCATION** I-80 at Francis Road (FAU 0306), **SEC.** 9, **TWP.** 102, **RNG.** 11 E, 3rd **PM**, **Latitude** 41.53105954, **Longitude** -87.98401641

COUNTY Will **DRILLING RIG** Rod Mobile **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 102%

STRUCT. NO. 099-0205
Station N/A

BORING NO. SGB-04
Station 58+20.51
Offset 1.04ft
Ground Surface Elev. 671.38 ft

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

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
10 inches of Asphalt				
670.56				
11 inches of Aggregate Base		6		
669.63		4	8.3	14
FILL: SILTY CLAY, trace gravel, trace organics, Brown, Moist		8	B	
		4		
		3	4.0	16
	-5	8	B	
		4		
		4	3.8	17
		6	B	
		3		
		5	4.6	18
661.38	-10	5	B	
End of Boring				

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)

APPENDIX D

LABORATORY TEST RESULTS

GSG CONSULTANTS, INC.

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Table D-1 – Atterberg Limits

Boring ID	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Classification
SGB-1	3.5-5.0	29.0	17.0	12.0	Silty Clay
SGB-3	3.5-5.0	33.0	18.0	15.0	Silty Clay

Table D-2 – Unit Weight

Boring ID	Sample Depth (ft)	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
SGB-1	3.5-5.0	137.2	113.6
SGB-3	6.0-7.5	135.0	114.2
SGB-4	6.0-7.5	133.2	113.8

Table D-3 – Organic Content

Boring ID	Depth (feet)	Soil Description	Organic Content (%)
SGB-2	3.5 – 5.0	Silty Clay	4.6
SGB-4	6.0 – 7.5	Silty Clay	1.7

APPENDIX E

IDOT PILE DESIGN TABLES

Pile Design Table for Francis Road Bridge West Abutement utilizing Boring #BSB-01

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls		
70	38	31
370	204	33
Metal Shell 14"Φ w/.25" walls		
85	47	31
Metal Shell 14"Φ w/.312" walls		
85	47	31
491	270	33
509	280	38
Metal Shell 16"Φ w/.312" walls		
101	56	31
600	330	38
Metal Shell 16"Φ w/.375" walls		
101	56	31
600	330	38
747	411	43
Steel HP 8 X 36		
146	80	56
183	101	57
286	157	59

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
153	84	43
167	92	48
180	99	53
188	103	56
227	125	57
335	184	58
Steel HP 10 X 57		
157	87	43
171	94	48
184	101	53
193	106	56
236	130	57
454	250	59
Steel HP 12 X 53		
159	87	38
188	104	43
212	116	48
229	126	53
238	131	56
272	150	57
418	230	59
Steel HP 12 X 63		
160	88	38
192	106	43
215	118	48
231	127	53
241	132	56
281	154	57
497	273	59
Steel HP 12 X 74		
96	53	33
163	90	38
195	107	43
219	120	48
235	129	53
245	135	56
288	158	57
589	324	60

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
99	55	33
166	91	38
197	109	43
221	122	48
239	131	53
249	137	56
294	162	57
664	365	60
Steel HP 14 X 73		
108	60	33
197	108	38
228	125	43
256	141	48
284	156	53
298	164	56
332	183	57
578	318	59
Steel HP 14 X 89		
114	63	33
200	110	38
232	128	43
260	143	48
288	159	53
302	166	56
343	188	57
705	388	60
Steel HP 14 X 102		
119	65	33
203	111	38
235	129	43
263	145	48
291	160	53
307	169	56
350	193	57
810	445	60
Steel HP 14 X 117		
124	68	33
205	113	38
239	131	43
268	147	48
296	163	53
311	171	56
361	198	57
929	511	61
Precast 14"x 14"		
108	60	31

