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Structure Geotechnical Report

Illinois Route 75 over Rock River

Route: FAP 505

Section: 77BR

Structure No.: 101-0230

Job No. P-92-058-08/D-92-058-08

PTB 195-29

Winnebago County, Illinois

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1.0 Project Description and Proposed Structure Information

1.1 Introduction

This report summarizes the results of a geotechnical investigation performed for the design of the replacement of the existing multi-span bridge carrying IL 75 over the Rock River located immediately south of Rockton, Illinois. The purpose of this study was to provide a geotechnical assessment for the proposed new structure based on subsurface conditions encountered at the borings performed by Millennia Professional Services (Millennia) and abutment borings performed by IDOT. This report describes the exploration procedures used, presents the field and laboratory data, includes an assessment of the subsurface conditions in the area, and provides geotechnical recommendations for design and construction.

1.2 Project Description

The existing structure will be a complete replacement. The three (3) commemorative plaques located at the existing sidewalk bump out on the west side of the bridge will be salvaged and placed on the new structure. The proposed new structure, SN 101-0230, will be a 5-span structure with a back-to-back abutment length of 590'-0" with an out-to-out width of 49'-2". The bridge will be built with a 90-degree skew to Rock River, and the structure centerline located at Station 937+46.75. The bridge deck will include two 12-foot driving lanes with 3-foot shoulders on both the northbound and southbound lanes. A 10-foot-wide multi-use path is included on the east side of the proposed structure, and a 5-foot-wide sidewalk is planned on the west side. The sidewalk and multi-use path will be separated from the driving lanes with a constant-slope parapet with railings. The constant slope parapet and railing will have a typical height of 4'-6". The construction will be performed using road closure and a detour to maintain traffic.

The general site area is shown on the attached Vicinity Map, Figure 1 in Appendix A, and plans showing the approximate boring locations performed for this study are presented as the Boring Location Plan, Figure 2 in Appendix A.

The preliminary loads for the abutment and pier locations have been provided by Quigg, and are listed in the table below:

Substructure Loading

Substructure Unit	Service Load (Total Axial) kips	Strength-I Loads (Total Axial) kips	Extreme Event-II Load (Total Axial) kips
Abutments	1713.2	2554.0	1324.3
Piers 1 & 4	4358.8	6250.5	3604.9
Piers 2 & 3	5302.1	7587.7	4409.6

2.0 Subsurface Exploration and Laboratory Testing

2.1 Subsurface Exploration

From July 7 to July 23, 2021, Millennia personnel conducted a subsurface exploration at the site, consisting of five (5) structure borings, two (2) roadway borings, and four (4) retaining wall borings. This report only addresses the structure borings designated SB-1 through SB-5, which were drilled at the intermediate pier locations. Abutment borings B-1 and B-2 were performed by IDOT personnel and provided for use in developing the recommendations in this report. The approximate locations of the structure borings are indicated on the Boring Location Plan, Figure 2.1 in Appendix A.

The borings were advanced using hollow-stem auger, 4-inch casing advance, continuous flight, and rock core drilling methods using an automatic hammer on a CME-55 rig, or a cathead hammer on a GP-750C drill rig. Samples were generally obtained at 2.5-foot intervals to a depth of 30-feet, and 5-foot intervals to termination depths. Split-spoon samples were recovered using a 2-inch outside-diameter, split-barrel sampler, driven by a 140-pound automatic hammer, in accordance with ASTM D 1586. The sampling sequence for each boring is summarized on the Boring Logs in Appendix D of this report. Each boring was checked for groundwater during and after drilling and backfilled. Extended groundwater level readings were obtained.

Unconfined compression tests were performed on applicable split-spoon samples using a Rimac field testing machine. The resulting unconfined compressive strengths are reported on the boring logs.

Borings SB-1, SB-2, SB-4A, and B-2 were advanced into bedrock utilizing NQ-sized rock coring methods. Rock was sampled to depths ranging from 17.5 to 20.0 feet below where top of rock was encountered. All core runs were timed, measured for recovery and rock quality designation (RQD), and were placed in boxes for further testing at the laboratory. The core sampling sequence and photos for each boring are summarized and included in Appendix B, Boring Logs.

2.2 Laboratory Testing

A laboratory testing program was conducted by Millennia to determine selected engineering properties of the obtained samples. The following laboratory tests were performed on the samples recovered from the borings:

- visual descriptions by color and texture (ASTM D 2488);
- natural moisture content (ASTM D 2216);
- Unconfined compressive strengths of intact samples using a Rimac spring tester; and
- Unconfined compressive strength of Rock Cores (ASTM C39, ASTM C42).

Data and observations from laboratory tests were recorded on laboratory data sheets during the testing program. The results of tests are summarized on the Boring Logs and on the Laboratory Test Reports in Appendix B. The boring logs are an interpretation of the subsurface conditions based on the field and laboratory data. Only data pertinent to the objectives of this report have been included on the logs; therefore, these logs should not be used for other purposes.

2.3 Data

The results of the field tests and measurements were recorded on field logs and appropriate data sheets in the field. These data sheets and logs contain information concerning the drilling methods, samples attempted and recovered, indications of the presence of various subsurface materials, and the observation of groundwater. The field logs and data sheets also contain the engineer's interpretations of the conditions between samples, based on the performance of the equipment and cuttings brought to the surface by the drilling tools.

Data and observations from laboratory tests were recorded on laboratory data sheets during the course of the testing program. The results of the tests are summarized on the Boring Logs in Appendix B.

The boring logs are an interpretation of the subsurface conditions based on a combination of the field and laboratory data. The analyses and conclusions contained in this report are based on these field and laboratory test results and on the interpretations of the subsurface conditions as reported in the Boring Logs. Only data pertinent to the objectives of this report have been included on these Logs; therefore, these records should not be used for other purposes.

Rock core samples were taken back to the laboratory and photographs were taken of each box. The photographs are included with the Boring Logs in Appendix B.

3.0 Subsurface Conditions

Details of the subsurface conditions encountered at the borings are shown on the boring logs. The general subsurface conditions encountered and their pertinent engineering characteristics are described in the following paragraphs. Conditions represented by the borings should be considered applicable only at the boring locations on the dates shown; the reported conditions may be different at other locations and at other times.

3.1 Generalized Subsurface Profile

In general, the subsurface conditions for the bridge site consist of cohesive soils overlying varying depths of granular materials overlying rock. The structure borings that were drilled at the abutment locations (B-1 and B-2) advanced through 5 to 15-feet of cohesive materials with varying amounts of granular materials, with interbedded layers of granular materials. The cohesive materials consisted of loam, silty clay loam, and sandy loam with N-values ranging from 7 to 19 bpf, and estimated compressive strength using a pocket penetrometer between 0.4 and 2.6 tsf. The moisture contents varied from 11 to 26 percent. The interbedded granular materials in the upper 15-feet of the soil profile consist of sand and sandy gravel, with N-values ranging from 6 to 15 bpf.

The structure borings drilled through the bridge deck at the intermediate piers (SB-1 through SB-5) and below the cohesive materials observed at the abutment borings encountered varying depths of granular materials prior to encountering bedrock. The granular materials consisted of varying gradations of sands and gravels. The N-values in the granular material ranged from 5 to 82 bpf. Below the granular material, bedrock was encountered at varying depths. The bedrock material consisted of limestone, dolomite, and sandstone. As previously mentioned, the bedrock was cored at four locations. The measured rock quality designation (RQD) ranged from 0 to 48 percent, and measured recovery between 70 and 100 percent. A rock cap consisting of an approximate 2.25-foot-thick layer of dolomite was encountered at boring SB-1. Below the cap rock, SB-1 advanced through approximately 8.25-feet of cobbles and boulders prior to encountering bedrock. The depths and elevations of the encountered bedrock are listed in the following table.

Top of Rock Details

Boring	Depth (ft.) ¹	Elevation (ft.)	Auger Refusal	Material	Rock Cored (Y/N)
RB-2	3	732.0	725.0	Limestone	N
B-1	92.5	637.4	634.9	Sandstone	N
B-2	9.0	724.1	723.1	Limestone	Y
SB-1	70.5 ²	637.0	--	Dolomite ²	Y
	81	626.5	626.5	Sandstone	Y
SB-2	71.5	637.2	633.7	Sandstone	Y
SB-3	54.25	655.5	653.2	Sandstone	N
SB-4A	5.25	705.5	701.2	Dolomite	Y
SB-5	0	710.0	706.4	Limestone	N

1. Borings were drilled through bridge deck. Depth is from the top of the soil profile/river bed

2. Approximate 2.25-foot thick capstone. Approximately 8.25-foot-thick layer of cobbles and boulders encountered below the capstone.

3.2 Groundwater

Groundwater was observed during drilling at boring B-1, which was located near the proposed north abutment, at a depth of 21 feet (Elevation 708.9). A delayed groundwater reading of 18 feet (Elevation 711.9) was obtained 24 hours following completion of B-1. Due to the location of structure borings SB-1 through SB-5 in the Rock River, groundwater levels were not applicable. The Rock River water surface was measured at each boring location for SB-1 through SB-5. The readings ranged from Elevation 711.3 to 712.7 over an approximate one-week period.

The presence or absence of groundwater at a particular location does not necessarily indicate that groundwater will be present or absent at that location at other times. Groundwater levels may vary significantly over time due to the effect of seasonal variations in precipitation, water level in the Rock River, or other factors not evident at the time of exploration.

4.0 Geotechnical Evaluations

4.1 Settlement Consideration

Substantial amounts of new fill are not anticipated to be needed for the construction of the proposed new structure. Fills from earthwork operations are anticipated to be no more than a one to two feet. Based on the stiff to very stiff soil conditions, as indicated on the boring logs, any settlement is anticipated to occur with construction activities, and a settlement analysis was not performed.

4.2 Seismic Considerations

The determination of Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1-Seismic Site Class Definition and the IDOT provided spreadsheet titled: '*Seismic Site Class Determination*.' Using these resources, the controlling global site class for this project is Soil Site Class C.

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

Parameter	Value
Soil Site Class	C
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.091g
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.053g
Seismic Performance Zone	1

As indicated in the table above, based on S_{D1} and Table 3.15.2 in the IDOT Bridge Manual, the Soil Site Class C, and Figure 2.3.10-2 in the IDOT Bridge Manual, the Seismic Performance Zone is 1. Since the structure is located in Seismic Performance Zone 1, as per the IDOT Bridge Manual, 2012, liquefaction analysis is not required.

4.3 Global Stability

Based on the proposed improvements, changes to the slopes and inclinations are not anticipated. Based on our understanding, the performance of the end and side slopes for the structures are stable, and the lack of newly placed fill material, a stability analysis for these structures has not been performed.

The existing creek banks located within the project area appear to have slope inclinations that are similar or in some cases might be steeper than those planned for this project. If the banks have not indicated signs of global stability failure or distress, then those slopes are stable, but could be at an equilibrium state just slightly above yield. The slope of any steep creek bank on most waterway systems located anywhere could slump during or soon after flooding due to scour and rapid drawdown effects.

The onsite soils can potentially be highly erosive, a mechanism of soil movement unrelated to global stability. Future erosion and shallow, superficial slumps are always a possibility, despite the results of advanced computer modeling for slope stability. Maintaining healthy vegetation, along with appropriate erosion control practices, will reduce the potential for these issues to become problematic.

In addition, the geotechnical conditions between the boring locations are essentially unknown. If the contractor exposes conditions during excavation and other earthwork activities that differ from those indicated at the boring locations, Millennia should be notified to assess the effect (if any) of the unanticipated conditions upon the findings of the global slope stability assessment.

As with any drainage way, shallow, surficial slumps of the creek bank, including in the vicinity of the bridge, are possible, particularly during and soon after flood events. Riprap or other means of erosion protection should be considered to reduce the potential for surficial slope failures. The riprap size, thickness, and any bedding or filter requirements should be selected by a qualified designer considering the hydraulic conditions at the project site.

4.4 Scour

Abutment slope protection should be included to protect against scour potential. Lining the abutment slopes with either Class A4 or A4 stone riprap appears to be appropriate scour protection for the proposed structure. Skin friction and lateral load design values for driven piles should be ignored in the scour zones. Due to the granular nature of the soils present, Millennia recommends using the scour depths with zero reductions. Based on information provided by Quigg, the design scour elevations for the 100-year and 200-year events for the proposed structure are shown in the table below:

Summary of Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)						Item 113
	S. Abut.	Pier 1	Pier 2	Pier 3	Pier 4	N. Abut.	
Q100	726.2	703.5	705.3	702.0	704.8	722.4	5
Q200	726.2	703.5	705.1	702.0	704.5	722.4	
Design	726.2	703.5	705.3	702.0	704.8	722.4	
Check	726.2	703.5	705.1	702.0	704.5	722.4	

4.5 Pile Supported Foundations - Abutments

The foundations supporting the proposed structure must provide sufficient support to resist dead and live loads, including seismic loading. Based on the encountered subsurface conditions, and information available to date, steel H-piles and metal-shell piles are feasible options for the proposed north abutment, and steel H-piles set in rock are feasible for the proposed south abutment. Millennia understands that the designer's preferred option for the foundational support needed for the proposed structure abutments are steel H-piles. Metal shell pile options are nevertheless presented below. Based on the encountered subsurface conditions, Millennia utilized the Modified IDOT Static Method of Estimating Pile Length (Appendix E) provided by IDOT BBS Foundations and Geotechnical Unit, and the information available to date, to estimate the pile lengths.

Integral abutments are anticipated to be used for the proposed structure. According to the IDOT Geotechnical Manual 2015, REV 2020, the feasibility of an integral abutment should be analyzed using the “Integral Abutment Feasibility Analysis” spreadsheet provided by the IDOT BBS. Due to the presence of hard limestone within the 10-foot zone at the south abutment, the analysis shows that integral abutments may not be feasible unless measures are taken to reduce the soil pressures on the pile during expansion. Such measures include pre-coring the pile locations to 10 feet below the abutment, backfilling the pre-core hole with bentonite pellets, and hydrating and mixing the bentonite. Another alternative would be to change to a semi-integral abutment type.

The piles supporting the south abutment will need to be set in rock rather than driven. Drilling and setting piles in rock is described in Section 512.17 of the 2022 IDOT Standard Specifications for Road and Bridge Construction (IDOT Standard Specifications). If integral abutments are used for the proposed structure, the pre-cored holes described in the previous paragraph will need to extend deeper than 10 feet below the pile cap to achieve the minimum tip elevation requirements to achieve fixity. Once the required pile embedment depth is reached, the bottom of the hole is filled with concrete to a depth of at least 6 inches, followed by placing and properly positioning the pile. Section 512.17 then requires that the hole be filled with concrete up to at least 6 inches above the top of rock. However, if integral abutments are used, the hole will be filled with concrete up to 10 feet below the bottom of the pile cap, followed by backfilling the remainder of the hole with bentonite. Millennia recommends developing a special provision and/or plan note to specify backfill requirement for the pre-cored holes.

Piles set into bedrock in the outlined above may be designed for side resistance within the bedrock socket in conjunction with tip resistance, if needed. The recommended side and tip resistance values for the bedrock socket are shown in the tables below.

Factored Side Resistance in Bedrock Based on IDOT Boring B-2

Material	Nominal Side Resistance (ksf)	Geotechnical Resistance Factor (ϕ)	Factored Side Resistance (ksf)
Limestone (Elev. 713- 703)	9.2	0.55	5.1

Factored Tip Resistance in Bedrock Based on IDOT Boring B-2

Material	Nominal Tip Resistance (ksf)	Geotechnical Resistance Factor (ϕ)	Factored Tip Resistance (ksf)
Limestone (Elev. 713- 703)	63.9	0.50	32.5

These values include an appropriate geotechnical resistance factor. It should be assumed that the upper approximately 2 feet of the socket will not contribute to side resistance in consideration of uncertainties caused by the potential for weathering of the upper bedrock surface. Uplift resistance of the shaft should only rely on the bedrock socket side friction. An uplift resistance factor of 0.50 is recommended based on AASHTO LRFD Bridge Design

Specifications (2010). With minimal fill placement anticipated at the abutment locations, downdrag does not appear to be a concern. The design capacities for the foundations should not exceed the structural capacities of the individual pile members.

Assuming that the pre-drilled piles are properly installed as discussed herein, total shaft settlement should be less than approximately 1 inch, with differential settlements up to approximately half the total.

The Maximum Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving, and will assist the contractor in selecting a proper hammer size. The Maximum Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the tip of the pile to support factored substructure loading. The maximum factored resistance available uses a LRFD Resistance Factor of 0.55. Millennia assumes that metal-shell piles will be driven to the maximum nominal bearing required in cohesive or granular material and will not be driven to bedrock. H-piles will be driven to the maximum nominal bearing in bedrock. Based on the geotechnical analysis performed for the proposed structure, the impacts of scour, downdrag and liquefaction do not result in a need to reduce the axial factored pile capacity.

MS 14" Φ w/.312" walls

Location	R_N Maximum Nominal Required Bearing (kips)	R_F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	570	314	54	724.4

MS 16" Φ w/.375" walls

Location	R_N Maximum Nominal Required Bearing (kips)	R_F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	782	430	64	724.4

HP 12X53

Location	R _N Maximum Nominal Required Bearing (kips)	R _F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	418	230	86	724.4

HP 14X89

Location	R _N Maximum Nominal Required Bearing (kips)	R _F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	705	388	88	724.4

HP 14X117

Location	R _N Maximum Nominal Required Bearing (kips)	R _F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	929	511	89	724.4

HP 16X141

Location	R _N Maximum Nominal Required Bearing (kips)	R _F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	1126	619	93*	724.4

* Estimated pile length extends below boring depth.

HP 16X162

Location	R _N Maximum Nominal Required Bearing (kips)	R _F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
North Abutment (Boring B-1)	1288	708	94*	724.4

* Estimated pile length extends below boring depth.

Other pile configurations are available and could be considered as substitutes for the sections summarized above. The pile group capacity may be designed as the sum of the individual piles with the understanding that a spacing of at least three pile widths is maintained between piles, center to center.

ASTM A 572 Grade 50 high-strength steel is recommended in order to be driven through the stiff soils, while minimizing potential bending, buckling, distortion, or curling of pile tips. The piles should be equipped with tip reinforcement/shoes to promote penetration through the stiff to hard layers. After the pile section and driving equipment have been selected, a termination driving criteria should be established using a wave equation analysis to help assure adequate capacity and reduce the potential for over stressing the piles during installation. Millennia recommends a test pile be performed at one of the abutments. Test piles are performed prior to production driving so that actual, on-site field data can be gathered to further evaluate pile driving requirements for the project. The test pile results will also provide data for use in assessing the contractor's proposed equipment and methodologies, previously identified in their Pile Installation Plan.

Assuming that the piles are properly installed, as discussed herein, total settlement should be less than approximately one inch, with differential settlements up to approximately half the total.

4.6 Foundations on Drilled Shafts

Based on the subsurface exploration, competent limestone, dolomite, or sandstone bedrock was encountered at varying depths across the footprint of the structure. It is Millennia's understanding that the designer prefers the utilization of drilled shafts for the foundation supports at the intermediate pier locations.

Recommendations for drilled shafts with varying sockets extending to various depths into the underlying competent limestone, dolomite, or sandstone, developing capacity from side and/or tip resistance, are provided for design support of the intermediate piers. The provided capacities are based on boring information presented on the boring logs, laboratory unconfined compressive strength tests performed on rock core samples from Borings SB1, SB-2, SB-4A, and B-2 and utilizing the IDOT Drilled Shaft Axial Capacity in Rock-Dolomite, Limestone, Sandstone, and Hard Shale spreadsheet as provided by IDOT BBS Foundations and Geotechnical Unit.

The table on the following pages contains a summary of Factored Shaft Resistances available for various socket diameters based on socket depths into the underlying dolomite, limestone, or sandstone for each structure. IDOT Drilled Axial Capacity in Rock Input sheets and Design Tables are included in Appendix F, for additional information.

Substructure Unit	Shaft Diameter (inches)	Socket Depth (ft)	Tip Elevation (ft)	Nominal Shaft Resistance (Kips)	Factored Shaft Resistance (Kips)	Resistance Method
Pier 1*	36	2	704.4	2,099	1,050	Tip
		4	702.4	2,292	1,208	Side & Tip
		5	701.25	11,246	5,623	Tip
		7	699.25	11,955	5,977	Tip
	42	2	704.4	2,818	1,409	Tip
		4	702.4	2,857	1,500	Side & Tip
		6	700.25	16,134	8,067	Tip
		8	698.25	15,788	7,894	Tip
	48	2	704.4	3,643	1,821	Tip
		5	701.25	3,899	2,055	Side & Tip
		7	699.25	20,740	10,370	Tip
		8	698.25	20,344	10,172	Tip
	54	2	704.4	4,572	2,286	Tip
		5	701.25	4,701	2,469	Side & Tip
		7	699.25	25,699	12,849	Tip
		8	698.25	25,476	12,738	Tip
Pier 2	36	4	697.25	2,816	1,450	Side & Tip
		6	695.25	11,361	5,680	Tip
		10	691.25	6,323	3,161	Tip
		12	689.25	5,798	3,084	Side & Tip
	42	4	697.25	3,608	1,852	Side & Tip
		6	695.25	15,268	7,634	Tip
		10	691.25	7,822	3,911	Tip
		12	689.25	7,305	3,868	Side & Tip
	48	4	697.25	4,500	2,304	Side & Tip
		6	695.25	4,754	2,443	Side & Tip
		7	694.25	15,968	7,984	Tip
		10	691.25	9,448	4,724	Tip
	54	4	697.25	5,492	2,807	Side & Tip
		6	695.25	5,514	2,845	Side & Tip
		7	694.25	18,536	9,268	Tip
		10	691.25	11,202	5,601	Tip
Pier 3	36	4	629.7	1,268	648	Side & Tip
		6	627.7	3,506	1,791	Side & Tip
		8	625.7	3,677	1,885	Side & Tip
		10	623.7	3,810	1,958	Side & Tip
	42	4	629.7	1,671	852	Side & Tip
		6	627.7	4,600	2,343	Side & Tip
		8	625.7	4,802	2,454	Side & Tip
		10	623.7	4,966	2,544	Side & Tip
	48	4	629.7	2,123	1,080	Side & Tip
		6	627.7	2,341	1,197	Side & Tip
		8	625.7	6,080	3,100	Side & Tip

	54	9	624.7	6,183	3,156	Side & Tip
		2	631.7	2,366	1,193	Side & Tip
		4	629.7	2,629	1,335	Side & Tip
		6	627.7	2,880	1,469	Side & Tip
		8	625.7	7,512	3,822	Side & Tip
Pier 4	36	6	620.5	5,397	2,759	Side & Tip
		8	618.5	6,447	3,312	Side & Tip
		10	616.5	6,835	3,526	Side & Tip
		12	614.5	7,070	3,667	Side & Tip
	42	6	620.5	7,626	3,887	Side & Tip
		8	618.5	8,534	4,370	Side & Tip
		10	616.5	8,957	4,605	Side & Tip
		12	614.5	9,183	4,745	Side & Tip
	48	4	622.5	2,930	1,492	Side & Tip
		6	620.5	4,428	2,261	Side & Tip
		8	618.5	10,904	5,570	Side & Tip
		10	616.5	11,352	5,821	Side & Tip
	54	4	622.5	3,757	1,909	Side & Tip
		6	620.5	5,606	2,857	Side & Tip
		8	618.5	13,556	6,911	Side & Tip
		10	616.5	14,017	7,171	Side & Tip

*Pier 1 data does not extend beyond 7 feet. In order to extend data, rock core data from SB-4A was used

Based on the general character of the granular soils, and assuming that the drilled shaft foundations are properly installed, the maximum anticipated settlement of the foundations should be approximately one inch or less. The majority of the settlement should take place during construction as the loads are applied to the foundations.

Drilled shafts should be maintained at a spacing no closer than three shaft diameters, center-to-center, so that stress overlap at the bearing level can be avoided, to reduce lateral capacity interaction, and so that possible installation problems associated with one structural member does not impact the integrity of the adjacent member.

Lateral load resistance and induced lateral deflection are typically assessed using finite difference computer models based on lateral modulus-of-subgrade reaction, such as LPILE. Recommendations for use in the design of drilled shaft foundations are presented in Section 4.5 Lateral Load Resistance.

4.7 Lateral Load Resistance

Lateral load resistance and induced lateral deflection for pile foundations are typically assessed using finite difference computer models based on the lateral modulus-of-subgrade reaction, such as LPILE. Based on the conditions encountered at the borings, the following parameters are recommended for use in the design of the substructure foundations:

**Parameters for Use in LPILE Analysis at Boring B-1
North Abutment**

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K_{static} (pci)	p-y Soil Modulus K_{cyclic} (pci)
721.9-712.4	Soft clay (Matlock)	120	650	n/a	0.015	n/a	65	n/a
712.4-708.9	Sand (Reese)	110	n/a	n/a	n/a	30	33	33
708.9-707.4	Sand (Reese)	48	n/a	n/a	n/a	28	13*	13*
707.4-694.9	Sand (Reese)	48	n/a	n/a	n/a	29	20*	20*
694.9-669.9	Sand (Reese)	48	n/a	n/a	n/a	30	26*	26*
669.9-664.9	Sand (Reese)	48	n/a	n/a	n/a	27	11*	11*
664.9-647.4	Sand (Reese)	48	n/a	n/a	n/a	30	26*	26*
647.4-644.9	Stiff Clay w/o Free Water	63	1,000	n/a	0.009	n/a	350	150
644.9-639.9	Sand (Reese)	48	n/a	n/a	n/a	30	26*	26*
639.9-637.4	Sand (Reese)	63	n/a	n/a	n/a	36	97*	97*
637.4-634.9	Sandstone: Strong Rock	145	n/a	2,000	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch
pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution

**Parameters for Use in LPILE Analysis at Boring SB-1
Pier 4**

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K_{static} (pci)	p-y Soil Modulus K_{cyclic} (pci)
707.5-705.1**	Sand (Reese)	48	n/a	n/a	n/a	27	11*	11*
705.1-687.5	Sand (Reese)	58	n/a	n/a	n/a	28	13*	13*
687.5-665.5	Sand (Reese)	58	n/a	n/a	n/a	30	26*	26*
665.5-645.25	Sand (Reese)	58	n/a	n/a	n/a	37	110*	110*
645.25-640.5	Stiff Clay w/o Free Water	63	2,000	n/a	0.006	n/a	650	250
640.5-637.0	Sand (Reese)	58	n/a	n/a	n/a	30	26*	26*
637.0-634.75	Dolomite: Hard Rock	145	n/a	5,000	n/a	n/a	n/a	n/a
634.75-626.5	Sand (Reese)	58	n/a	n/a	n/a	38	138*	138*
626.5-620.5	Sandstone: Strong Rock	145	n/a	2,020	n/a	n/a	n/a	n/a
620.5-615.5	Sandstone: Strong Rock	145	n/a	1,500	n/a	n/a	n/a	n/a
615.5-606.5	Sandstone: Strong Rock	145	n/a	2,500	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch
pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution

**Parameters for Use in LPILE Analysis at Boring SB-2
Pier 3**

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K_{static} (pci)	p-y Soil Modulus K_{cyclic} (pci)
708.75-702.0**	Sand (Reese)	58	n/a	n/a	n/a	27	11*	11*
702.0-682.25	Sand (Reese)	58	n/a	n/a	n/a	27	11*	11*
682.25-666.25	Sand (Reese)	58	n/a	n/a	n/a	29	20*	20*
662.25-637.25	Sand (Reese)	58	n/a	n/a	n/a	31	41*	41*
637.25-616.25	Sandstone: Strong Rock	145	n/a	1,080	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch
pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution

Parameters for Use in LPILE Analysis at Boring SB-3

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K_{static} (pci)	p-y Soil Modulus K_{cyclic} (pci)
709.7-702.0**	Sand (Reese)	63	n/a	n/a	n/a	28	13*	13*
702.0-698.75	Sand (Reese)	63	n/a	n/a	n/a	28	13*	13*
698.75-689.25	Sand (Reese)	58	n/a	n/a	n/a	29	20*	20*
689.25-681.75	Sand (Reese)	58	n/a	n/a	n/a	32	51*	51*
681.75-671.25	Sand (Reese)	58	n/a	n/a	n/a	29	20*	20*
671.25-666.25	Sand (Reese)	58	n/a	n/a	n/a	26	10*	10*
666.25-655.5	Sand (Reese)	58	n/a	n/a	n/a	28	13*	13*
655.5-653.25	Sandstone: Strong Rock	145	n/a	1,500	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch

pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution

**Parameters for Use in LPILE Analysis at Boring SB-4 & SB-4A
Pier 2**

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K _{static} (pci)	p-y Soil Modulus K _{cyclic} (pci)
710.75-705.1**	Sand (Reese)	58	n/a	n/a	n/a	28	13*	13*
705.1-705.2	Sand (Reese)	58	n/a	n/a	n/a	29	20*	20*
705.5-701.25	Sandstone: Strong Rock	145	n/a	1,500	n/a	n/a	n/a	n/a
701.25-694.25	Dolomite: Strong Rock	145	n/a	5,200	n/a	n/a	n/a	n/a
694.25-688.25	Dolomitic Sandstone: Strong Rock	145	n/a	4,050	n/a	n/a	n/a	n/a
688.25-681.25	145	n/a	900	n/a	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch
pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution

**Parameters for Use in LPILE Analysis at Boring SB-5
Pier 1**

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K _{static} (pci)	p-y Soil Modulus K _{cyclic} (pci)
710-706.4	Limestone: Strong Rock	145	n/a	5,000	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch
pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution.

**Parameters for Use in LPILE Analysis at Boring B-2
South Abutment**

Approximate Elevation (ft)	LPILE Soil Type	Effective Unit Weight (pcf)	Undrained Cohesion (psf)	Uniaxial Compressive Strength (psi)	Strain at 50% Maximum Stress	Angle of Internal Friction (degrees)	p-y Soil Modulus K_{static} (pci)	p-y Soil Modulus K_{cyclic} (pci)
725.7-715.7	Stiff Clay w/o Free Water	120	1,500	n/a	0.007	n/a	500	200
715.7-703.1	Limestone: Strong Rock	145	n/a	4,200	n/a	n/a	n/a	n/a

pcf = pounds per cubic foot psf = pounds per square foot psi = pounds per square inch
pci = pounds per cubic inch * = submerged value ** = scour zone, ignore contribution

4.8 Lateral Earth Pressures

Lateral earth pressure parameters are provided for the design of any below grade structures. Structures that are restricted from movement at the top should be designed to resist at-rest earth pressures. Structures that are free to move and deflect at the top may be designed to resist active earth pressures. A horizontal deflection at the top of the structure of approximately 1% of the supported height is typically required to permit active pressure to develop. Earth pressures are a function of the excavation configuration and the backfill materials. The following design parameters are recommended for the indicated backfill materials:

Lateral Earth Pressure Parameters

Parameter		Crushed Limestone	Cohesive Soil
At-Rest Equivalent Fluid Pressure	Drained	55 pcf	65 pcf
	Submerged	90 pcf	95 pcf
Active Equivalent Fluid Pressure	Drained	35 pcf	45 pcf
	Submerged	80 pcf	85 pcf
Passive Equivalent Fluid Pressure	Drained	480 pcf	320 pcf
	Submerged	310 pcf	215 pcf
Soil Wet Unit Weight		130 pcf	120 pcf
Angle of Internal Friction		35°	27°
Assumed Surcharge Condition		None	None
Ground Surface Profile		Horizontal	Horizontal

No factor of safety has been applied to the values above.

pcf = pounds per cubic foot

Submerged values should be used for the calculation of lateral pressures for those portions of the structure that extend below the highest level of anticipated groundwater. The values for undrained fluid pressure for active and at-rest conditions include hydrostatic pressures.

Significant movement would generally be necessary to develop the full values of passive pressures given; typically, the passive values stated are reduced by up to one-half for design. The effects of vertical surcharge loads or sloping ground behind the structures are not included for the stated fluid pressures. To use the lateral earth pressures recommended in the table above for design, the backfill material should be placed within a zone defined by a line beginning at the bottom edge of the structure pad or foundation and extending up at a 45° inclination. Resistance to sliding of the structure base may be analyzed using the resistance factors displayed in Section 4.7.

5.0 Construction Considerations

5.1 Subgrade, Fill, and Backfill

Earthwork activities including backfill and fill should be performed in accordance with Section 205 of the IDOT Standard Specifications.

5.2 Subgrade Protection

Construction areas should be properly drained in order to reduce or prevent surface runoff from collecting on the subgrade. Any ponded water on the exposed subgrade should be removed immediately. To prevent unnecessary disturbance of the subgrade soils, trucks and other heavy construction vehicles should be restricted from traveling through the finished subgrade area. If disturbed areas develop, they should be reworked and compacted as previously described.

If this project is constructed during the winter season, fill materials should be carefully observed to see that no ice or frozen soils are placed as fill or remain in the base materials upon which fill is placed.

5.3 Site Excavations

Millennia recommends that excavations be performed in accordance with Occupational Safety and Health Administration (OSHA) regulations, and any other applicable regulatory agencies. In accordance with the OSHA excavation regulations, the soil encountered in most of the boring locations would be classified as Type C materials. Excavations in sands, gravels, or silts will likely need to be at gentler inclinations, particularly if the soils are saturated. According to OSHA requirements, any excavation extending to a depth of more than 20 feet must be designed by a registered professional engineer. All excavations for this project are anticipated to be less than 20 feet.

In some areas of the project, existing utility trenches and existing substructures could contain crushed limestone or other types of granular bedding and backfill. It is possible that such granular materials are saturated and will be unstable when excavating through or adjacent to them. Undermining of adjacent utilities and structures could occur due to flowing and caving of the granular bedding and backfill, along with any overlying soil. A properly designed retention system, underpinning, or other suitable means of support should be used to maintain the integrity of nearby utilities and other structures.

It is anticipated that groundwater encountered in the site excavations can be controlled by a sump and pump arrangement in most situations. The sump and pump should be of large enough size to handle a high volume of flow that could be encountered if water-bearing zones of soil with significant granular content are intersected. Surface water should be routed away from the top of the excavations and prevented from flowing into the excavations.

Worker safety and classification of the excavation classifications are ultimately the responsibility of the contractor. Where the excavation lies within the zone of influence of existing pavements, buildings, slabs, utilities, or other structures, the integrity of those elements must be maintained by a properly designed earth retention system, underpinning, or other suitable means.

5.4 Temporary Sheet piling and Soil Retention

As full closures with detours are anticipated for this project, temporary shoring may or may not be required at the proposed structures during construction. The IDOT Temporary Sheet Piling Design Guide and Charts should be used for a Cantilevered Sheet Piling System. If the necessary retained heights exceed what is feasible according to the design guide, the design charts will no longer be feasible and a soil retention system will be required. An Illinois-licensed structural engineer is required to seal the design of the temporary soil retention system, if deemed necessary.

It should be noted, that dense to very dense granular materials with blow counts up to 72 bpf are present at the abutment locations, and denser granular materials are present throughout the river channel. These very-dense granular materials may impact the embedment depths of a driven sheet pile system.

5.5 Drilled Shaft Construction

Drilled shaft construction should be performed in accordance with Section 516 of the IDOT Standard Specifications for Road and Bridge Construction. It is recommended that drilled shaft construction be performed by an experienced, knowledgeable contractor familiar with the conditions in the project area. Based on the locations of the drilled shafts in the river and presence of large gravel and potential boulders, seepage and caving of the drilled pier excavations could be problematic without appropriate planning. The contractor should be prepared to handle water seepage and sloughing of the walls. The use of permanent casing construction methods will likely to be required at all the pier locations.

Shafts should be cast the same day drilled to reduce the potential for bearing surface deterioration and caving. For stable, relatively dry holes, the base of each shaft excavation should be pumped as necessary to prevent the accumulation of water. For relatively dry holes, the concrete may be placed by central drop free-fall using a funnel. The concrete should be vibrated near the surface to obtain a consolidated placement. Concrete should be placed by tremie methods when more than two inches of water is present in the excavation.

Due to the presence of granular materials that may include cobbles and boulders, the contractor should anticipate some challenges while drilling the shaft excavations. There is also potential for encountering significantly hard rock prior to reaching final depth. In addition, an approximate 2.25-foot-thick dolomite capstone was encountered in SB-1 during the subsurface exploration. There is potential for encountering additional locations where the capstone is present.

It is important that the shaft excavations be observed by a competent geotechnical representative before being filled with concrete to verify the bearing conditions. During concrete placement, the geotechnical representative would also observe for proper placement to reduce the potential for voids or soil intrusion into the concrete.

6.0 Closing

This report has been prepared for the exclusive use of Quigg Engineering, Inc. and the Illinois Department of Transportation for use in the design and construction of the proposed new structure carrying IL 75 over the Rock River in Winnebago County, Illinois. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made to the professional advice and recommendations included herein. This report is not for use by parties other than those named or for purposes other than those stated herein. It may not contain sufficient information for the use of other parties or for other purposes.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed by Millennia to determine the applicability of the analyses and recommendations considering the changed conditions and time lapse. The report should also be reviewed by Millennia if changes occur in structure locations, sizes, and types, or in the planned loads, elevations, grading plans, and project concepts.

These analyses and recommendations are based on data obtained from site reconnaissance, the borings performed for this study and other pertinent information presented herein. This report does not reflect any variations between, beyond, or below the borings. Should such variations become evident, it may be necessary to re-evaluate the recommendations of this report after performing on-site observation during the construction period and noting the characteristics of any such variation.

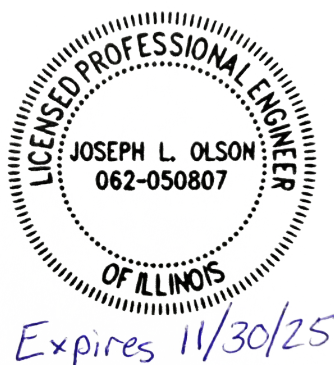
We appreciate this opportunity to be of service to you and would be pleased to discuss any aspect of this report with you at your convenience.

Sincerely,

Millennia Professional Services, Ltd.



Joseph L. Olson, P.E.
Senior Geotechnical Engineer



Appendix A: Vicinity Map and Boring Location Plan



Millennia Professional Services

11 Executive Drive #12, Fairview Heights, IL

Phone: (618) 624-8610

Fax: (618) 624-8611

Project No.: MG21035

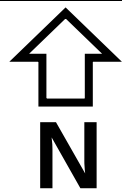
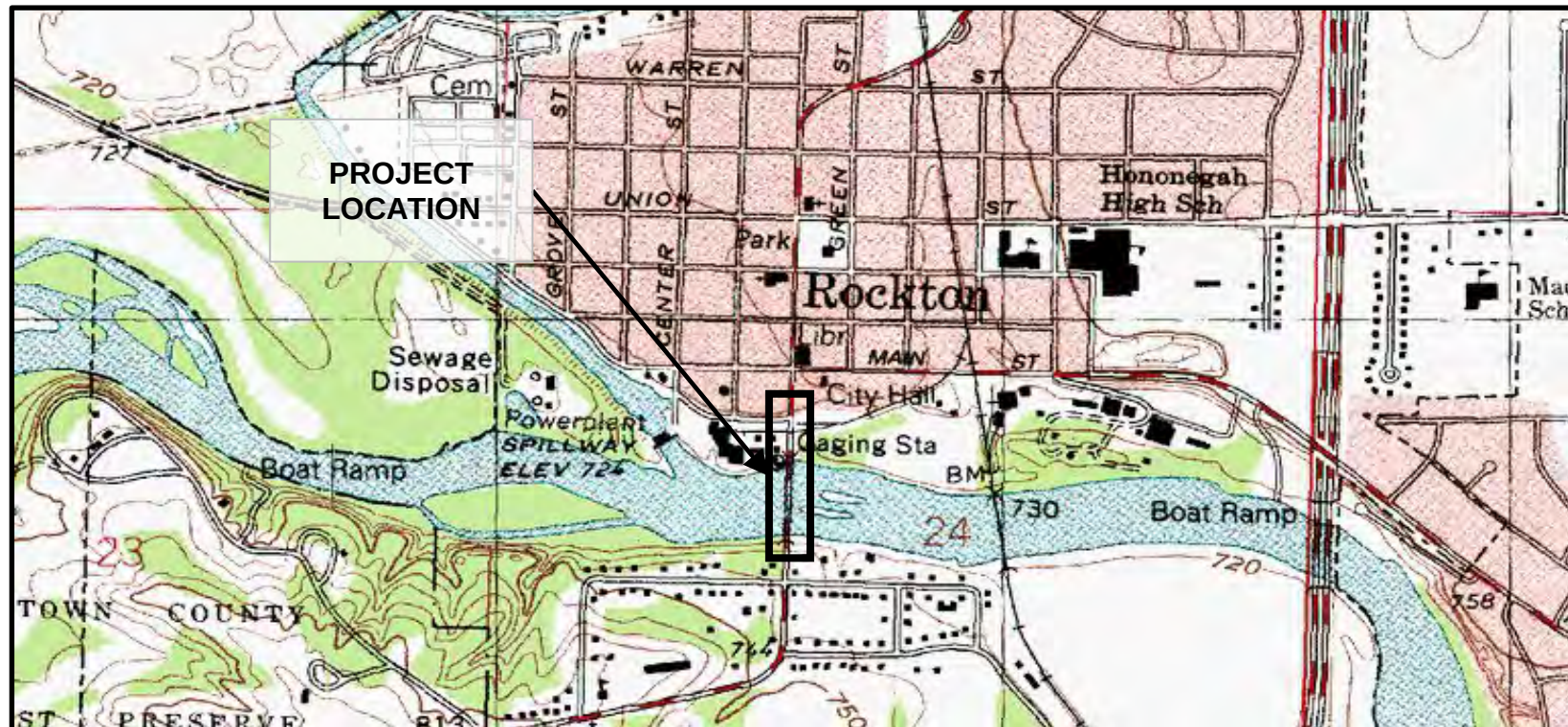