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

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls		
45	25	11
76	42	14
87	48	16
112	61	19
160	88	24
173	95	25
201	111	30
331	182	35
354	195	38
Metal Shell 14"Φ w/.25" walls		
61	34	11
98	54	14
109	60	16
137	75	19
194	106	24
208	115	25
238	131	30
410	225	35
436	240	38
Metal Shell 14"Φ w/.312" walls		
61	34	11
98	54	14
109	60	16
137	75	19
194	106	24
208	115	25
238	131	30
410	225	35
436	240	38
503	276	40
540	297	43
562	309	44
Metal Shell 16"Φ w/.312" walls		
80	44	11
123	68	14
132	73	16
165	91	19
229	126	24
246	135	25
276	152	30
494	272	35
525	289	38
607	334	40
650	357	43
Metal Shell 16"Φ w/.375" walls		
80	44	11
123	68	14
132	73	16
165	91	19
229	126	24
246	135	25
276	152	30
494	272	35
525	289	38
607	334	40
650	357	43
675	371	44
Steel HP 8 X 36		
5	3	11
26	14	14
45	25	16
64	35	19
95	52	24
101	56	25
113	62	30
144	79	35
147	81	38
158	87	40
164	90	43
167	92	44
182	100	45
219	121	46
286	157	47

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
6	3	11
32	18	14
56	31	16
79	44	19
123	68	24
131	72	25
142	78	30
183	101	35
188	103	38
203	112	40
210	115	43
213	117	44
236	130	45
273	150	46
335	184	47
Steel HP 10 X 57		
9	5	11
35	19	14
58	32	16
82	45	19
126	69	24
134	74	25
145	80	30
188	103	35
193	106	38
208	114	40
215	118	43
219	120	44
243	133	45
281	155	46
454	250	48
Steel HP 12 X 53		
8	4	11
39	21	14
67	37	16
95	52	19
152	84	24
167	92	25
175	96	30
230	127	35
236	130	38
256	141	40
264	145	43
269	148	44
302	166	45
327	180	46
418	230	47
Steel HP 12 X 63		
9	5	11
41	23	14
69	38	16
98	54	19
156	86	24
169	93	25
177	97	30
233	128	35
238	131	38
259	142	40
267	147	43
272	150	44
305	168	45
336	185	46
497	273	48
Steel HP 12 X 74		
11	6	11
43	24	14
70	39	16
99	55	19
158	87	24
171	94	25
180	99	30
236	130	35
242	133	38
263	145	40
271	149	43
276	152	44
310	171	45
343	189	46
589	324	48

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
12	7	11
45	25	14
72	39	16
101	56	19
160	88	24
174	96	25
182	100	30
240	132	35
246	135	38
267	147	40
276	152	43
281	154	44
315	173	45
350	192	46
664	365	48
Steel HP 14 X 73		
11	6	11
48	27	14
81	45	16
116	64	19
184	101	24
204	112	25
213	117	30
286	157	35
292	161	38
320	176	40
329	181	43
335	184	44
365	201	45
397	219	46
578	318	48
Steel HP 14 X 89		
13	7	11
51	28	14
84	46	16
118	65	19
188	103	24
208	114	25
216	119	30
290	159	35
296	163	38
324	178	40
334	184	43
339	187	44
371	204	45
409	225	46
705	388	48
Steel HP 14 X 102		
15	8	11
54	29	14
86	47	16
120	66	19
190	104	24
210	116	25
219	120	30
294	161	35
300	165	38
329	181	40
338	186	43
344	189	44
375	206	45
417	229	46
810	445	48
Steel HP 14 X 117		
17	10	11
56	31	14
88	48	16
123	68	19
193	106	24
213	117	25
221	122	30
298	164	35
304	167	38
333	183	40
343	189	43
349	192	44
381	210	45
427	235	46
929	511	48
Precast 14"x 14"		
78	43	11
125	69	14
139	76	16
175	96	19
247	136	24