Image obtained from MyTopo

*Not to scale

FIGURE 1: VICINITY MAP

**IL-75 over Rock River
Rockton, Illinois**

Drawn by:

B. Fisher

Checked by:

C. Graham

Project No.:

MG21035

Date:

8/10/2021



Millennia Professional Services

2600 Warrenville Rd #203, Downers Grove, IL 60515

Phone: (618) 624-8610

Fax: (618) 624-8611

Project No.: MG21035



FIGURE 2.1: BORING LOCATION PLAN

IL-75 over Rock River
Rockton, Illinois

Approximate
Boring Location:



Image obtained from Google Earth

*Not to scale

Drawn by:

B. Fisher

Checked by:

J. Olson

Project No.:

MG21035

Date:

7/24/2024



Millennia Professional Services

2600 Warrenville Rd #203, Downers Grove, IL 60515

Phone: (618) 624-8610

Fax: (618) 624-8611

Project No.: MG21035

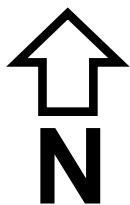


FIGURE 2.2: BORING LOCATION PLAN

IL-75 over Rock River
Rockton, Illinois

Approximate
Boring Location:



Image obtained from Google Earth

*Not to scale

Drawn by:

B. Fisher

Checked by:

J. Schaeffer

Project No.:

MG21035

Date:

8/10/2021



Millennia Professional Services

2600 Warrenville Rd #203, Downers Grove, IL 60515

Phone: (618) 624-8610

Fax: (618) 624-8611

Project No.: MG21035

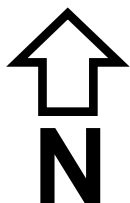


FIGURE 2.3: BORING LOCATION PLAN

IL-75 over Rock River
Rockton, Illinois

Approximate
Boring Location:



Image obtained from Google Earth

*Not to scale

Drawn by:

B. Fisher

Checked by:

J. Schaeffer

Project No.:

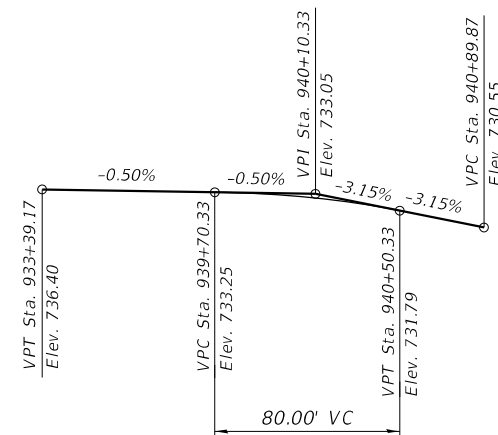
MG21035

Date:

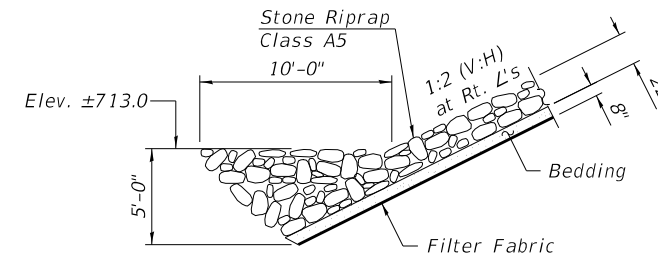
8/10/2021

Appendix B: Existing Structure Plans and Proposed Structure Drawing

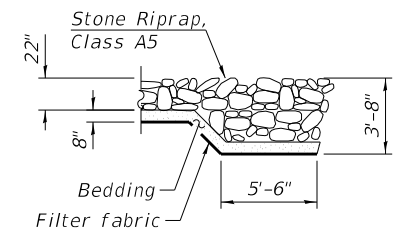
Salvage: The three commemorative plaques located at the sidewalk bump out on the west side of the bridge, the Illinois Benchmark Sediment Monitoring Station, and the US Geological Survey Flow Monitoring Device will be salvaged and placed on the new structure.



PROFILE
(Along & IL-75)



SECTION A-A



SECTION B-B

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design
Specifications, 9th Edition

LOADING HL-93

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

LIVE LOAD DEFLECTION

$$\Delta LL+I = Span Length/1000$$

DESIGN STRESSES

FIELD UNITS

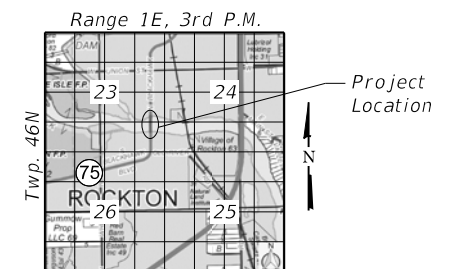
$f'_c = 3,500 \text{ psi}$
 $f'_c = 4,000 \text{ psi}$ (Superstructure)
 $f_y = 60,000 \text{ psi}$ (Reinforcement)
 $f_y = 50,000 \text{ psi}$ (M270 Grade 50) *

HIGHWAY CLASSIFICATION

FAP Route 505 – IL-75
Functional Class: Minor Arterial
ADT: 7,750 (2021), 7,828 (2046)
ADTT: 543 (2021), 548 (2046)
DHV: 905 (Two-Way)
Design Speed: 35 m.p.h.
Posted Speed: 30 m.p.h.
2-Way Traffic
Directional Distribution: 50:50

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.053g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.091g
Soil Site Class = C



LOCATION SKETCH

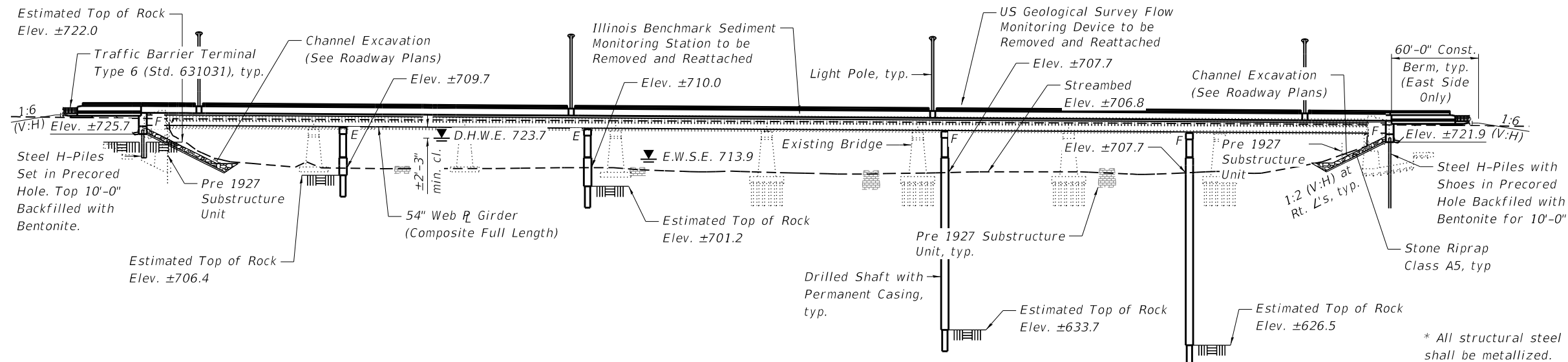
GENERAL PLAN & ELEVATION
IL ROUTE 75 OVER ROCK RIVER
(PUBLIC WATERS)

FAP ROUTE 505 - SECTION 77BR

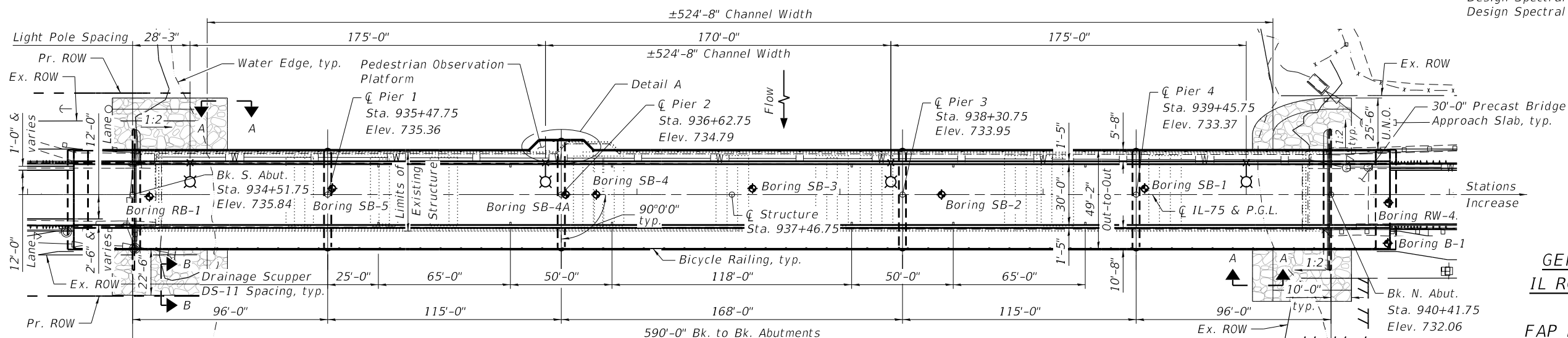
WINNEBAGO COUNTY

STATION 937+46.75

STRUCTURE NUMBER 101-0230

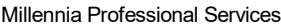


ELEVATION



PLAN

Appendix C: Soil Profile



CLIENT Quigg Engineering

PROJECT NUMBER MG21035

SUBSURFACE DIAGRAM
IL 75 over Rock River (IDOT Abutment Borings)

PROJECT NAME IL 75 over Rock River

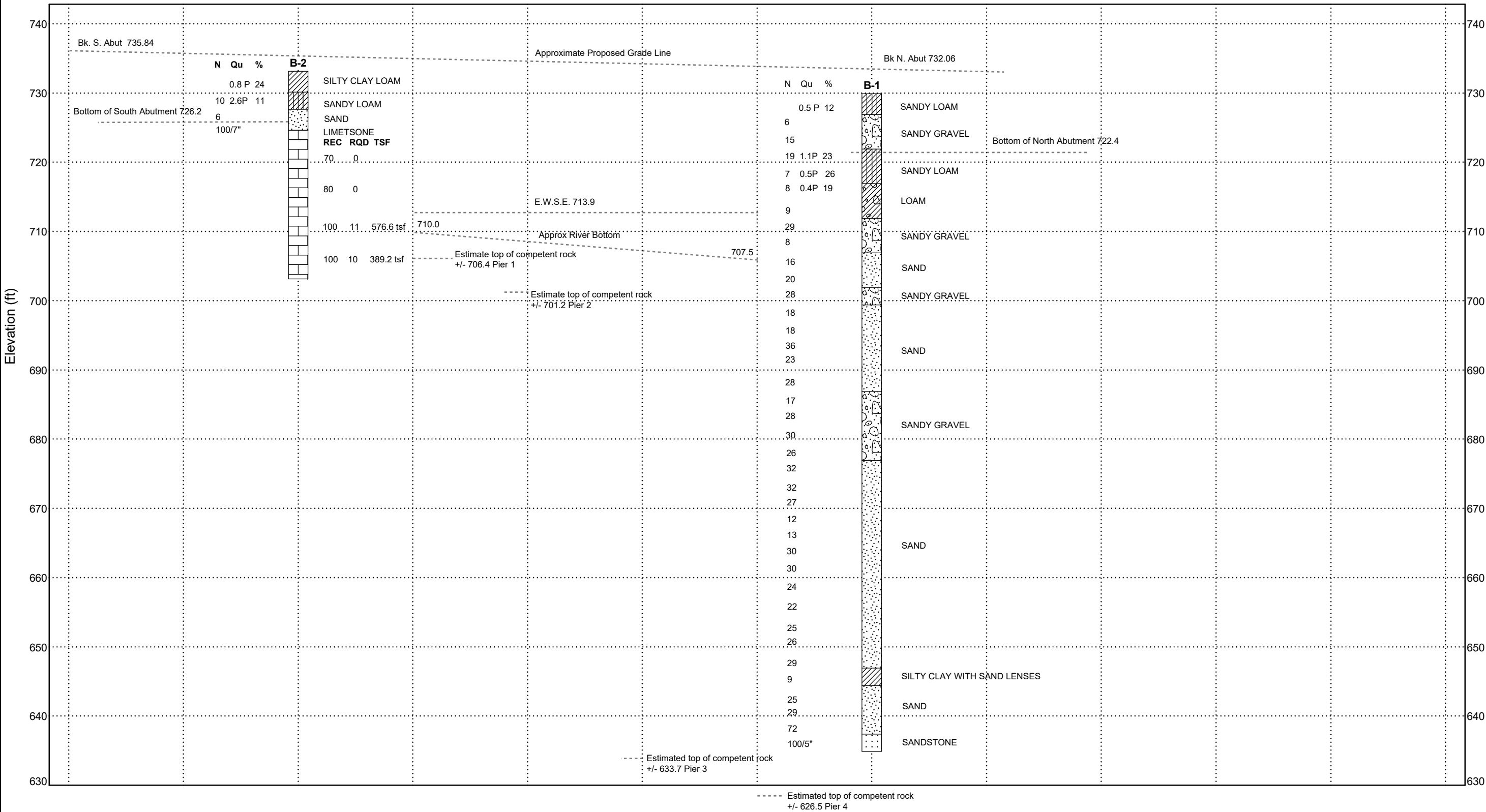
PROJECT LOCATION Winnebago County, Illinois

 SANDY LOAM
 SAND
 LIMESTONE

 SANDY GRAVEL

 SILTY CLAY

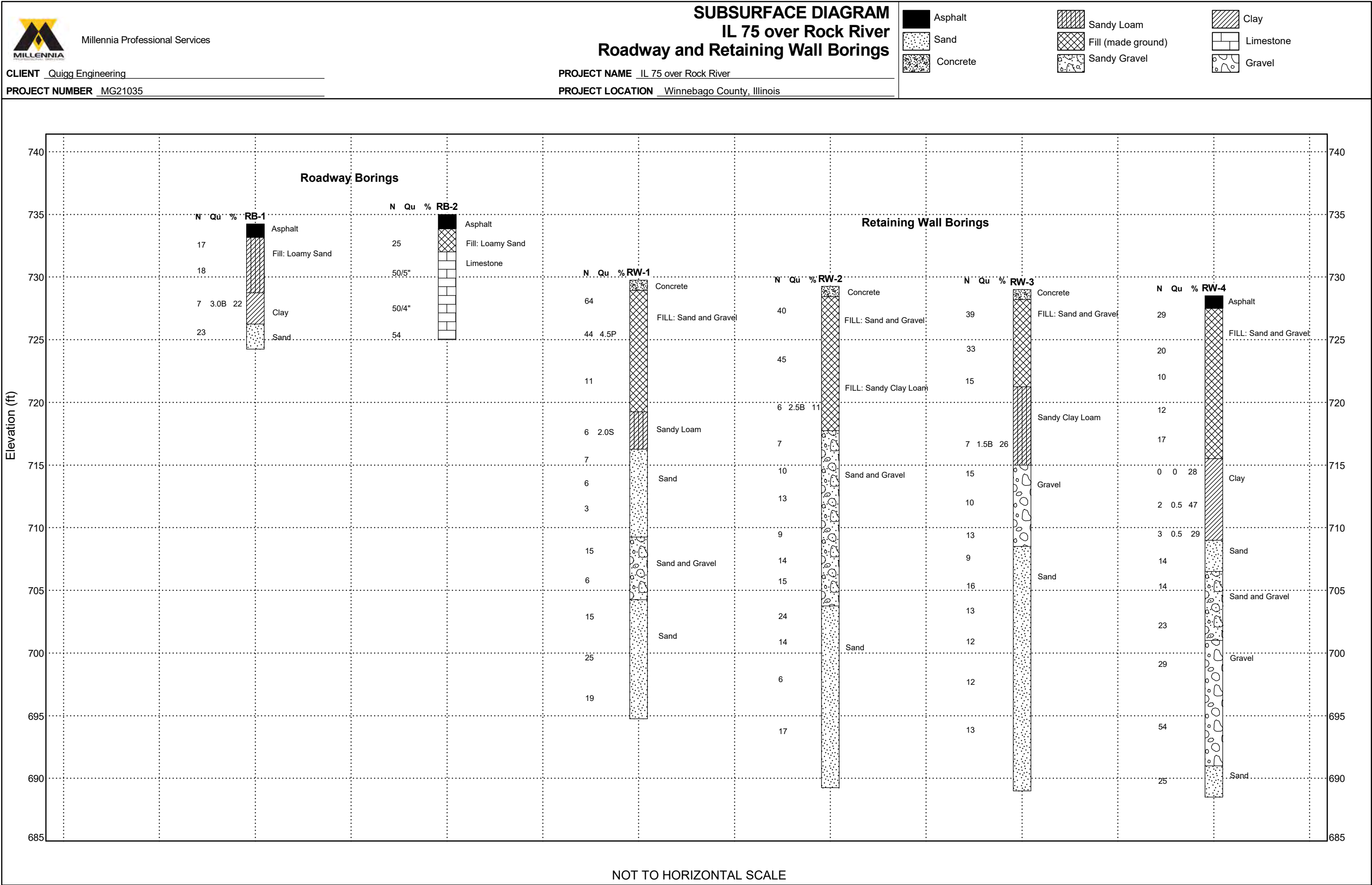
 LOAM
 SANDSTONE



NOT TO HORIZONTAL SCALE

STRATIGRAPHY & GW - B SIZE - GINT STD US LAB.GDT - 6/21/23 12:31 - G:\PROJECT FILES\2021\MG21035 PTB 195-029 IL-75 OVER ROCK RIVER - PH I\FIELD DATA\DOT DRILLED BORING FOR SOIL PROFILE.GPJ

STRATIGRAPHY & GW - B SIZE - GINT STD US LAB.GDT - 6/21/23 15:25 - G:\PROJECT FILES\2021\MG21035 PTB 195-029 IL-75 OVER ROCK RIVER - PH I\FIELD DATA\DOT DRILLED BORING FOR SOIL PROFILE.GPJ



Appendix D: Boring Logs

RB-1

SOIL BORING LOG

Sheet 1 of 1

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE CME-55
DRILLING METHOD Continuous Flight Auger HAMMER TYPE Automatic EFFICIENCY _____

BORING NO.	RB-2	E L E V	D E P T H	B L O W S	U C S Qu	M O I S T	Surface Water Elev.	_____	ft	E L E V	D E P T H	B L O W S	U C S Qu	M O I S T		
	Station						933+50 (approx)	Stream Bed Elev.	_____						ft	
	Offset						1	ft West	Groundwater Elev.:							
	Northing						42°26'55.96"	First Encounter	_____						N/E	ft
	Easting						89° 4'20.83"	Upon Completion	_____						Dry	ft
	Ground Surface Elev.	735.00	ft				After _____ Hrs.	_____	ft							
LITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)	LITHOLOGY			(ft)	(ft)	(/6")	(tsf)	(%)		
ASPHALT (14.0")																
	733.80		6													
FILL: Brown and grey, LOAMY SAND, medium-dense, dry, with gravel			13													
			12													
	732.00															
Tan LIMESTONE, highly weathered			50/5"													
		-5								-25						
			50/4"													
						</										

RW-1
SOIL BORING LOG

Sheet 1 of 1

COUNTY Winnebago
SECTION 77BR
ROUTE IL-75
JOB NO. MG21035
DATE 7/7/2021

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE CME-55
DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic EFFICIENCY

BORING NO.	RW-1	E	D	B	U	M	Surface Water Elev.	ft	E	D	B	U	M
Station	942+10 (approx)	L	E	L	C	O	Stream Bed Elev.	ft	E	E	P	L	O
Offset	4 ft East	V	T	W	S	I	Groundwater Elev.:		V	H	S	Qu	S
Northing	42°27'4.28"						First Encounter	713.8 ft					
Easting	89° 4'21.41"						Upon Completion	715.8 ft					
Ground Surface Elev.	729.75 ft						After	Hrs.					
		(ft)	(ft)	(/6")	(tsf)	(%)			(ft)	(ft)	(/6")	(tsf)	(%)
LITHOLOGY							LITHOLOGY						
CONCRETE (9.75")	728.95							709.25					
FILL: Brown, SAND AND GRAVEL, dense to very-dense, dry, with crushed rock				28			Brown, SAND AND GRAVEL, loose to medium-dense, with trace shell fragments				4		
				30							7		
				34							8		
				18							2		
				28	>4.5						2		
				16	S						4		
				-5									
								704.25					
- trace brick fragments below 6.0 ft.				12			Brown, SAND, fine- to coarse-grained, medium-dense, with trace gravel and shell fragments				3		
				7							5		
				4							10		
							- coarse-grained from 28.5 to 30.0 ft.				5		
											10		
				-10							15		
	719.25												
FILL: Brown, SANDY LOAM, medium-stiff, dry, with trace organics				1									
				3	2.0								
				3	S								
	716.50												
Brown, SAND, fine- to medium-grained, loose, moist to wet, with trace shell fragments				2							6		
				3							7		
				4							12		
				-15									
								694.75					
							End of Boring						
				1									
				1									
				5									
				1									
				1									
				2									
				-20									

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

RW-2
SOIL BORING LOG

Sheet 1 of 1

COUNTY Winnebago
SECTION 77BR
ROUTE IL-75
JOB NO. MG21035
DATE 7/8/2021

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE CME-55
DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic EFFICIENCY

BORING NO.	RW-2	E	D	B	U	M	Surface Water Elev.	ft	E	D	B	U	M
Station	941+70 (approx)	L	E	L	C	O	Stream Bed Elev.	ft	L	E	L	C	O
Offset	4 ft East	E	P	O	S	I	Groundwater Elev.:		E	P	O	S	I
Northing	42°27'3.80"	V	T	W	Qu	S	First Encounter	713.3 ft	V	T	W	Qu	S
Easting	89° 4'21.40"	H	S				Upon Completion	714.3 ft	H	S			
Ground Surface Elev.	729.25 ft						After	Hrs.					
		(ft)	(ft)	(/6")	(tsf)	(%)			(ft)	(ft)	(/6")	(tsf)	(%)
LITHOLOGY							LITHOLOGY						
CONCRETE (9.75")	728.45						Grey to brown, SAND AND GRAVEL, loose to medium-dense, moist to wet, with trace cobbles and shell fragments (continued)				8		
FILL: Tan to grey, GRAVEL AND SAND, dense, dry, with trace crushed rock				18							7		
				18							7		
				22									
				20							4		
				25							7		
				20							8		
				-5							-25		
	723.75												
FILL: Tan to grey, SANDY CLAY LOAM, medium-stiff, dry, with trace brick fragments							Brown, SAND, fine- to coarse-grained, loose to medium-dense, with trace gravel, cobbles, and shell fragments				8		
											11		
											13		
				3							5		
				2	2.5	11					7		
				4	B						7		
				-10							-30		
				2									
	717.75			3									
Grey to brown, SAND AND GRAVEL, loose to medium-dense, moist to wet, with trace cobbles and shell fragments				4									
				5							4		
				5							3		
				5							3		
				-15							-35		
				3									
				7									
				6									
				4							3		
				4							7		
				5							10		
				-20							-40		

End of Boring

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

Printed 9/8/2021

RW-3 SOIL BORING LOG

Sheet 1 of 1

COUNTY	Winnebago
SECTION	77BR
ROUTE	IL-75
JOB NO.	MG21035
DATE	7/8/2021

DESCRIPTION	IL-75 over Rock River	DISTRICT	2		
LOCATION	Rockton, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	Testing Service Corporation	LOGGED BY	B. Fisher	RIG TYPE	CME-55
DRILLING METHOD	Hollow Stem Auger	HAMMER TYPE	Automatic	EFFICIENCY	

BORING NO.	RW-3	E	D	B	U	M	Surface Water Elev.	_____ ft	E	D	B	U	M
Station	941+20 (approx)	L	E	L	C	O	Stream Bed Elev.	_____ ft	L	E	L	C	O
Offset	4 ft East	E	P	O	S	I	Groundwater Elev.:		E	P	O	S	I
Northing	42°27'3.31"	V	T	W		S	First Encounter	713.0 ft▼	V	T	W		S
Easting	89° 4'21.39"		H	S	Qu	T	Upon Completion	714.0 ft▽		H	S	Qu	T
Ground Surface Elev.	729.00 ft						After _____ Hrs.	_____ ft					
UTLITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)	UTLITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)

LITHOLOGY		(ft)	(ft)	(/6")	(tst)	(%)	LITHOLOGY		(ft)	(ft)	(/6")	(tst)	(%)
CONCRETE (9.75")													
			728.20						708.50				
FILL: Brown to grey, SAND AND GRAVEL, dense, dry, with trace crushed rock				20			Brown, SAND, fine- to coarse-grained, loose to medium-dense, with trace gravel and shell fragments				4		
				18							3		
				21							6		
				7			- medium- to coarse-grained below 23.5 ft.				5		
				14							7		
		-5		19					-25		9		
				10							5		
				8							5		
				7							8		
			721.25										
Black, SANDY CLAY LOAM, medium-stiff, dry, with trace gravel							- fine- to coarse-grained below 28.5 ft.				4		
											5		
		-10							-30		7		
				3									
				2	1.5	26							
				5	B								
			715.00	2							5		
Brown, GRAVEL, loose to medium-dense, with trace sand				5							5		
		▽ -15		10					-35		7		
		▼											
				3									
				5									
				5									
				5			- medium- to coarse-grained below 38.5 ft.				5		
				6							5		
				7							8		
		-20							689.00	-40			

End of Boring

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

Printed 9/8/2021

RW-4
SOIL BORING LOG

Sheet 1 of 1

COUNTY Winnebago
SECTION 77BR
ROUTE IL-75
JOB NO. MG21035
DATE 7/8/2021

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE CME-55
DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic EFFICIENCY _____

BORING NO.	RW-4	E L E V	D E P T H	B L O W S	U C S	M O I S T	Surface Water Elev.	ft	E L E V	D E P T H	B L O W S	U C S	M O I S T
Station	940+70 (approx)						Stream Bed Elev.	ft					
Offset	4 ft East						Groundwater Elev.:						
Northing	42°27'2.85"						First Encounter	709.0 ft▼					
Easting	89° 4'21.39"						Upon Completion	708.5 ft▽					
Ground Surface Elev.	728.50 ft		After ____ Hrs.	ft									
LITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)	LITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)
ASPHALT (12.0")							Grey, SAND, fine- to coarse-grained, medium-dense, with trace gravel and shell fragments (continued)						
727.50											8		
FILL: Grey to brown, SAND AND GRAVEL, loose to medium-dense, dry, with trace crushed rock				25							7		
				14				706.50			7		
				15			Red to brown, SAND AND GRAVEL, medium-dense, with trace crushed rock				4		
				4							4		
				7							5		
				-5							9		
				5							16		
				5							13		
				5				701.00			10		
							Brown, GRAVEL, medium-dense to very dense, with trace coarse sand				10		
				6									
				6							13		
				-10							16		
				7									
				8									
				9									
715.50													
Dark grey to black, CLAY, very-soft, moist, with trace sand and shell fragments				0							23		
				0	0.0	28					27		
				-15							27		
				0									
				1	0.5	47							
				1	B								
- trace coal fragments and an organic odor below 18.0 ft.								691.00					
				1							7		
709.00▼				1	0.5	29					8		
				2	B						16		
				-20									
			</										

End of Boring

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

SB-1
SOIL BORING LOG
Sheet 1 of 3

COUNTY Winnebago
SECTION 77BR
ROUTE IL-75
JOB NO. MG21035
DATE 7/15/2021

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE GP-750C
DRILLING METHOD 4" Drill Casing HAMMER TYPE Cathead EFFICIENCY _____

BORING NO.		SB-1	E L E V	D E P T H	B L O W S	U C S Qu	M O I S T	Surface Water Elev. 19.25 ft			E L E V	D E P T H	B L O W S	U C S Qu	M O I S T	
Station		939+50 (approx)						Stream Bed Elev. 23.00 ft								
Offset		3 ft West						Groundwater Elev.:								
Northing		42°27'1.91"						First Encounter ft								
Easting		89° 4'20.77"						Upon Completion ft								
Ground Surface Elev.		730.50 ft						After ____ Hrs. ft								
LITHOLOGY			(ft)	(ft)	(/6")	(tsf)	(%)	LITHOLOGY			(ft)	(ft)	(/6")	(tsf)	(%)	
ASPHALT (1.0")			730.40													
CONCRETE (7.5")			729.80													
- 0.75" rebar at 0.25 ft.																
- 0.75" rebar at 0.5 ft.																

SB-1
SOIL BORING LOG

Sheet 2 of 3

COUNTY Winnebago
SECTION 77BR
ROUTE IL-75
JOB NO. MG21035
DATE 7/15/2021

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE GP-750C
DRILLING METHOD 4" Drill Casing HAMMER TYPE Cathead EFFICIENCY _____

BORING NO. <u>SB-1</u>	E	D	B	U	M	Surface Water Elev. <u>19.25 ft</u>	E	D	B	U	M
Station <u>939+50 (approx)</u>	L	E	L	C	O	Stream Bed Elev. <u>23.00 ft</u>	L	E	L	C	O
Offset <u>3 ft West</u>	E	P	O	S	I	Groundwater Elev.: _____	E	P	O	S	I
Northing _____	V	T	W	Qu	S	First Encounter _____ ft	V	T	W	Qu	S
Easting _____	H	H	S		T	Upon Completion _____ ft	H	H	S		T
Ground Surface Elev. <u>730.50 ft</u>						After _____ Hrs. _____ ft					
LITHOLOGY	(ft)	(ft)	(/6")	(tsf)	(%)	LITHOLOGY	(ft)	(ft)	(/6")	(tsf)	(%)
Grey, SAND, medium- to coarse-grained, medium-dense to dense, with trace gravel			6			Grey, SAND, medium- to coarse-grained, medium-dense to dense, with trace gravel (continued)					
			11					14			
			8					12			
			8					14			
			13								
- fine- to coarse-grained below 44.0 ft.	-45		11				-65				
			10								
			10					30			
			10					42			
			15					50/5"			
			17								
	-50		10				-70				
			11								
			10					33			
			10					27			
			15					24			
	-55						-75				
			20					27			
			32					40			
			41					42			
	-60						-80				

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

SB-1
SOIL BORING LOG

Sheet 3 of 3

COUNTY Winnebago
SECTION 77BR
ROUTE IL-75
JOB NO. MG21035
DATE 7/15/2021

DESCRIPTION IL-75 over Rock River DISTRICT 2
LOCATION Rockton, Illinois CONSULTANT Millennia Professional Services
DRILLED BY Testing Service Corporation LOGGED BY B. Fisher RIG TYPE GP-750C
DRILLING METHOD 4" Drill Casing HAMMER TYPE Cathead EFFICIENCY _____

BORING NO.	SB-1	E L E V	D E P T H	B L O W S	U C S Qu	M O I S T	Surface Water Elev.	19.25	ft	E L E V	D E P T H	B L O W S	U C S Qu	M O I S T
	Station						939+50 (approx)							
	Offset						3	ft	West					
	Northing													
	Easting													
Ground Surface Elev.		730.50	ft				Groundwater Elev.:		ft					
							First Encounter		ft					
							Upon Completion		ft					
							After _____ Hrs.		ft					
LITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)	LITHOLOGY			(ft)	(ft)	(/6")	(tsf)	(%)
Grey, SAND, medium- to coarse-grained, medium-dense to dense, with trace gravel <i>(continued)</i> - medium- to coarse-grained below 81.5 ft.							COBBLES AND BOULDERS <i>(continued)</i>							
							626.50							
		645.25	-85				Borehole continued with rock coring.							
Grey, SANDY CLAY LOAM, very stiff										-105				
												</		



Rock Core Photographs
IL-75 over Rock River
Project No.: MG21035
Boring: SB-1

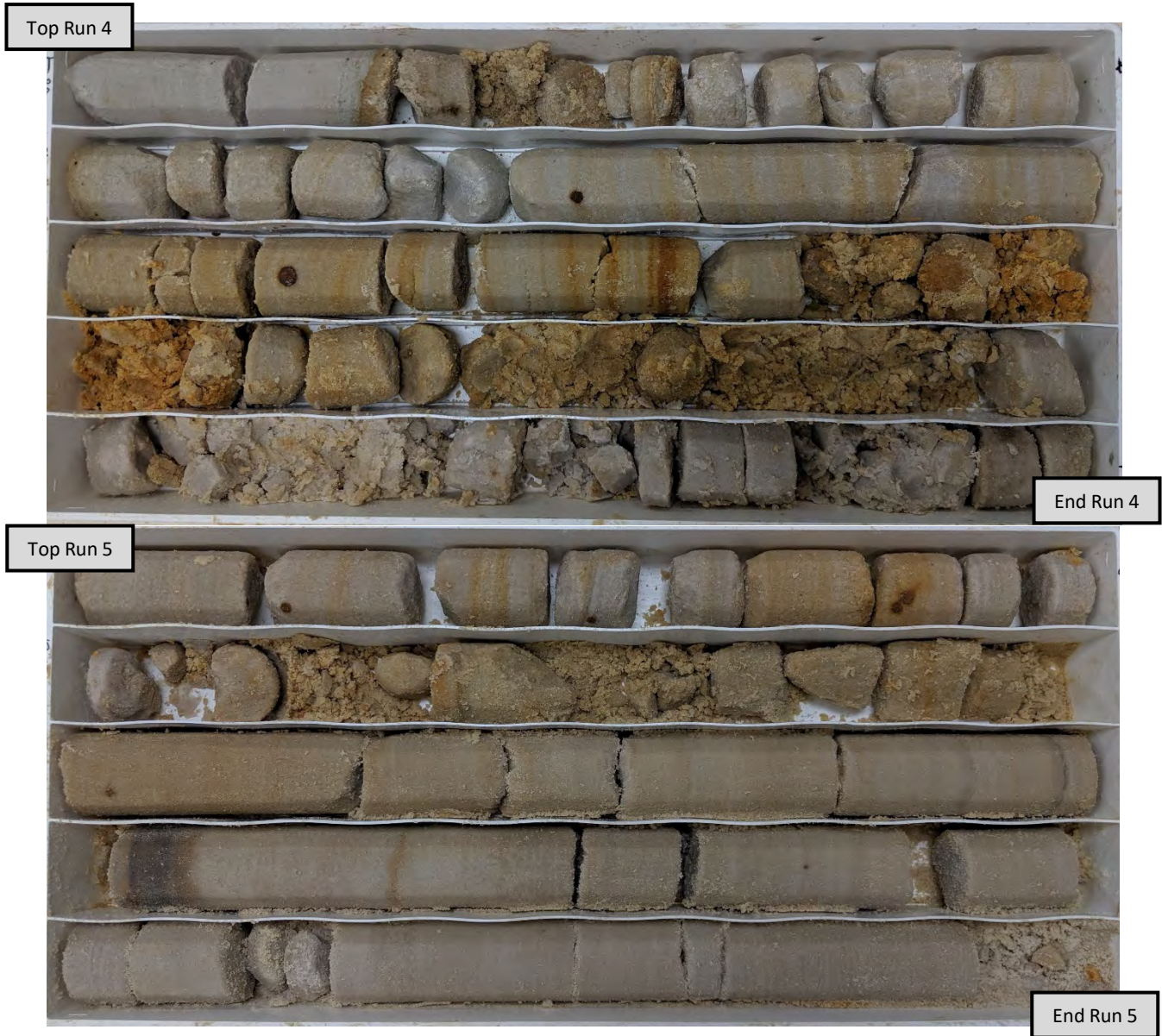
BOULDERS AT BORING SB-1



Run	Depth (ft.)	Recovery (%)	RQD (%)
1	95.0-97.0	45	-
2	97.0-99.0	30	-
3	99.0-104.0	65	-



Rock Core Photographs
IL-75 over Rock River
Project No.: MG21035
Boring: SB-1



Run	Depth (ft.)	Recovery (%)	RQD (%)
4	104.0-114.0	77	12
5	114-124.0	80	48

SB-2 SOIL BORING LOG

Sheet 1 of 3

COUNTY	Winnebago
SECTION	77BR
ROUTE	IL-75
JOB NO.	MG21035
DATE	7/22/2021

DESCRIPTION	IL-75 over Rock River	DISTRICT	2		
LOCATION	Rockton, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	Testing Service Corporation	LOGGED BY	B. Fisher	RIG TYPE	GP-750C
DRILLING METHOD	4" Drill Casing	HAMMER TYPE	Cathead	EFFICIENCY	

BORING NO.	SB-2	E	D	B	U	M	Surface Water Elev.	19.60	ft	E	D	B	U	M
Station	938+50 (approx)	L	E	L	C	O	Stream Bed Elev.	23.50	ft	L	E	L	C	O
Offset	ft	E	P	O	S	I	Groundwater Elev.:			E	P	O	S	I
Northing	42°27'0.78"	V	T	W		S	First Encounter	ft		V	T	W		S
Easting	89° 4'21.03"		H	S	Qu	T	Upon Completion	ft			H	S	Qu	T
Ground Surface Elev.	732.25 ft						After _____ Hrs.	ft						
		(ft)	(ft)	((/6"))	(tsf)	(%)				(ft)	(ft)	((/6"))	(tsf)	(%)
	LITHOLOGY							LITHOLOGY						

[illegible]

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

Printed 9/8/2021

SB-2 SOIL BORING LOG

Sheet 2 of 3

COUNTY	Winnebago
SECTION	77BR
ROUTE	IL-75
JOB NO.	MG21035
DATE	7/22/2021

DESCRIPTION	IL-75 over Rock River	DISTRICT	2		
LOCATION	Rockton, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	Testing Service Corporation	LOGGED BY	B. Fisher	RIG TYPE	GP-750C
DRILLING METHOD	4" Drill Casing	HAMMER TYPE	Cathead	EFFICIENCY	

BORING NO.	SB-2	E	D	B	U	M	Surface Water Elev.	19.60 ft	E	D	B	U	M
Station	938+50 (approx)	L	E	L	C	O	Stream Bed Elev.	23.50 ft	L	E	L	C	O
Offset	ft	E	P	O	S	I	Groundwater Elev.:		E	P	O	S	I
Northing		V	T	W		S	First Encounter	ft	V	T	W		S
Easting			H	S	Qu	T	Upon Completion	ft		H	S	Qu	T
Ground Surface Elev.	732.25 ft						After _____ Hrs.	ft					
	(ft)	(ft)	(/6")	(tsf)	(%)				(ft)	(ft)	(/6")	(tsf)	(%)
	LITHOLOGY							LITHOLOGY					

[illegible]

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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SB-2 SOIL BORING LOG

Sheet 3 of 3

COUNTY	Winnebago
SECTION	77BR
ROUTE	IL-75
JOB NO.	MG21035
DATE	7/22/2021

DESCRIPTION	IL-75 over Rock River	DISTRICT	2		
LOCATION	Rockton, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	Testing Service Corporation	LOGGED BY	B. Fisher	RIG TYPE	GP-750C
DRILLING METHOD	4" Drill Casing	HAMMER TYPE	Cathead	EFFICIENCY	

BORING NO.	SB-2
Station	938+50 (approx)
Offset	ft
Northing	
Easting	
Ground Surface Elev.	732.25 ft

ELEV	DEPTH	BLOSS	UCS	MOST
(ft)	(ft)	(/6")	(tsf)	(%)

Surface Water Elev.	19.60	ft
Stream Bed Elev.	23.50	ft
Groundwater Elev.:		
First Encounter		ft
Upon Completion		ft
After Hrs.		ft

LITHOLOGY	(ft)	(ft) (/6")	(tst)	(%)
Grey, SAND, fine- to coarse-grained, loose to medium-dense, with trace gravel and shell fragments (<i>continued</i>)	-85 645.75	16 14 16		
Grey, SAND AND GRAVEL, very dense, with trace rock fragments	-90 637.25	43 31 23		
Brown to white, WEATHERED SANDSTONE, very dense	-95 633.75	50/5"		
Borehole continued with rock coring.	-100			

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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ROCK CORE LOG

Page 1 of 1

Date 7/22/21

ROUTE IL-75 DESCRIPTION IL-75 over Rock River LOGGED BY B. Fisher

SECTION 77BR LOCATION Rockton, Illinois, SEC. , TWP. , RNG. ,
Latitude , Longitude

COUNTY Winnebago CORING METHOD Drill Casing

STRUCT. NO.	MG21035	CORING BARREL TYPE & SIZE	NQ	DEPTH	CORE	RECOVERY	R.Q.D.	CORE TIME	STRENGTH
Station	101-0109	Core Diameter	2 in	(ft)	(#)	(%)	(%)	(min/ft)	(tsf)
BORING NO.	SB-2	Top of Rock Elev.	633.75 ft						
Station	938+50 (approx)	Begin Core Elev.	633.75 ft						
Offset									
Ground Surface Elev.	732.25 ft								