Pile Design Table for Francis 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		
71	39	6
147	81	13
152	84	14
Metal Shell 14"Φ w/.25" walls		
88	48	6
175	96	13
181	100	14
Metal Shell 14"Φ w/.312" walls		
88	48	6
175	96	13
181	100	14
393	216	18
Metal Shell 16"Φ w/.312" walls		
106	58	6
203	112	13
211	116	14
Metal Shell 16"Φ w/.375" walls		
106	58	6
203	112	13
211	116	14
472	260	18
536	295	25
Steel HP 8 X 36		
60	33	14
89	49	17
90	49	18
98	54	25
127	70	35
128	71	36
130	71	37
131	72	38
171	94	39
286	157	41

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42		
63	35	7
72	40	10
73	40	13
77	42	14
110	61	17
116	64	18
123	68	25
163	89	35
164	90	36
166	91	37
168	93	38
212	117	39
335	184	41
Steel HP 10 X 57		
65	36	7
75	41	10
75	41	13
79	43	14
115	63	17
119	66	18
126	69	25
167	92	35
169	93	36
170	94	37
172	95	38
221	121	39
454	250	41
Steel HP 12 X 53		
59	32	6
74	41	7
86	48	10
93	51	13
98	54	14
132	73	17
148	81	18
152	83	25
201	111	30
205	113	35
208	114	36
210	115	37
212	117	38
254	140	39
418	230	41
Steel HP 12 X 63		
60	33	6
76	42	7
89	49	10
94	52	13
99	54	14
137	75	17
150	83	18
153	84	25
206	113	30
208	114	35
210	115	36
212	117	37
214	118	38
263	144	39
497	273	41
Steel HP 12 X 74		
61	34	6
78	43	7
91	50	10
95	52	13
100	55	14
141	77	17
153	84	18
155	85	25
209	115	30
211	116	35
213	117	36
216	119	37
218	120	38
269	148	39
589	324	41

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84		
63	34	6
80	44	7
93	51	10
97	53	13
102	56	14
144	79	17
155	85	18
158	87	25
212	116	30
214	118	35
217	119	36
219	120	37
221	122	38
276	152	39
664	365	41
Steel HP 14 X 73		
44	24	3
71	39	6
89	49	7
105	58	10
116	64	13
122	67	14
162	89	17
179	98	18
185	102	25
244	134	30
256	141	35
259	142	36
261	144	37
264	145	38
311	171	39
578	318	41
Steel HP 14 X 89		
47	26	3
73	40	6
91	50	7
108	60	10
118	65	13
124	68	14
168	92	17
182	100	18
187	103	25
249	137	30
260	143	35
262	144	36
265	146	37
268	147	38
321	177	39
705	388	41
Steel HP 14 X 102		
50	27	3
74	41	6
93	51	7
111	61	10
120	66	13
125	69	14
172	95	17
184	101	18
190	104	25
252	139	30
263	145	35
266	146	36
269	148	37
272	149	38
329	181	39
810	445	41
Steel HP 14 X 117		
53	29	3
76	42	6
96	53	7
113	62	10
121	67	13
127	70	14
177	97	17
187	103	18
192	106	25
257	141	30
267	147	35
270	148	36
273	150	37
275	151	38
339	186	39
929	511	41
Precast 14"x 14"		
112	61	6

APPENDIX F

SOIL PARAMETER TABLES

GSG CONSULTANTS, INC.