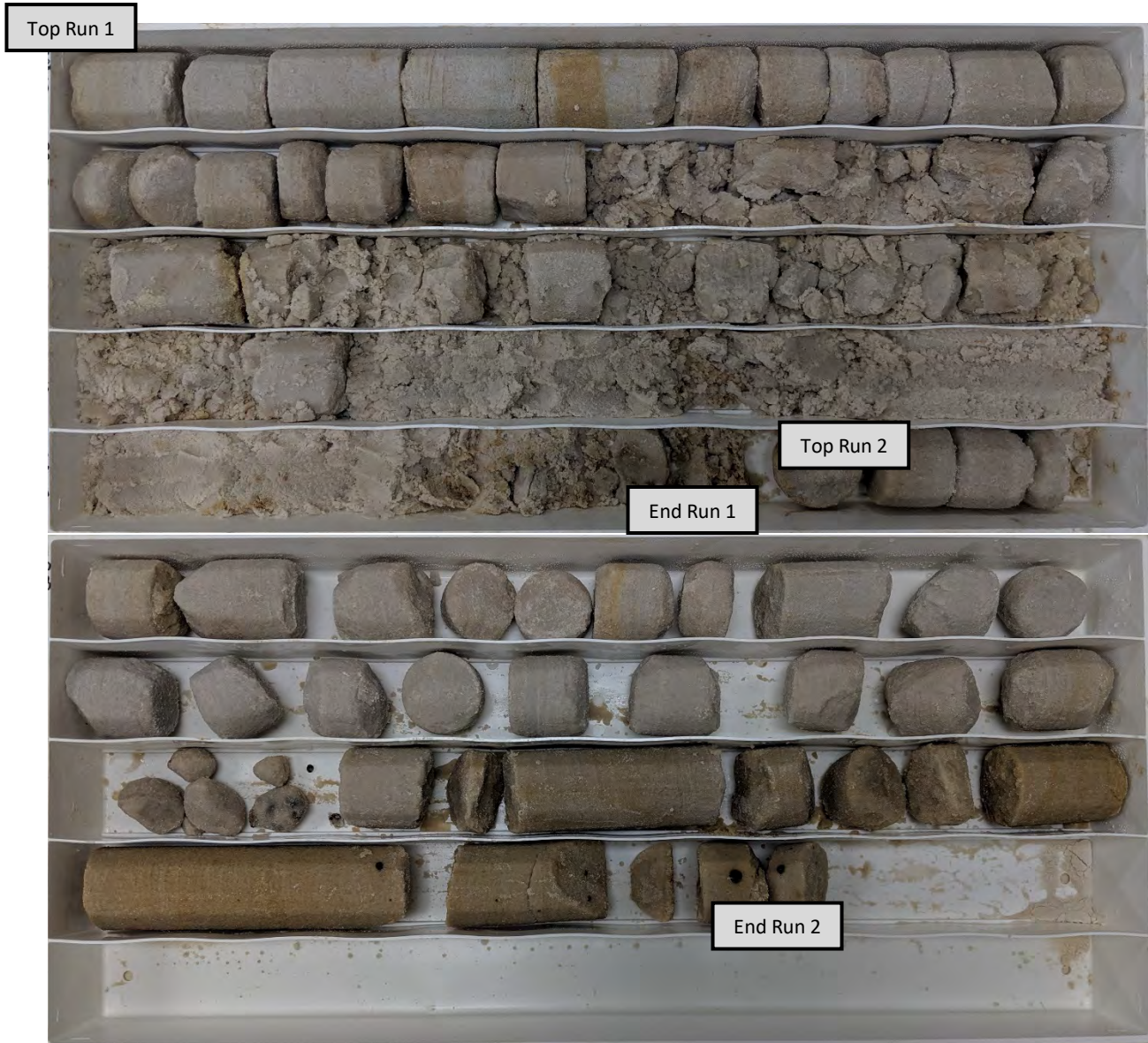
SANDSTONE Moderately to highly weathered, moderately to highly fractured, white, soft, sandy, coarse grained, with tan banding	633.75	1	102	0	1	
	-100					
	-105					
	-110	2	68	15	1	
- trace iron inclusions below 111.5 ft. - tan below 112.0 ft.	-115					
- compressive strength at 114.5 ft. = 77.8 tsf	616.25					77.8
End of Boring						

Color pictures of the cores _____

Cores will be stored for examination until _____

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Rock Core Photographs
 IL-75 over Rock River
 Project No.: MG21035
Boring: SB-2



Run	Depth (ft.)	Recovery (%)	RQD (%)
1	98.5-108.0	89	0
2	108.0-116.0	71	16

SB-3 SOIL BORING LOG



Sheet 2 of 2

BORING NO.	SB-3	E	D	B	U	M	Surface Water Elev.	20.00 ft	E	D	B	U	M
Station	937+50 (approx)	L	E	L	C	O	Stream Bed Elev.	22.50 ft	L	E	L	C	O
Offset	3 ft West	E	P	O	S	I	Groundwater Elev.:		E	P	O	S	I
Northing		V	T	W		S	First Encounter	ft	V	T	W		S
Easting			H	S	Qu	T	Upon Completion	ft		H	S	Qu	T
Ground Surface Elev.	732.25 ft	(ft)	(ft)	(/6")	(tsf)	(%)	After _____ Hrs.	ft	(ft)	(ft)	(/6")	(tsf)	(%)
		LITHOLOGY						LITHOLOGY					

Printed 9/8/2021



SB-4
SOIL BORING LOG
Sheet 1 of 1

BORING NO.	SB-4	E L E V	D E P T H	B L O S S	U C S Qu	M O I S T	Surface Water Elev.	<u>20.40</u>	ft	E L E V	D E P T H	B L O S S	U C S Qu	M O I S T		
Station	<u>936+75 (approx)</u>						Stream Bed Elev.	<u>21.50</u>	ft							
Offset	<u>5</u>						ft north	Groundwater Elev.:								
Northing	<u>42°26'59.10"</u>						First Encounter	<u></u>	ft							
Easting	<u>89° 4'21.06"</u>						Upon Completion	<u></u>	ft							
Ground Surface Elev.	<u>732.25</u>						ft	After _____ Hrs.	<u></u>						ft	
LITHOLOGY		(ft)	(ft)	(/6")	(tsf)	(%)	LITHOLOGY					(ft)	(ft)	(/6")	(tsf)	(%)

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

SB-4A SOIL BORING LOG

ROCK CORE LOG

 Page 1 of 1

 Date 7/23/21

 ROUTE IL-75 DESCRIPTION IL-75 over Rock River LOGGED BY B. Fisher

 SECTION 77BR LOCATION Rockton, Illinois, SEC. , TWP. , RNG. ,
Latitude , Longitude

 COUNTY Winnebago CORING METHOD Drill Casing

STRUCT. NO. <u>MG21035</u>	CORING BARREL TYPE & SIZE <u>NQ</u>	D E P T H (ft)	C O R E (#)	R E C O V E R Y (%)	R · Q · D · (%)	C O R E T I M E (min/ft)	S T R E N G T H (tsf)
Station <u>101-0109</u>							
	Core Diameter <u>2</u> in						
BORING NO. <u>SB-4A</u>	Top of Rock Elev. <u>701.25</u> ft						
Station <u>936+65 (approx)</u>	Begin Core Elev. <u>701.25</u> ft						
Offset <u>13.0 ft South</u>							
Ground Surface Elev. <u>732.25</u> ft							

DOLOMITE Highly weathered, highly fractured, grey to tan, hard, slightly vuggy, slightly pitted - compressive strength at 32.0 ft. = 318.2 tsf	701.25	1	2	0		
		2	2	0		
		3	2	0	2	318.2
		4	3	0	2	
	698.25	5	1	0		
SANDY DOLOMITE Highly weathered, highly fractured, tan, moderately hard, slightly pitted		6	69	30		
	-35					
	694.25					
DOLOMITIC SANDSTONE Highly weathered, highly fractured, tan to orange, moderately hard, pitted, with oxidation stains - compressive strength at 38.5 ft. = 438.5 tsf						438.5
		7	58	22	2	
	-40					
	688.25					293.0
SANDSTONE Moderately to highly weathered, highly fractured, grey to tan to orange, slightly vuggy, with orange banding - compressive strength at 47.25 ft. = 64.8 tsf						
	-45	8	6	0		
		9	6	0		
		10	66	6	3	64.8
	-50					
	681.25					

 End of Boring
 Color pictures of the cores _____

Cores will be stored for examination until _____

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

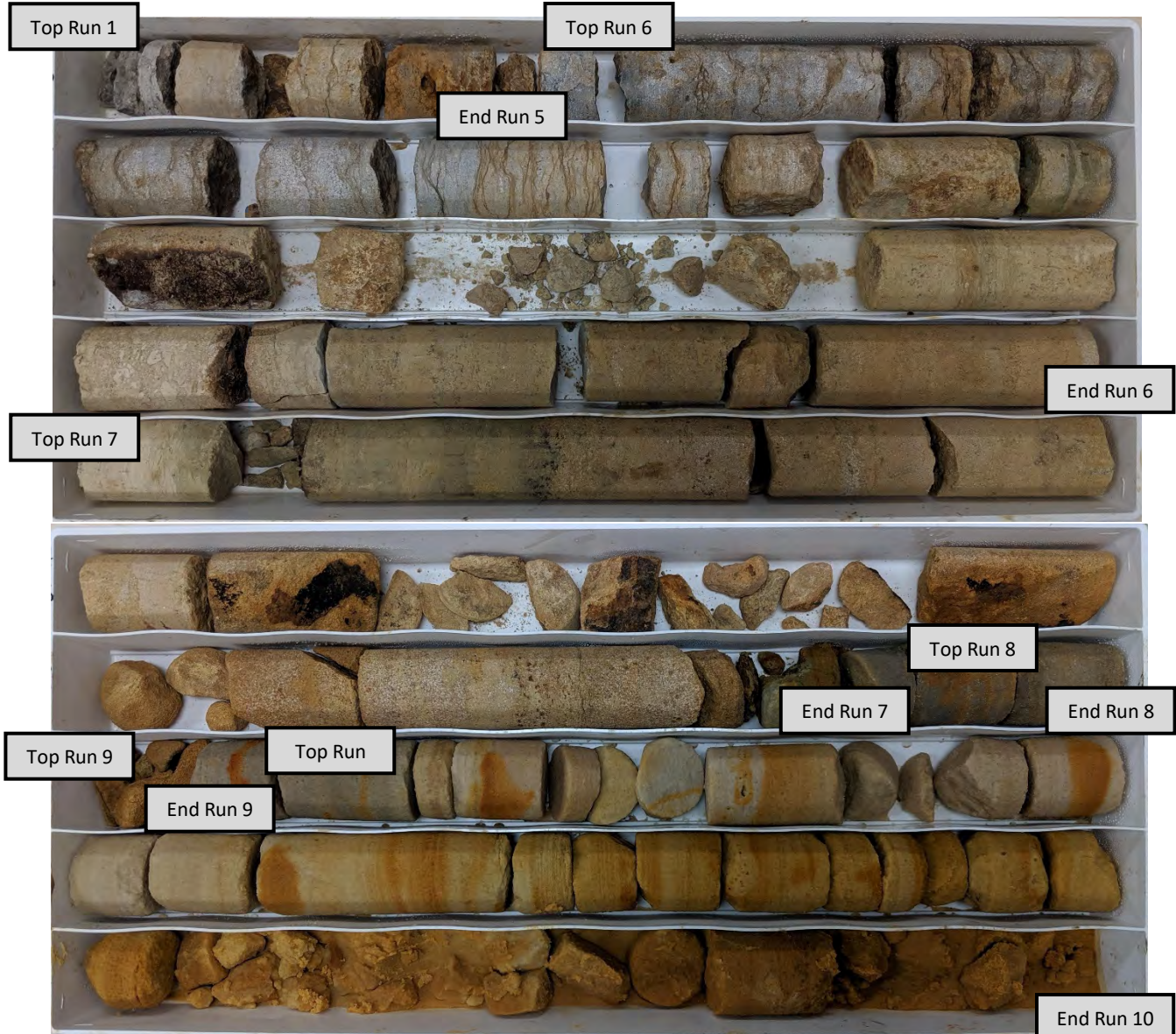


Rock Core Photographs

IL-75 over Rock River

Project No.: MG21035

Boring: SB-4A



Run	Depth (ft.)	Recovery (%)	RQD (%)
1	31.0-31.15	100	0
2	31.15-31.33	100	0
3	31.33-31.5	100	0
4	31.5-31.75	100	0
5	31.75-31.8	100	0
6	31.8-39.0	80	35
7	39.0-44.5	88	33
8	44.5-45.0	100	0
9	45.0-45.5	100	0
10	45.5-51.0	100	9

SB-5 SOIL BORING LOG

Sheet 1 of 1

COUNTY	Winnebago
SECTION	77BR
ROUTE	IL-75
JOB NO.	MG21035
DATE	7/20/2021

DESCRIPTION	IL-75 over Rock River	DISTRICT	2		
LOCATION	Rockton, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	Testing Service Corporation	LOGGED BY	B. Fisher	RIG TYPE	GP-750C
DRILLING METHOD	4" Drill Casing	HAMMER TYPE	Cathead	EFFICIENCY	

BORING NO.	SB-5	E	D	B	U	M	Surface Water Elev.	21.00 ft	E	D	B	U	M
Station	935+50 (approx)	L	E	L	C	O	Stream Bed Elev.	22.50 ft	L	E	L	C	O
Offset	3 ft West	E	P	O	S	I	Groundwater Elev.:		E	P	O	S	I
Northing	42°26'57.97"	V	T	W		S	First Encounter	ft	V	T	W		S
Easting	89° 4'20.77"		H	S	Qu	T	Upon Completion	ft		H	S	Qu	T
Ground Surface Elev.	732.50 ft	(ft)	(ft)	((6"))	(tsf)	(%)	After _____ Hrs.	ft	(ft)	(ft)	((6"))	(tsf)	(%)
							LITHOLOGY						

[illegible]

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

Printed 9/8/2021



SOIL BORING LOG

Date 2/2/20

ROUTE FAP 505 (IL 75) DESCRIPTION P92-058-08 - Bridge carrying IL 75 over Rock River LOGGED BY W. Garza

SECTION 77BR LOCATION W 1/2 24, Rockton, SEC. , TWP. 46N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-75 Automatic

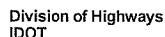
STRUCT. NO. 101-0109 Station _____ Latitude 42° 27' 02.94" Northing 2,108,708.3756
Longitude -89° 04' 20.65" Easting 2,591,901.5582

BORING NO. B-1
Station 204+74
Offset 24.00ft Lt of CL
Ground Surface Elev. 729.90 ft

D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)	Surface Water Elev. _____ ft Stream Bed Elev. <u>705.00</u> ft Groundwater Elev.: First Encounter <u>708.9</u> ft ▼ Upon Completion <u>Wash</u> ft After <u>24</u> Hrs. <u>711.9</u> ft ▼	D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)
MEDIUM brown SANDY LOAM		0.5 P	12.0	LOOSE tan SANDY GRAVEL	707.40	4 4 4		
LOOSE tan SANDY GRAVEL	726.40	3 3 3		MEDIUM tan MEDIUM SAND 8" Wash	704.90	6 7 9		
MEDIUM tan SANDY GRAVEL	722.40	3 6 9		MEDIUM tan MEDIUM SAND	702.40	4 7 13		
STIFF brown SANDY LOAM with GRAVEL	719.90	5 10 9	1.1 P	MEDIUM tan SANDY GRAVEL	699.90	12 13 15		
MEDIUM gray SANDY LOAM	717.40	3 3 4	0.5 P	MEDIUM tan MEDIUM SAND	697.40	5 12 6		
SOFT brown LOAM with GRAVEL	714.90	4 3 5	0.4 P	MEDIUM tan FINE SAND	694.90	11 9 9		
No Recovery	712.40	3 4 5		DENSE tan MEDIUM SAND 6" Wash	692.40	12 17 19		
MEDIUM tan moist SANDY GRAVEL	709.90	5 16 13		MEDIUM tan MEDIUM SAND	689.90	7 9 14		

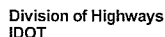
Northing and Easting were calculated using the LHP-WF coordinate system

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)



Date 2/2/20

BBS, from 137 (Rev. 8-99)



BBS, from 137 (Rev. 8-99)



Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Page 1 of 2

Date 3/4/20

ROUTE FAP 505 (IL 75) DESCRIPTION P92-058-08 - Bridge carrying IL 75 over Rock River LOGGED BY W. Garza

SECTION 77BR LOCATION W 1/2 24, Rockton, SEC. , TWP. 46N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-75 Automatic

STRUCT. NO. 101-0109
Station _____

Latitude 42° 26' 56.68"
Longitude -89° 04' 20.61"

Northing 2,108,075.0353
Easting 2,591,912.4235

BORING NO. B-2
Station 932+59
Offset 28.00ft Lt of CL
Ground Surface Elev. 733.13 ft

DEPTH TH (ft)	BLOW W (/6")	UCS Qu (tsf)	MOIST S (%)
---------------------	--------------------	--------------------	-------------------

Surface Water Elev. _____ ft
Stream Bed Elev. 705.00 ft
Groundwater Elev.:
First Encounter _____ ft
Upon Completion _____ ft
After _____ Hrs. _____ ft

MEDIUM brown SILTY CLAY
LOAM

729.63

STIFF brown SANDY LOAM

728.13

LOOSE tan DRY MEDIUM SAND

725.63

VERY DENSE tan WEATHERED
LIMESTONE

723.13

Borehole continued with rock
coring.

Northing and Easting were calculated using the ILHP-WF coordinate system

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, from 137 (Rev. 8-99)



Illinois Department of Transportation

Division of Highways
IDOT

ROCK CORE LOG

Page 2 of 2

Date 3/4/20

ROUTE FAP 505 (IL 75) DESCRIPTION P92-058-08 - Bridge carrying IL 75 over Rock River LOGGED BY W. Garza

SECTION 77BR LOCATION W 1/2 24, Rockton, SEC. , TWP. 46N, RNG. 1E

COUNTY Winnebago CORING METHOD Diamond bit core barrel

CORING BARREL TYPE & SIZE NQZ, 3.0 in

STRUCT. NO. 101-0109 Core Diameter 20 in
Station Top of Rock Elev. 724.13 ft
Begin Core Elev. 723.13 ft

BORING NO. B-2 Latitude 42° 26' 56.68"
Station 932+59 Longitude -89° 04' 20.61"
Offset 28.00ft Lt of CL Northing 2,108,075.0353
Ground Surface Elev. 733.13 ft Easting 2,591,912.4235

DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
---------------	-------------	-----------------	---------------	--------------------------	-------------------

Limestone: moderately hard, tan, moderately weathered in upper 1-2 ft, very intensely fractured, thin bedding planes 723.13

No testable segments

718.13 -15

Limestone: moderately hard to hard, tan, very intensely fractured, thin bedded

No testable segments

713.13 -20

Limestone: hard, tan to light gray, intensely to moderately fractured with some vertical fracturing, thin bedded, pitting and vugs from 1.5' to 5'

T.S.F. - 710.77 to 709.89

Note: Length to diameter ratio not in conformance due to breaking during test preparation - results may not be representative

708.13 -25

Limestone: hard, tan to gray, intensely to moderately fractured, thin bedded, pitting throughout

T.S.F. - 705.50 to 704.37

703.13 -30

Northing and Easting were calculated using the ILHP-WF coordinate system

Core pictures of the cores Yes

Cores will be stored for examination until construction

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Appendix E: IDOT Estimated Pile Length Spreadsheets

SUBSTRUCTURE===== **North Abutment**
 REFERENCE BORING ===== **B-1**
 LRFD or ASD or SEISMIC ===== **LRFD**
 PILE CUTOFF ELEV. ===== **724.40** ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = **722.40** ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== **None**
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

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

Maximum Nominal Req'd Bearing of <u>Pile</u>	Maximum Nominal Req'd Bearing of <u>Boring</u>	Maximum Factored Resistance Available in <u>Boring</u>	Maximum Pile Driveable Length in <u>Boring</u>
1126 KIPS	1126 KIPS	619 KIPS	93 FT.

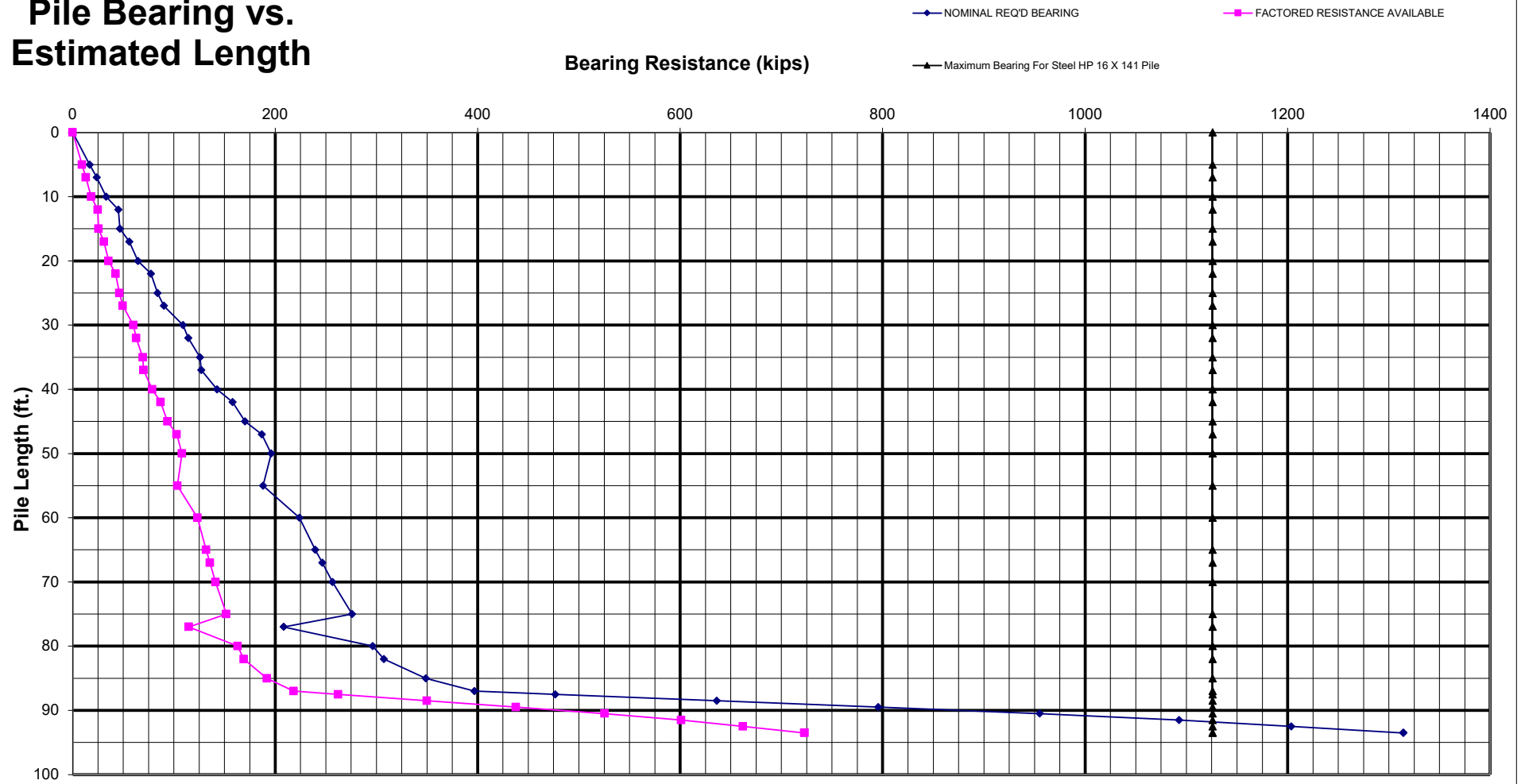
TOTAL FACTORED SUBSTRUCTURE LOAD ===== **2554** kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== **49.16** ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== **1**
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 415.62 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 155.86 KIPS

PILE TYPE AND SIZE ===== **Steel HP 16 X 141**

Plugged Pile Perimeter===== 5.333 FT. Unplugged Pile Perimeter===== 7.686 FT.
 Plugged Pile End Bearing Area===== 1.778 SQFT. Unplugged Pile End Bearing Area===== 0.290 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL UNPLUG'D			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
719.90	2.50	1.10			10.2		22.7	14.7		16.8	17	0	0	9	5
717.40	2.50	0.50			5.2	12.5	25.4	7.5	2.0	23.8	24	0	0	13	7
714.90	2.50	0.40			4.2	10.0	49.5	6.1	1.6	33.2	33	0	0	18	10
712.40	2.50		9	Sandy Gravel	2.8	29.9	101.3	4.0	4.9	45.2	45	0	0	25	12
709.90	2.50		19	Sandy Gravel	5.9	78.9	63.8	8.5	12.9	46.7	47	0	0	26	15
707.40	2.50		8	Sandy Gravel	2.5	35.4	101.7	3.6	5.8	56.0	56	0	0	31	17
704.90	2.50		16	Medium Sand	3.9	70.9	123.3	5.6	11.5	64.5	65	0	0	35	20
702.40	2.50		20	Medium Sand	4.9	88.6	163.6	7.0	14.4	77.3	77	0	0	43	22
699.90	2.50		28	Sandy Gravel	9.5	124.0	128.8	13.7	20.2	83.8	84	0	0	46	25
697.40	2.50		18	Medium Sand	4.4	79.7	133.2	6.3	13.0	90.1	90	0	0	50	27
694.90	2.50		18	Fine Sand	4.1	79.7	217.1	5.9	13.0	109.0	109	0	0	60	30
692.40	2.50		36	Medium Sand	10.1	159.5	169.6	14.5	26.0	114.1	114	0	0	63	32
689.90	2.50		23	Medium Sand	5.6	101.9	197.3	8.1	16.6	125.8	126	0	0	69	35
687.40	2.50		28	Fine Sand	6.4	124.0	155.0	9.2	20.2	127.1	127	0	0	70	37
684.90	2.50		17	Sandy Gravel	5.3	75.3	209.0	7.6	12.3	142.6	143	0	0	78	40
682.40	2.50		28	Sandy Gravel	9.5	124.0	227.4	13.7	20.2	157.8	158	0	0	87	42
679.90	2.50		30	Sandy Gravel	10.7	132.9	220.3	15.4	21.6	170.3	170	0	0	94	45
677.40	2.50		26	Sandy Gravel	8.5	115.2	255.4	12.2	18.8	186.9	187	0	0	103	47
674.90	2.50		32	Fine Sand	7.5	141.7	254.0	10.8	23.1	196.2	196	0	0	108	50
669.90	5.00		30	Fine Sand	13.8	132.9	188.1	19.9	21.6	203.1	188	0	0	103	55
664.90	5.00		12	Fine Sand	5.5	53.2	273.3	7.9	8.7	224.0	224	0	0	123	60
659.90	5.00		30	Fine Sand	13.8	132.9	260.5	19.9	21.6	239.6	240	0	0	132	65
657.40	2.50		24	Medium Sand	5.8	106.3	257.5	8.4	17.3	246.5	247	0	0	136	67
654.90	2.50		22	Fine Sand	5.0	97.4	280.2	7.2	15.9	256.6	257	0	0	141	70
649.90	5.00		26	Fine Sand	11.9	115.2	305.4	17.1	18.8	275.9	276	0	0	152	75
647.40	2.50		29	Fine Sand	6.6	128.4	208.5	9.5	20.9	268.6	208	0	0	115	77
644.90	2.50	1.00	9		9.5	24.9	303.8	13.7	4.1	296.2	296	0	0	163	80
642.40	2.50		25	Fine Sand	5.7	110.7	327.2	8.2	18.0	307.4	307	0	0	169	82
639.90	2.50		29	Medium Sand	7.3	128.4	524.9	10.5	20.9	348.9	349	0	0	192	85
637.40	2.50		72	Fine Sand	28.6	318.9	594.5	41.2	51.9	396.8	397	0	0	218	87
636.90	0.50			Sandstone	55.4	359.9	649.9	79.8	58.6	476.6	477	0	0	262	87.5
635.90	1.00			Sandstone	110.7	359.9	760.6	159.6	58.6	636.1	636	0	0	350	88.5
634.90	1.00			Sandstone	110.7	359.9	871.3	159.6	58.6	795.7	796	0	0	438	89.5
633.90	1.00			Sandstone	110.7	359.9	982.1	159.6	58.6	955.3	955	0	0	525	90.5
632.90	1.00			Sandstone	110.7	359.9	1092.8	159.6	58.6	1114.8	1093	0	0	601	91.5
631.90	1.00			Sandstone	110.7	359.9	1203.5	159.6	58.6	1274.4	1204	0	0	662	92.5
630.90	1.00			Sandstone	110.7	359.9	1314.3	159.6	58.6	1434.0	1314	0	0	723	93.5
629.90	1.00			Sandstone		359.9			58.6						

Pile Bearing vs. Estimated Length



Pile Design Table for North Abutment utilizing Boring #B-1

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 16 X 141			Steel HP 12 X 84		
281	154	37	208	115	77	260	143	85
351	193	40	296	163	80	296	163	87
389	214	42	307	169	82	664	365	91
Metal Shell 14"Φ w/.25" walls			349	192	85	Steel HP 14 X 73		
260	143	27	397	218	87	271	149	82
343	189	32	1126	619	93	296	163	85
344	189	37	Steel HP 16 X 162			337	185	87
436	240	40	211	116	77	578	318	90
Metal Shell 14"Φ w/.312" walls			301	166	80	Steel HP 14 X 89		
260	143	27	313	172	82	275	151	82
343	189	32	359	197	85	304	167	85
344	189	37	408	224	87	346	190	87
436	240	40	1288	708	94	705	388	90
483	266	42	Steel HP 16 X 183			Steel HP 14 X 102		
493	271	45	214	118	77	278	153	82
Metal Shell 16"Φ w/.312" walls			307	169	80	310	171	85
260	143	20	319	175	82	353	194	87
299	165	25	370	203	85	810	445	91
317	174	27	420	231	87	Steel HP 14 X 117		
412	226	37	1461	803	95	282	155	82
529	291	40	Steel HP 12 X 63			318	175	85
585	322	42	250	138	85	361	199	87
Metal Shell 16"Φ w/.375" walls			285	157	87	929	511	92
260	143	20	497	273	90	Precast 14"x 14"		
299	165	25	Steel HP 12 X 74			214	117	17
317	174	27	255	140	85			
412	226	37	291	160	87			
529	291	40	589	324	90			

Appendix F: IDOT Drilled Shaft Axial Capacity in Rock Input Sheets & Table



DRILLED SHAFT AXIAL CAPACITY IN ROCK -
DOLOMITE, LIMESTONE, SANDSTONE, AND HARD SHALE

Drilled Shaft Dia.'s for Design Table

STRUCTURE ===== IL 75 over Rock River
SUBSTRUCTURE & REFERENCE BORING ===== Pier 1 (SB-5/SB-4A/B-2)
GROUND SURFACE ELEVATION ===== 711.50 FT
GROUND WATER ELEVATION ===== 710.00 FT
ESTIMATED TOP OF ROCK ELEVATION ===== 706.40 FT
DRILLED SHAFT DIAMETER IN ROCK ===== 36 IN.
FACTORED AXIAL LOAD ===== 6250 KIPS
DRILLED SHAFT CONCRETE STRENGTH, f'c ===== 3.5 KSI

FOUNDATION REDUNDANCY === REDUNDANT

30 IN.
36 IN,
42 IN.
48 IN.
54 IN.
60 IN.

SOCKET DEPTH (FT)	TIP ELEV. (FT)	LAYER THICK. (FT)	UNCONFINED COMPRESSIVE STRENGTH (q _u) (KSF)	ROCK TYPE	GSI	ROCK CONDITION	RQD (%)	JOINT TYPE	ROCK INTACT OR TIGHTLY JOINTED?	SIDE RESISTANCE						AVG. q _u W/IN 2 - SHAFT DIA. (KSF)	TIP RESISTANCE			COMBINED SIDE & TIP RESISTANCE					
										NOM. RESIST. (KIPS)	Σ NOM. RESIST. (KIPS)	Σ FACT. RESIST. (KIPS)	SETTLEMENT				NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTL. w _{Rn} (IN.)	R _P /R _n	NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTLEMENT		
													Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)								Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)
1.00	705.40	1.00	778.4	Limestone	50	Normal	10	Open	Yes	308	308	169	104	0.005	0.335	734.6	2118	1059	0.409	0.81	1620	825	133	0.006	0.259
2.00	704.40	1.00	778.4	Limestone	50	Normal	10	Open	Yes	308	616	339	213	0.018	0.360	711.0	2099	1050	0.469	0.67	1863	962	294	0.018	0.291
3.00	703.40	1.00	778.4	Limestone	50	Normal	10	Open	Yes	308	924	508	325	0.025	0.373	687.3	2079	1039	0.551	0.56	2077	1085	431	0.027	0.311
4.00	702.40	1.00	778.4	Limestone	50	Normal	10	Open	Yes	308	1232	678	442	0.032	0.381	663.6	2055	1028	0.606	0.46	2292	1208	561	0.034	0.325
5.15	701.25	1.15	778.4	Limestone	50	Normal	10	Open	Yes	354	1587	873	582	0.038	0.386	636.4	11246	5623	3.793	0.38	2549	1354	709	0.041	0.338
6.15	700.25	1.00	636.4	Dolomite	50	Normal	0	Open	Yes	308	1895	1042	685	0.046	0.447	636.4	11246	5623	3.832	0.37	2994	1592	835	0.049	0.394
7.15	699.25	1.00	636.4	Dolomite	50	Normal	0	Open	Yes	308	2203	1211	789	0.054	0.501	676.5	11955	5977	3.896	0.37	3482	1851	973	0.058	0.441
8.15	698.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	2511	1381	894	0.062	0.550	668.1	11806	5903	3.635	0.37	3969	2110	1114	0.067	0.484
9.15	697.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	2819	1550	1001	0.069	0.593	659.7	11658	5829	3.368	0.37	4471	2376	1262	0.076	0.522
10.15	696.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	3127	1720	1109	0.077	0.633	651.3	11509	5755	3.135	0.37	4988	2650	1418	0.085	0.556
11.15	695.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	3435	1889	1219	0.084	0.670	642.9	11361	5680	2.850	0.38	5527	2935	1584	0.095	0.587
12.15	694.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	3743	2059	1330	0.091	0.704	634.5	11213	5606	2.583	0.39	6094	3234	1763	0.105	0.615
13.15	693.25	1.00	877.0	Dolomite	60	Normal	30	Open	Yes	308	4051	2228	1477	0.099	0.701	509.9	9011	4506	2.493	0.33	6018	3212	1852	0.111	0.630
14.15	692.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	4359	2398	1596	0.104	0.703	433.9	7667	3834	2.505	0.28	6033	3234	1913	0.114	0.646
15.15	691.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	4667	2567	1718	0.108	0.706										
16.15	690.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	4975	2736	1842	0.113	0.710										
17.15	689.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	5283	2906	1968	0.119	0.714										
18.15	688.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	5592	3075	2097	0.124	0.720										
19.15	687.25	1.00	129.6	Sandstone	40	Normal	0.0	Open	Yes	156	5748	3161	2129	0.128	0.750										
20.15	686.25	1.00	129.6	Sandstone	40	Normal	0.0	Open	Yes	156	5904	3247	2161	0.131	0.781										

Drilled Shaft Design Table for Pier 1 (SB-5/SB-4A/B-2)
Estimated Top of Rock Elevation: 706.40

(Page 1 of 3)

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RESIST. METHOD	SETTLEMENT DATA		
					Q _{C1} (KIPS)	W _{C1} (IN.)	W _{Rn} (IN.)
30 in. Diameter Drilled Shaft							
1	705.4	1508	754	TIP	--	--	0.305
2	704.4	1486	743	TIP	--	--	0.367
3	703.4	1609	843	SIDE + TIP	364	0.026	0.261
4	702.4	8211	4105	TIP	--	--	2.919
5.15	701.25	7810	3905	TIP	--	--	3.194
6.15	700.25	7810	3905	TIP	--	--	3.226
7.15	699.25	7810	3905	TIP	--	--	3.286
8.15	698.25	8400	4200	TIP	--	--	3.323
9.15	697.25	8277	4138	TIP	--	--	3.095
10.15	696.25	8153	4076	TIP	--	--	2.829
11.15	695.25	8029	4015	TIP	--	--	2.543
12.15	694.25	7906	3953	TIP	--	--	2.265
13.15	693.25	7191	3596	TIP	--	--	2.064
14.15	692.25	6071	3036	TIP	--	--	2.194
15.15	691.25	4951	2475	TIP	--	--	2.128
16.15	690.25	4146	2280	SIDE	1590	0.113	0.613
17.15	689.25	4403	2422	SIDE	1702	0.119	0.619
18.15	688.25	4660	2563	SIDE	1815	0.126	0.626
19.15	687.25	4790	2634	SIDE	1840	0.129	0.654
20.15	686.25	4920	2706	SIDE	1865	0.132	0.682
36 in. Diameter Drilled Shaft							
1	705.4	2118	1059	TIP	--	--	0.409
2	704.4	2099	1050	TIP	--	--	0.469
3	703.4	2079	1039	TIP	--	--	0.551
4	702.4	2292	1208	SIDE + TIP	561	0.034	0.325
5.15	701.25	11246	5623	TIP	--	--	3.793
6.15	700.25	11246	5623	TIP	--	--	3.832
7.15	699.25	11955	5977	TIP	--	--	3.896
8.15	698.25	11806	5903	TIP	--	--	3.635
9.15	697.25	11658	5829	TIP	--	--	3.368
10.15	696.25	11509	5755	TIP	--	--	3.135
11.15	695.25	11361	5680	TIP	--	--	2.850
12.15	694.25	11213	5606	TIP	--	--	2.583
13.15	693.25	9011	4506	TIP	--	--	2.493
14.15	692.25	7667	3834	TIP	--	--	2.505
15.15	691.25	4667	2567	SIDE	1718	0.108	0.706
16.15	690.25	4975	2736	SIDE	1842	0.113	0.710
17.15	689.25	5283	2906	SIDE	1968	0.119	0.714
18.15	688.25	5592	3075	SIDE	2097	0.124	0.720
19.15	687.25	5748	3161	SIDE	2129	0.128	0.750
20.15	686.25	5904	3247	SIDE	2161	0.131	0.781
42 in. Diameter Drilled Shaft							
1	705.4	2831	1416	TIP	--	--	0.522
2	704.4	2818	1409	TIP	--	--	0.590
3	703.4	2802	1401	TIP	--	--	0.656
4	702.4	2857	1500	SIDE + TIP	651	0.035	0.374
5.15	701.25	3164	1675	SIDE + TIP	824	0.042	0.389
6.15	700.25	16134	8067	TIP	--	--	4.427
7.15	699.25	15961	7980	TIP	--	--	4.205
8.15	698.25	15788	7894	TIP	--	--	3.933
9.15	697.25	15614	7807	TIP	--	--	3.710
10.15	696.25	15441	7721	TIP	--	--	3.444
11.15	695.25	15268	7634	TIP	--	--	3.179
12.15	694.25	13527	6763	TIP	--	--	3.077
13.15	693.25	10958	5479	TIP	--	--	2.850
14.15	692.25	5086	2797	SIDE	1819	0.106	0.806
15.15	691.25	5445	2995	SIDE	1955	0.111	0.808
16.15	690.25	5805	3193	SIDE	2093	0.115	0.810
17.15	689.25	6164	3390	SIDE	2233	0.120	0.813
18.15	688.25	6523	3588	SIDE	2376	0.125	0.817
19.15	687.25	6706	3688	SIDE	2414	0.128	0.851
20.15	686.25	6888	3788	SIDE	2452	0.131	0.884