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Table F-1 – Summary of Soil Parameters (Abutments - BSB-01 & BSB-03)

Depth Range (Elevation)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained		L-Pile Soil Parameters		
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)	L-Pile Soil Type	Constant for Lateral Modulus of Subgrade Reaction k_{py} (pci)*	Soil Strain (ε_{50})
	New Engineered Clay Fill	125	1,000	0	100	30	Stiff Clay w/o Free Water	1,000	0.005
	New Engineered Granular Fill	125	0	32	0	32	Sand (Reese)	90	N/A
0-13.5 (670.5 – 658.95) **BSB-01**	Brown Silty Clay Fill	138	3,000	0	300	25	Stiff Clay w/o Free Water (Reese)	1,000	0.005
0-21 (674.0 – 653.0) **BSB-03**	Brown and Gray Silty Clay Fill	138	4,100	0	410	25	Stiff Clay w/o Free Water (Reese)	2,000	0.004
13.5-22.0 (658.95 – 650.45)	Brown Very Stiff to Hard Silty Clay	138	5,300	0	530	28	Stiff Clay w/o Free Water (Reese)	2,000	0.004
22.0-28.5 (650.45 – 643.95)	Gray Very Stiff Silty Clay	138	3,900	0	390	28	Sand (Reese)	1,000	0.005
28.5-33.5 (643.95 – 638.95) **BSB-01 only**	Gray Very Loose Silty Sand	108	0	27	0	27	Sand (Reese)	20	N/A

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Depth Range (Elevation)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained		L-Pile Soil Parameters		
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)	L-Pile Soil Type	Constant for Lateral Modulus of Subgrade Reaction k_{py} (pci)*	Soil Strain (ε_{50})
33.5-39.5 (638.95 - 632.95)	Gray Very Stiff Silty Clay	138	2,500	0	250	28	Stiff Clay w/o Free Water	1,000	0.005
39.5-44.5 (632.95 – 627.95)	Medium Dense Sand with Gravel	125	0	41	0	42	Sand (Reese)	60	N/A
44.5-48.5 (627.95 – 623.95)	Very Dense Gravel/Sandy Gravel	135	0	42	0	42	Sand (Reese)	125	N/A
48.5-53.5 (623.95 – 618.95)	Medium Dense Sand	128	0	42	0	39	Sand (Reese)	60	N/A
53.5-63.0 (618.95 – 612.45)	Medium Dense Gravel/Boulders/Cobbles	133	0	42	0	42	Sand (Reese)	125	N/A
63.0-65.10 (618.95 – 612.45) **BSB-01 only**	Weathered Limestone	137	0	42	0	42	Weak Rock (Reese)	125	N/A

*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.

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Table F-2 – Summary of Soil Parameters (Central Pier - BSB-02)

Depth Range (Elevation)	Soil Description	In situ Unit	Undrained		Drained		L-Pile Soil Parameters		
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)	L-Pile Soil Type	Constant for Lateral Modulus of Subgrade Reaction k_{py} (pci)*	Soil Strain (ε_{50})
	New Engineered Clay Fill	125	1,000	0	100	30	Stiff Clay w/o Free Water (Reese)	1,000	0.005
	New Engineered Granular Fill	125	0	32	0	32	Sand (Reese)	90	N/A
0-6.0 (650.6 - 644.6)	Brown Silty Clay Fill	138	5,200	0	520	25	Stiff Clay w/o Free Water (Reese)	2,000	0.004
6.0-10.0 (642.1 - 640.6)	Brown and Gray Very Stiff Silty Clay	138	5,000	0	500	28	Stiff Clay w/o Free Water (Reese)	2,000	0.004
10.0-16.0 (640.6 – 634.6)	Medium Dense Sandy Loam	130	0	42	0	42	Sand (Reese)	60	N/A
16.0-19.5 (634.6 - 632.1)	Brown and Gray Very Stiff Silty Clay	138	2,000	0	200	28	Stiff Clay w/o Free Water (Reese)	1,000	0.005
19.5-28.5 (630.6 – 622.1)	Medium Dense to Dense Silty Sand and Gravel	131	0	42	0	42	Sand (Reese)	125	N/A
28.5-38.5 (622.1 – 612.1)	Loose to Dense Sand	128	0	42	0	42	Sand (Reese)	60	N/A
38.5-42.0 (612.1 – 608.6)	Medium Dense Gravel	128	0	42	0	42	Sand (Reese)	25	N/A