48 in. Diameter Drilled Shaft							
1	705.4	3647	1824	TIP	--	--	0.624
2	704.4	3643	1821	TIP	--	--	0.693
3	703.4	3634	1817	TIP	--	--	0.760
4	702.4	3621	1810	TIP	--	--	0.826
5.15	701.25	3899	2055	SIDE + TIP	949	0.043	0.436
6.15	700.25	20740	10370	TIP	--	--	4.767
7.15	699.25	20542	10271	TIP	--	--	4.541
8.15	698.25	20344	10172	TIP	--	--	4.260
9.15	697.25	20146	10073	TIP	--	--	3.998
10.15	696.25	19948	9974	TIP	--	--	3.723
11.15	695.25	17958	8979	TIP	--	--	3.614
12.15	694.25	15968	7984	TIP	--	--	3.446
13.15	693.25	5402	2971	SIDE	1896	0.105	0.909
14.15	692.25	5812	3197	SIDE	2042	0.109	0.909
15.15	691.25	6223	3423	SIDE	2192	0.113	0.910
16.15	690.25	6634	3649	SIDE	2343	0.118	0.912
17.15	689.25	7045	3875	SIDE	2498	0.122	0.914
18.15	688.25	7455	4100	SIDE	2655	0.127	0.917
19.15	687.25	7664	4215	SIDE	2698	0.130	0.954
20.15	686.25	7872	4330	SIDE	2743	0.133	0.991
54 in. Diameter Drilled Shaft							
1	705.4	4567	2283	TIP	--	--	0.713
2	704.4	4572	2286	TIP	--	--	0.796
3	703.4	4573	2286	TIP	--	--	0.864
4	702.4	4708	2354	TIP	--	--	0.950
5.15	701.25	4701	2469	SIDE + TIP	1074	0.045	0.482
6.15	700.25	5616	2950	SIDE + TIP	1284	0.055	0.557
7.15	699.25	25699	12849	TIP	--	--	4.816
8.15	698.25	25476	12738	TIP	--	--	4.544
9.15	697.25	25253	12627	TIP	--	--	4.333
10.15	696.25	23014	11507	TIP	--	--	4.181
11.15	695.25	20775	10388	TIP	--	--	4.015
12.15	694.25	5615	3088	SIDE	1903	0.102	1.021
13.15	693.25	6077	3342	SIDE	2105	0.109	1.013
14.15	692.25	6539	3596	SIDE	2266	0.113	1.013
15.15	691.25	7001	3851	SIDE	2429	0.117	1.014
16.15	690.25	7463	4105	SIDE	2594	0.121	1.015
17.15	689.25	7925	4359	SIDE	2763	0.125	1.016
18.15	688.25	8387	4613	SIDE	2933	0.129	1.019
19.15	687.25	8622	4742	SIDE	2983	0.132	1.059
20.15	686.25	8856	4871	SIDE	3033	0.135	1.099
60 in. Diameter Drilled Shaft							
1	705.4	5589	2794	TIP	--	--	0.855
2	704.4	5607	2804	TIP	--	--	0.884
3	703.4	5774	2887	TIP	--	--	0.960
4	702.4	5777	2888	TIP	--	--	0.962
5.15	701.25	5734	2867	TIP	--	--	1.014
6.15	700.25	6667	3491	SIDE + TIP	1439	0.056	0.610
7.15	699.25	7740	4054	SIDE + TIP	1682	0.067	0.681
8.15	698.25	31183	15592	TIP	--	--	4.879
9.15	697.25	28696	14348	TIP	--	--	4.762
10.15	696.25	26208	13104	TIP	--	--	4.583
11.15	695.25	5725	3149	SIDE	1925	0.097	1.074
12.15	694.25	6238	3431	SIDE	2095	0.105	1.126
13.15	693.25	6752	3714	SIDE	2315	0.112	1.116
14.15	692.25	7265	3996	SIDE	2489	0.116	1.116
15.15	691.25	7779	4278	SIDE	2666	0.120	1.117
16.15	690.25	8292	4561	SIDE	2846	0.124	1.118
17.15	689.25	8806	4843	SIDE	3028	0.128	1.119
18.15	688.25	9319	5126	SIDE	3212	0.132	1.121
19.15	687.25	9580	5269	SIDE	3267	0.135	1.165
20.15	686.25	9840	5412	SIDE	3322	0.138	1.208



DRILLED SHAFT AXIAL CAPACITY IN ROCK -
DOLOMITE, LIMESTONE, SANDSTONE, AND HARD SHALE

Drilled Shaft Dia.'s for Design Table

STRUCTURE ===== I 75 over Rock River
SUBSTRUCTURE & REFERENCE BORING ===== Pier 2 (SB-4A)
GROUND SURFACE ELEVATION ===== 710.75 FT
GROUND WATER ELEVATION ===== 710.00 FT
ESTIMATED TOP OF ROCK ELEVATION ===== 701.25 FT
DRILLED SHAFT DIAMETER IN ROCK ===== 36 IN.
FACTORED AXIAL LOAD ===== 7588 KIPS
DRILLED SHAFT CONCRETE STRENGTH, f'c ===== 3.5 KSI

FOUNDATION REDUNDANCY === REDUNDANT

30 IN.
36 IN,
42 IN.
48 IN.
54 IN.
60 IN.

SOCKET DEPTH (FT)	TIP ELEV. (FT)	LAYER THICK. (FT)	UNCONFINED COMPRESSIVE STRENGTH (q _u) (KSF)	ROCK TYPE	GSI	ROCK CONDITION	RQD (%)	JOINT TYPE	ROCK INTACT OR TIGHTLY JOINTED?	SIDE RESISTANCE						AVG. q _u W/IN 2 - SHAFT DIA. (KSF)	TIP RESISTANCE			COMBINED SIDE & TIP RESISTANCE					
										NOM. RESIST. (KIPS)	Σ NOM. RESIST. (KIPS)	Σ FACT. RESIST. (KIPS)	SETTLEMENT				NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTL. w _{Rn} (IN.)	R _P /R _n	NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTLEMENT		
													Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)								Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)
1.00	700.25	1.00	636.4	Dolomite	50	Normal	0	Open	Yes	308	308	169	90	0.010	0.980	636.4	1795	898	0.571	0.88	2037	1031	120	0.010	0.580
2.00	699.25	1.00	636.4	Dolomite	50	Normal	0	Open	Yes	308	616	339	182	0.034	1.054	676.5	1938	969	0.577	0.81	2406	1226	298	0.035	0.596
3.00	698.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	924	508	274	0.049	1.095	668.1	1953	976	0.568	0.75	2620	1343	454	0.052	0.572
4.00	697.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	1232	678	368	0.061	1.123	659.7	1967	983	0.527	0.70	2816	1450	608	0.064	0.543
5.00	696.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	1540	847	463	0.070	1.144	651.3	11509	5755	2.930	0.71	5262	2708	765	0.075	0.955
6.00	695.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	1848	1017	560	0.078	1.160	642.9	11361	5680	2.647	0.69	5897	3041	932	0.086	0.962
7.00	694.25	1.00	636.4	Dolomite	50	Normal	30	Open	Yes	308	2157	1186	658	0.086	1.174	634.5	11213	5606	2.400	0.67	6579	3397	1111	0.096	0.965
8.00	693.25	1.00	877.0	Dolomite	60	Normal	30	Open	Yes	308	2465	1356	784	0.090	1.067	509.9	9011	4506	2.333	0.58	5862	3054	1169	0.100	0.913
9.00	692.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	2773	1525	885	0.090	1.000	433.9	7667	3834	2.385	0.50	5491	2884	1201	0.098	0.881
10.00	691.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	3081	1694	989	0.091	0.954	357.8	6323	3161	2.089	0.44	5506	2907	1283	0.100	0.852
11.00	690.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	3389	1864	1096	0.093	0.920	281.7	4979	2489	1.719	0.40	5637	2988	1382	0.102	0.830
12.00	689.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	3697	2033	1204	0.096	0.895	205.7	3634	1817	1.284	0.36	5798	3084	1484	0.105	0.815
13.00	688.25	1.00	586.0	Sandstone	60	Normal	22	Open	Yes	308	4005	2203	1316	0.099	0.877	129.6	2290	1145	0.835	0.33	5978	3189	1590	0.108	0.805
14.00	687.25	1.00	129.6	Sandstone	40	Normal	0	Open	Yes	156	4161	2289	1350	0.102	0.917	129.6	2290	1145	0.772	0.35	6417	3417	1655	0.112	0.838
15.00	686.25	1.00	129.6	Sandstone	40	Normal	0	Open	Yes	156	4317	2375	1384	0.105	0.955										
16.00	685.25	1.00	129.6	Sandstone	50	Normal	6	Open	Yes	156	4474	2460	1422	0.106	0.971										
17.00	684.25	1.00	129.6	Sandstone	55	Normal	6	Open	Yes	156	4630	2546	1463	0.106	0.973										
18.00	683.25	1.00	129.6	Sandstone	55	Normal	6	Open	Yes	156	4786	2632	1504	0.106	0.976										
19.00	682.25	1.00	129.6	Sandstone	55	Normal	6.0	Open	Yes	156	4942	2718	1544	0.107	0.980										
20.00	681.25	1.00	129.6	Sandstone	55	Normal	6.0	Open	Yes	156	5099	2804	1585	0.108	0.985										

Drilled Shaft Design Table for Pier 2 (SB-4A)
Estimated Top of Rock Elevation: 701.25
(Page 1 of 3)

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RESIST. METHOD	SETTLEMENT DATA		
					Q _{C1} (KIPS)	W _{C1} (IN.)	W _{Rn} (IN.)
30 in. Diameter Drilled Shaft							
1	700.25	1445	732	SIDE + TIP	110	0.014	0.485
2	699.25	1658	848	SIDE + TIP	242	0.035	0.503
3	698.25	1961	1009	SIDE + TIP	365	0.049	0.518
4	697.25	8277	4138	TIP	--	--	2.882
5	696.25	8153	4076	TIP	--	--	2.606
6	695.25	8029	4015	TIP	--	--	2.337
7	694.25	7906	3953	TIP	--	--	2.084
8	693.25	7191	3596	TIP	--	--	1.873
9	692.25	6071	3036	TIP	--	--	2.017
10	691.25	4951	2475	TIP	--	--	2.007
11	690.25	4298	2290	SIDE + TIP	1136	0.097	0.716
12	689.25	4446	2377	SIDE + TIP	1225	0.100	0.705
13	688.25	4609	2471	SIDE + TIP	1316	0.104	0.698
14	687.25	4940	2643	SIDE + TIP	1368	0.108	0.729
15	686.25	4998	2669	SIDE + TIP	1426	0.112	0.705
16	685.25	3728	2050	SIDE	1213	0.103	0.830
17	684.25	3858	2122	SIDE	1248	0.104	0.833
18	683.25	3988	2194	SIDE	1283	0.105	0.838
19	682.25	4119	2265	SIDE	1317	0.106	0.843
20	681.25	4249	2337	SIDE	1352	0.107	0.850
36 in. Diameter Drilled Shaft							
1	700.25	2037	1031	SIDE + TIP	120	0.010	0.580
2	699.25	2406	1226	SIDE + TIP	298	0.035	0.596
3	698.25	2620	1343	SIDE + TIP	454	0.052	0.572
4	697.25	2816	1450	SIDE + TIP	608	0.064	0.543
5	696.25	11509	5755	TIP	--	--	2.930
6	695.25	11361	5680	TIP	--	--	2.647
7	694.25	11213	5606	TIP	--	--	2.400
8	693.25	9011	4506	TIP	--	--	2.333
9	692.25	7667	3834	TIP	--	--	2.385
10	691.25	6323	3161	TIP	--	--	2.089
11	690.25	5637	2988	SIDE + TIP	1382	0.102	0.830
12	689.25	5798	3084	SIDE + TIP	1484	0.105	0.815
13	688.25	5978	3189	SIDE + TIP	1590	0.108	0.805
14	687.25	6417	3417	SIDE + TIP	1655	0.112	0.838
15	686.25	4317	2375	SIDE	1384	0.105	0.955
16	685.25	4474	2460	SIDE	1422	0.106	0.971
17	684.25	4630	2546	SIDE	1463	0.106	0.973
18	683.25	4786	2632	SIDE	1504	0.106	0.976
19	682.25	4942	2718	SIDE	1544	0.107	0.980
20	681.25	5099	2804	SIDE	1585	0.108	0.985
42 in. Diameter Drilled Shaft							
1	700.25	2850	1439	SIDE + TIP	124	0.005	0.672
2	699.25	3124	1589	SIDE + TIP	350	0.034	0.650
3	698.25	3375	1725	SIDE + TIP	545	0.053	0.624
4	697.25	3608	1852	SIDE + TIP	733	0.067	0.595
5	696.25	3823	1970	SIDE + TIP	924	0.079	0.564
6	695.25	15268	7634	TIP	--	--	2.960
7	694.25	13527	6763	TIP	--	--	2.870
8	693.25	10958	5479	TIP	--	--	2.707
9	692.25	9390	4695	TIP	--	--	2.487
10	691.25	7822	3911	TIP	--	--	2.121
11	690.25	7137	3766	SIDE + TIP	1636	0.107	0.943
12	689.25	7305	3868	SIDE + TIP	1752	0.110	0.925
13	688.25	7500	3984	SIDE + TIP	1872	0.113	0.911
14	687.25	4855	2670	SIDE	1548	0.106	1.053
15	686.25	5037	2770	SIDE	1587	0.109	1.097
16	685.25	5219	2871	SIDE	1631	0.109	1.114
17	684.25	5401	2971	SIDE	1677	0.109	1.115
18	683.25	5584	3071	SIDE	1723	0.109	1.117
19	682.25	5766	3171	SIDE	1769	0.110	1.120
20	681.25	5948	3272	SIDE	1816	0.110	1.124

48 in. Diameter Drilled Shaft							
1	700.25	3301	1650	TIP	--	--	0.726
2	699.25	3936	1998	SIDE + TIP	398	0.033	0.703
3	698.25	4228	2157	SIDE + TIP	635	0.053	0.676
4	697.25	4500	2304	SIDE + TIP	860	0.069	0.648
5	696.25	4754	2443	SIDE + TIP	1085	0.083	0.618
6	695.25	4757	2456	SIDE + TIP	1233	0.094	0.626
7	694.25	15968	7984	TIP	--	--	3.297
8	693.25	13033	6516	TIP	--	--	2.845
9	692.25	11241	5620	TIP	--	--	2.495
10	691.25	9448	4724	TIP	--	--	2.168
11	690.25	8794	4623	SIDE + TIP	1897	0.112	1.055
12	689.25	8966	4729	SIDE + TIP	2027	0.114	1.033
13	688.25	5340	2937	SIDE	1701	0.108	1.139
14	687.25	5548	3052	SIDE	1746	0.110	1.190
15	686.25	5757	3166	SIDE	1791	0.113	1.239
16	685.25	5965	3281	SIDE	1839	0.113	1.258
17	684.25	6173	3395	SIDE	1891	0.113	1.258
18	683.25	6381	3510	SIDE	1942	0.113	1.260
19	682.25	6590	3624	SIDE	1994	0.113	1.263
20	681.25	6798	3739	SIDE	2046	0.113	1.266
54 in. Diameter Drilled Shaft							
1	700.25	4129	2065	TIP	--	--	0.764
2	699.25	4843	2454	SIDE + TIP	440	0.030	0.754
3	698.25	5178	2636	SIDE + TIP	722	0.053	0.728
4	697.25	5492	2807	SIDE + TIP	987	0.071	0.701
5	696.25	5512	2831	SIDE + TIP	1179	0.085	0.708
6	695.25	5514	2845	SIDE + TIP	1354	0.096	0.709
7	694.25	18536	9268	TIP	--	--	3.452
8	693.25	15235	7617	TIP	--	--	2.856
9	692.25	13218	6609	TIP	--	--	2.556
10	691.25	11202	5601	TIP	--	--	2.249
11	690.25	10607	5558	SIDE + TIP	2163	0.116	1.166
12	689.25	5545	3050	SIDE	1741	0.110	1.300
13	688.25	6007	3304	SIDE	1894	0.112	1.271
14	687.25	6242	3433	SIDE	1944	0.115	1.327
15	686.25	6476	3562	SIDE	1994	0.117	1.381
16	685.25	6710	3691	SIDE	2048	0.118	1.402
17	684.25	6945	3820	SIDE	2105	0.117	1.402
18	683.25	7179	3949	SIDE	2161	0.117	1.404
19	682.25	7413	4077	SIDE	2218	0.117	1.406
20	681.25	7648	4206	SIDE	2275	0.117	1.409
60 in. Diameter Drilled Shaft							
1	700.25	5051	2525	TIP	--	--	0.856
2	699.25	5845	2959	SIDE + TIP	475	0.027	0.805
3	698.25	6225	3164	SIDE + TIP	806	0.053	0.780
4	697.25	6269	3202	SIDE + TIP	1058	0.071	0.788
5	696.25	6294	3230	SIDE + TIP	1278	0.086	0.790
6	695.25	6242	3216	SIDE + TIP	1516	0.099	0.740
7	694.25	6138	3174	SIDE + TIP	1763	0.111	0.675
8	693.25	17563	8782	TIP	--	--	2.952
9	692.25	15323	7662	TIP	--	--	2.586
10	691.25	13083	6541	TIP	--	--	2.286
11	690.25	5648	3106	SIDE	1755	0.112	1.475
12	689.25	6161	3389	SIDE	1920	0.114	1.434
13	688.25	6675	3671	SIDE	2087	0.116	1.401
14	687.25	6935	3814	SIDE	2142	0.119	1.464
15	686.25	7196	3958	SIDE	2197	0.122	1.523
16	685.25	7456	4101	SIDE	2256	0.122	1.546
17	684.25	7716	4244	SIDE	2318	0.121	1.546
18	683.25	7977	4387	SIDE	2380	0.121	1.548
19	682.25	8237	4530	SIDE	2442	0.120	1.550
20	681.25	8498	4674	SIDE	2505	0.120	1.553



DRILLED SHAFT AXIAL CAPACITY IN ROCK -
DOLOMITE, LIMESTONE, SANDSTONE, AND HARD SHALE

Drilled Shaft Dia.'s for Design Table

STRUCTURE ===== I 75 over Rock River
SUBSTRUCTURE & REFERENCE BORING ===== Pier 3 (SB-2)
GROUND SURFACE ELEVATION ===== 708.75 FT
GROUND WATER ELEVATION ===== 708.00 FT
ESTIMATED TOP OF ROCK ELEVATION ===== 633.70 FT
DRILLED SHAFT DIAMETER IN ROCK ===== 36 IN.
FACTORED AXIAL LOAD ===== 7587 KIPS
DRILLED SHAFT CONCRETE STRENGTH, f'c ===== 3.5 KSI

FOUNDATION REDUNDANCY === REDUNDANT

30 IN.
36 IN.
42 IN.
48 IN.
54 IN.
60 IN.

SOCKET DEPTH (FT)	TIP ELEV. (FT)	LAYER THICK. (FT)	UNCONFINED COMPRESSIVE STRENGTH (q _u) (KSF)	ROCK TYPE	GSI	ROCK CONDITION	RQD (%)	JOINT TYPE	ROCK INTACT OR TIGHTLY JOINTED?	SIDE RESISTANCE						AVG. q _u W/IN 2 - SHAFT DIA. (KSF)	TIP RESISTANCE			COMBINED SIDE & TIP RESISTANCE					
										NOM. RESIST. (KIPS)	Σ NOM. RESIST. (KIPS)	Σ FACT. RESIST. (KIPS)	SETTLEMENT				NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTL. w _{Rn} (IN.)	R _P /R _n	NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTLEMENT		
													Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)								Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)
1.00	632.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	171	94	35	0.007	1.945	155.6	943	471	0.432	0.93	1012	509	50	0.007	0.441
2.00	631.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	342	188	70	0.019	1.998	155.6	959	479	0.434	0.87	1097	555	111	0.019	0.452
3.00	630.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	514	282	106	0.026	2.028	155.6	974	487	0.462	0.82	1182	601	162	0.027	0.464
4.00	629.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	685	377	141	0.032	2.048	155.6	989	495	0.464	0.78	1268	648	208	0.032	0.476
5.00	628.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	856	471	177	0.036	2.063	155.6	2750	1375	1.340	0.81	3407	1736	252	0.037	1.329
6.00	627.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	1027	565	213	0.040	2.076	155.6	2750	1375	1.254	0.78	3506	1791	300	0.041	1.263
7.00	626.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	1198	659	249	0.043	2.086	155.6	2750	1375	1.202	0.76	3596	1840	348	0.045	1.196
8.00	625.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	1369	753	285	0.046	2.095	155.6	2750	1375	1.116	0.75	3677	1885	397	0.048	1.130
9.00	624.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	1541	847	321	0.049	2.103	155.6	2750	1375	1.064	0.73	3748	1924	447	0.051	1.064
10.00	623.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	1712	941	358	0.051	2.111	155.6	2750	1375	0.978	0.72	3810	1958	499	0.054	0.998
11.00	622.70	1.00	155.6	Sandstone	40	Normal	0	Open	Yes	171	1883	1036	394	0.054	2.118	155.6	2750	1375	0.926	0.71	3863	1987	553	0.058	0.932
12.00	621.70	1.00	155.6	Sandstone	50	Normal	15	Open	Yes	171	2054	1130	432	0.054	2.025										
13.00	620.70	1.00	155.6	Sandstone	50	Normal	15	Open	Yes	171	2225	1224	469	0.055	1.954										
14.00	619.70	1.00	155.6	Sandstone	50	Normal	15	Open	Yes	171	2396	1318	507	0.056	1.898										
15.00	618.70	1.00	155.6	Sandstone	50	Normal	15	Open	Yes	171	2568	1412	545	0.057	1.854										
16.00	617.70	1.00	155.6	Sandstone	50	Normal	15	Open	Yes	171	2739	1506	583	0.058	1.817										
17.00	616.70	1.00	155.6	Sandstone	50	Normal	15	Open	Yes	171	2910	1600	621	0.060	1.787										
17.50	616.20	0.50	155.6	Sandstone	50	Normal	15	Open	Yes	86	2996	1648	640	0.060	1.774										

Drilled Shaft Design Table for Pier 3 (SB-2)
Estimated Top of Rock Elevation: 633.70
(Page 1 of 2)

SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RESIST. METHOD	SETTLEMENT DATA		
					Q _{C1} (KIPS)	W _{C1} (IN.)	W _{Rn} (IN.)
30 in. Diameter Drilled Shaft							
1	632.7	712	359	SIDE + TIP	45	0.009	0.368
2	631.7	780	396	SIDE + TIP	92	0.019	0.378
3	630.7	849	433	SIDE + TIP	132	0.025	0.389
4	629.7	2348	1196	SIDE + TIP	169	0.030	1.106
5	628.7	2457	1256	SIDE + TIP	204	0.034	1.118
6	627.7	2566	1316	SIDE + TIP	239	0.037	1.130
7	626.7	2640	1357	SIDE + TIP	278	0.041	1.064
8	625.7	2705	1392	SIDE + TIP	318	0.044	0.999
9	624.7	2761	1423	SIDE + TIP	358	0.047	0.933
10	623.7	2808	1449	SIDE + TIP	401	0.050	0.868
11	622.7	2845	1469	SIDE + TIP	445	0.053	0.802
12	621.7	2970	1538	SIDE + TIP	473	0.054	0.818
13	620.7	1854	1020	SIDE	393	0.051	1.642
14	619.7	1997	1098	SIDE	425	0.052	1.596
15	618.7	2140	1177	SIDE	457	0.053	1.559
16	617.7	2282	1255	SIDE	489	0.055	1.530
17	616.7	2425	1334	SIDE	522	0.056	1.506
17.5	616.2	2496	1373	SIDE	538	0.057	1.496
36 in. Diameter Drilled Shaft							
1	632.7	1012	509	SIDE + TIP	50	0.007	0.441
2	631.7	1097	555	SIDE + TIP	111	0.019	0.452
3	630.7	1182	601	SIDE + TIP	162	0.027	0.464
4	629.7	1268	648	SIDE + TIP	208	0.032	0.476
5	628.7	3407	1736	SIDE + TIP	252	0.037	1.329
6	627.7	3506	1791	SIDE + TIP	300	0.041	1.263
7	626.7	3596	1840	SIDE + TIP	348	0.045	1.196
8	625.7	3677	1885	SIDE + TIP	397	0.048	1.130
9	624.7	3748	1924	SIDE + TIP	447	0.051	1.064
10	623.7	3810	1958	SIDE + TIP	499	0.054	0.998
11	622.7	3863	1987	SIDE + TIP	553	0.058	0.932
12	621.7	2054	1130	SIDE	432	0.054	2.025
13	620.7	2225	1224	SIDE	469	0.055	1.954
14	619.7	2396	1318	SIDE	507	0.056	1.898
15	618.7	2568	1412	SIDE	545	0.057	1.854
16	617.7	2739	1506	SIDE	583	0.058	1.817
17	616.7	2910	1600	SIDE	621	0.060	1.787
17.5	616.2	2996	1648	SIDE	640	0.060	1.774
42 in. Diameter Drilled Shaft							
1	632.7	1365	687	SIDE + TIP	54	0.005	0.514
2	631.7	1466	741	SIDE + TIP	130	0.019	0.526
3	630.7	1568	796	SIDE + TIP	192	0.028	0.539
4	629.7	1671	852	SIDE + TIP	248	0.034	0.552
5	628.7	1766	903	SIDE + TIP	306	0.039	0.537
6	627.7	4600	2343	SIDE + TIP	363	0.044	1.395
7	626.7	4705	2401	SIDE + TIP	421	0.048	1.328
8	625.7	4802	2454	SIDE + TIP	480	0.052	1.262
9	624.7	4888	2501	SIDE + TIP	540	0.055	1.195
10	623.7	4966	2544	SIDE + TIP	602	0.059	1.129
11	622.7	2197	1208	SIDE	459	0.058	2.458
12	621.7	2396	1318	SIDE	502	0.058	2.350
13	620.7	2596	1428	SIDE	545	0.059	2.267
14	619.7	2796	1538	SIDE	589	0.060	2.201
15	618.7	2996	1648	SIDE	632	0.061	2.148
16	617.7	3195	1757	SIDE	676	0.062	2.105
17	616.7	3395	1867	SIDE	721	0.063	2.069
17.5	616.2	3495	1922	SIDE	743	0.064	2.053
48 in. Diameter Drilled Shaft							
1	632.7	1770	890	SIDE + TIP	55	0.003	0.587
2	631.7	1889	954	SIDE + TIP	148	0.019	0.600
3	630.7	2009	1018	SIDE + TIP	221	0.029	0.614
4	629.7	2123	1080	SIDE + TIP	293	0.036	0.600
5	628.7	2233	1139	SIDE + TIP	361	0.042	0.585

6	627.7	2341	1197	SIDE + TIP	429	0.046	0.570
7	626.7	5968	3038	SIDE + TIP	498	0.051	1.461
8	625.7	6080	3100	SIDE + TIP	566	0.055	1.394
9	624.7	6183	3156	SIDE + TIP	636	0.059	1.328
10	623.7	2282	1255	SIDE	474	0.059	2.788
11	622.7	2511	1381	SIDE	523	0.062	2.796
12	621.7	2739	1506	SIDE	572	0.062	2.673
13	620.7	2967	1632	SIDE	621	0.063	2.579
14	619.7	3195	1757	SIDE	670	0.063	2.504
15	618.7	3424	1883	SIDE	720	0.064	2.443
16	617.7	3652	2008	SIDE	770	0.065	2.393
17	616.7	3880	2134	SIDE	820	0.066	2.351
17.5	616.2	3994	2197	SIDE	845	0.067	2.333
54 in. Diameter Drilled Shaft							
1	632.7	2227	1119	SIDE + TIP	53	0.000	0.660
2	631.7	2366	1193	SIDE + TIP	164	0.018	0.674
3	630.7	2499	1265	SIDE + TIP	255	0.029	0.661
4	629.7	2629	1335	SIDE + TIP	338	0.037	0.648
5	628.7	2756	1403	SIDE + TIP	418	0.043	0.633
6	627.7	2880	1469	SIDE + TIP	497	0.049	0.618
7	626.7	7383	3751	SIDE + TIP	576	0.054	1.594
8	625.7	7512	3822	SIDE + TIP	655	0.058	1.527
9	624.7	2311	1271	SIDE	479	0.059	3.113
10	623.7	2568	1412	SIDE	533	0.063	3.124
11	622.7	2824	1553	SIDE	587	0.066	3.134
12	621.7	3081	1695	SIDE	642	0.066	2.996
13	620.7	3338	1836	SIDE	697	0.066	2.890
14	619.7	3595	1977	SIDE	752	0.067	2.806
15	618.7	3851	2118	SIDE	808	0.068	2.737
16	617.7	4108	2260	SIDE	863	0.069	2.681
17	616.7	4365	2401	SIDE	919	0.070	2.634
17.5	616.2	4493	2471	SIDE	947	0.070	2.613
60 in. Diameter Drilled Shaft							
1	632.7	2619	1310	TIP	--	--	0.761
2	631.7	2892	1457	SIDE + TIP	181	0.017	0.721
3	630.7	3042	1538	SIDE + TIP	287	0.029	0.709
4	629.7	3190	1617	SIDE + TIP	384	0.038	0.696
5	628.7	3335	1695	SIDE + TIP	476	0.045	0.682
6	627.7	3476	1770	SIDE + TIP	567	0.051	0.667
7	626.7	3615	1845	SIDE + TIP	656	0.056	0.652
8	625.7	2282	1255	SIDE	472	0.059	3.434
9	624.7	2568	1412	SIDE	531	0.062	3.448
10	623.7	2853	1569	SIDE	591	0.066	3.459
11	622.7	3138	1726	SIDE	651	0.069	3.470
12	621.7	3424	1883	SIDE	712	0.069	3.318
13	620.7	3709	2040	SIDE	773	0.070	3.200
14	619.7	3994	2197	SIDE	834	0.070	3.107
15	618.7	4279	2354	SIDE	895	0.071	3.031
16	617.7	4565	2511	SIDE	957	0.072	2.968
17	616.7	4850	2667	SIDE	1018	0.073	2.916
17.5	616.2	4993	2746	SIDE	1049	0.074	2.892



DRILLED SHAFT AXIAL CAPACITY IN ROCK -
DOLOMITE, LIMESTONE, SANDSTONE, AND HARD SHALE

Drilled Shaft Dia.'s for Design Table

STRUCTURE ===== 175 over Rock River
SUBSTRUCTURE & REFERENCE BORING ===== Pier 4 (SB-1)
GROUND SURFACE ELEVATION ===== 707.50 FT
GROUND WATER ELEVATION ===== 707.00 FT
ESTIMATED TOP OF ROCK ELEVATION ===== 626.50 FT
DRILLED SHAFT DIAMETER IN ROCK ===== 36 IN.
FACTORED AXIAL LOAD ===== 6251 KIPS
DRILLED SHAFT CONCRETE STRENGTH, f'c ===== 3.5 KSI

FOUNDATION REDUNDANCY === REDUNDANT

30 IN.
36 IN,
42 IN.
48 IN.
54 IN.
60 IN.

SOCKET DEPTH (FT)	TIP ELEV. (FT)	LAYER THICK. (FT)	UNCONFINED COMPRESSIVE STRENGTH (q _u) (KSF)	ROCK TYPE	GSI	ROCK CONDITION	RQD (%)	JOINT TYPE	ROCK INTACT OR TIGHTLY JOINTED?	SIDE RESISTANCE						AVG. q _u W/IN 2 - SHAFT DIA. (KSF)	TIP RESISTANCE			COMBINED SIDE & TIP RESISTANCE					
										NOM. RESIST. (KIPS)	Σ NOM. RESIST. (KIPS)	Σ FACT. RESIST. (KIPS)	SETTLEMENT				NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTL. w _{Rn} (IN.)	R _P /R _n	NOM. RESIST. (KIPS)	FACT. RESIST. (KIPS)	SETTLEMENT		
													Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)								Q _{C1} (KIPS)	w _{C1} (IN.)	w _{Rn} (IN.)
1.00	625.50	1.00	292.4	Sandstone	40	Normal	14	Open	Yes	235	235	129	54	0.011	1.716	265.0	1375	687	0.556	0.92	1496	754	80	0.011	0.564
2.00	624.50	1.00	292.4	Sandstone	40	Normal	14	Open	Yes	235	469	258	107	0.029	1.789	251.3	1346	673	0.502	0.86	1571	797	185	0.030	0.520
3.00	623.50	1.00	292.4	Sandstone	40	Normal	14	Open	Yes	235	704	387	162	0.040	1.829	237.6	1316	658	0.474	0.81	1634	833	276	0.041	0.476
4.00	622.50	1.00	292.4	Sandstone	40	Normal	14	Open	Yes	235	939	516	216	0.048	1.857	223.9	1282	641	0.421	0.76	1686	863	365	0.050	0.434
5.00	621.50	1.00	292.4	Sandstone	40	Normal	14	Open	Yes	235	1173	645	271	0.055	1.878	210.2	3715	1857	1.168	0.80	4626	2359	455	0.058	1.159
6.00	620.50	1.00	210.2	Sandstone	50	Normal	14	Open	Yes	199	1372	755	316	0.054	1.736	236.6	4181	2091	1.269	0.77	5397	2759	499	0.057	1.281
7.00	619.50	1.00	210.2	Sandstone	50	Normal	14	Open	Yes	199	1571	864	361	0.054	1.651	263.0	4648	2324	1.396	0.75	6194	3174	548	0.057	1.398
8.00	618.50	1.00	210.2	Sandstone	50	Normal	14	Open	Yes	199	1770	974	407	0.054	1.594	289.4	5114	2557	1.484	0.73	6447	3312	598	0.058	1.381
9.00	617.50	1.00	210.2	Sandstone	50	Normal	14	Open	Yes	199	1969	1083	453	0.055	1.555	315.8	5581	2790	1.600	0.70	6625	3411	650	0.060	1.351
10.00	616.50	1.00	210.2	Sandstone	50	Normal	14	Open	Yes	199	2168	1192	499	0.057	1.526	342.2	6047	3024	1.676	0.68	6835	3526	704	0.061	1.330
11.00	615.50	1.00	210.2	Sandstone	50	Normal	14	Open	Yes	199	2367	1302	546	0.058	1.504	368.6	6514	3257	1.779	0.67	7066	3651	758	0.064	1.315
12.00	614.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	2630	1447	615	0.061	1.440	368.6	6514	3257	1.785	0.63	7070	3667	830	0.067	1.269
13.00	613.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	2894	1592	685	0.064	1.391	368.6	6514	3257	1.807	0.59	7123	3706	902	0.070	1.236
14.00	612.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	3157	1737	756	0.067	1.354	368.6	6514	3257	1.847	0.56	7210	3763	975	0.073	1.212
15.00	611.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	3421	1881	828	0.070	1.324										
16.00	610.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	3684	2026	900	0.073	1.300										
17.00	609.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	3948	2171	974	0.076	1.281										
18.00	608.50	1.00	368.6	Sandstone	55	Normal	58	Open	Yes	263	4211	2316	1048	0.080	1.266										
19.00	607.50	1.00	368.6	Sandstone	55	Normal	58.0	Open	Yes	263	4475	2461	1124	0.083	1.254										
20.00	606.50	1.00	368.6	Sandstone	55	Normal	58.0	Open	Yes	263	4738	2606	1200	0.087	1.244										

Drilled Shaft Design Table for Pier 4 (SB-1)
Estimated Top of Rock Elevation: 626.50

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SOCKET DEPTH (FT)	TIP ELEV. (FT)	NOMINAL SHAFT RESIST. (KIPS)	FACTORED SHAFT RESIST. (KIPS)	RESIST. METHOD	SETTLEMENT DATA		
					Q _{C1} (KIPS)	W _{C1} (IN.)	W _{Rn} (IN.)
30 in. Diameter Drilled Shaft							
1	625.5	1086	548	SIDE + TIP	70	0.013	0.511
2	624.5	1148	584	SIDE + TIP	150	0.029	0.464
3	623.5	1198	613	SIDE + TIP	222	0.039	0.419
4	622.5	3469	1769	SIDE + TIP	293	0.047	1.153
5	621.5	3338	1707	SIDE + TIP	366	0.053	0.980
6	620.5	3527	1811	SIDE + TIP	398	0.052	0.997
7	619.5	4201	2162	SIDE + TIP	438	0.053	1.124
8	618.5	4645	2396	SIDE + TIP	480	0.054	1.177
9	617.5	4806	2485	SIDE + TIP	523	0.055	1.152
10	616.5	4988	2584	SIDE + TIP	567	0.057	1.135
11	615.5	5186	2692	SIDE + TIP	612	0.059	1.124
12	614.5	5218	2719	SIDE + TIP	672	0.062	1.088
13	613.5	5285	2763	SIDE + TIP	732	0.066	1.062
14	612.5	5375	2819	SIDE + TIP	792	0.069	1.044
15	611.5	5482	2884	SIDE + TIP	852	0.073	1.031
16	610.5	3070	1689	SIDE	761	0.070	1.101
17	609.5	3290	1809	SIDE	824	0.073	1.087
18	608.5	3509	1930	SIDE	887	0.077	1.077
19	607.5	3729	2051	SIDE	952	0.081	1.070
20	606.5	3948	2172	SIDE	1017	0.085	1.065
36 in. Diameter Drilled Shaft							
1	625.5	1496	754	SIDE + TIP	80	0.011	0.564
2	624.5	1571	797	SIDE + TIP	185	0.030	0.520
3	623.5	1634	833	SIDE + TIP	276	0.041	0.476
4	622.5	1686	863	SIDE + TIP	365	0.050	0.434
5	621.5	4626	2359	SIDE + TIP	455	0.058	1.159
6	620.5	5397	2759	SIDE + TIP	499	0.057	1.281
7	619.5	6194	3174	SIDE + TIP	548	0.057	1.398
8	618.5	6447	3312	SIDE + TIP	598	0.058	1.381
9	617.5	6625	3411	SIDE + TIP	650	0.060	1.351
10	616.5	6835	3526	SIDE + TIP	704	0.061	1.330
11	615.5	7066	3651	SIDE + TIP	758	0.064	1.315
12	614.5	7070	3667	SIDE + TIP	830	0.067	1.269
13	613.5	7123	3706	SIDE + TIP	902	0.070	1.236
14	612.5	7210	3763	SIDE + TIP	975	0.073	1.212
15	611.5	3421	1881	SIDE	828	0.070	1.324
16	610.5	3684	2026	SIDE	900	0.073	1.300
17	609.5	3948	2171	SIDE	974	0.076	1.281
18	608.5	4211	2316	SIDE	1048	0.080	1.266
19	607.5	4475	2461	SIDE	1124	0.083	1.254
20	606.5	4738	2606	SIDE	1200	0.087	1.244
42 in. Diameter Drilled Shaft							
1	625.5	1972	993	SIDE + TIP	86	0.008	0.619
2	624.5	2061	1043	SIDE + TIP	219	0.030	0.576
3	623.5	2138	1087	SIDE + TIP	332	0.043	0.534
4	622.5	2203	1125	SIDE + TIP	440	0.053	0.493
5	621.5	2387	1222	SIDE + TIP	554	0.061	0.471
6	620.5	7626	3887	SIDE + TIP	606	0.061	1.556
7	619.5	8406	4295	SIDE + TIP	662	0.061	1.636
8	618.5	8534	4370	SIDE + TIP	722	0.062	1.584
9	617.5	8725	4477	SIDE + TIP	783	0.064	1.548
10	616.5	8957	4605	SIDE + TIP	846	0.066	1.523
11	615.5	9218	4747	SIDE + TIP	909	0.068	1.504
12	614.5	9183	4745	SIDE + TIP	993	0.070	1.450
13	613.5	9214	4776	SIDE + TIP	1078	0.074	1.410
14	612.5	3684	2026	SIDE	874	0.070	1.565
15	611.5	3991	2195	SIDE	956	0.073	1.529
16	610.5	4298	2364	SIDE	1040	0.076	1.500
17	609.5	4606	2533	SIDE	1124	0.079	1.476
18	608.5	4913	2702	SIDE	1209	0.083	1.457
19	607.5	5220	2871	SIDE	1295	0.086	1.441
20	606.5	5528	3040	SIDE	1382	0.089	1.428

48 in. Diameter Drilled Shaft							
1	625.5	2513	1264	SIDE + TIP	87	0.005	0.674
2	624.5	2618	1324	SIDE + TIP	250	0.029	0.633
3	623.5	2709	1375	SIDE + TIP	387	0.044	0.592
4	622.5	2930	1492	SIDE + TIP	520	0.055	0.571
5	621.5	3146	1606	SIDE + TIP	656	0.065	0.547
6	620.5	4428	2261	SIDE + TIP	716	0.064	0.752
7	619.5	10789	5499	SIDE + TIP	781	0.065	1.845
8	618.5	10904	5570	SIDE + TIP	850	0.066	1.785
9	617.5	11101	5682	SIDE + TIP	920	0.067	1.744
10	616.5	11352	5821	SIDE + TIP	992	0.069	1.715
11	615.5	11639	5977	SIDE + TIP	1065	0.071	1.694
12	614.5	11580	5790	TIP	--	--	2.278
13	613.5	3859	2122	SIDE	901	0.071	1.829
14	612.5	4210	2315	SIDE	992	0.074	1.777
15	611.5	4561	2509	SIDE	1085	0.077	1.735
16	610.5	4912	2702	SIDE	1179	0.080	1.701
17	609.5	5264	2895	SIDE	1273	0.083	1.673
18	608.5	5615	3088	SIDE	1369	0.086	1.650
19	607.5	5966	3281	SIDE	1465	0.089	1.630
20	606.5	6318	3475	SIDE	1563	0.092	1.614
54 in. Diameter Drilled Shaft							
1	625.5	3120	1569	SIDE + TIP	82	0.000	0.730
2	624.5	3241	1637	SIDE + TIP	279	0.028	0.690
3	623.5	3502	1775	SIDE + TIP	445	0.045	0.670
4	622.5	3757	1909	SIDE + TIP	602	0.057	0.647
5	621.5	4005	2040	SIDE + TIP	759	0.067	0.621
6	620.5	5606	2857	SIDE + TIP	828	0.067	0.850
7	619.5	13463	6849	SIDE + TIP	903	0.068	2.051
8	618.5	13556	6911	SIDE + TIP	981	0.069	1.985
9	617.5	13753	7024	SIDE + TIP	1061	0.071	1.939
10	616.5	14017	7171	SIDE + TIP	1142	0.073	1.906
11	615.5	14656	7328	TIP	--	--	2.519
12	614.5	3946	2170	SIDE	908	0.072	2.121
13	613.5	4341	2387	SIDE	1009	0.075	2.047
14	612.5	4736	2605	SIDE	1111	0.078	1.988
15	611.5	5131	2822	SIDE	1214	0.081	1.941
16	610.5	5526	3040	SIDE	1318	0.083	1.902
17	609.5	5922	3257	SIDE	1423	0.086	1.870
18	608.5	6317	3474	SIDE	1529	0.089	1.843
19	607.5	6712	3692	SIDE	1636	0.093	1.820
20	606.5	7107	3909	SIDE	1743	0.096	1.801
60 in. Diameter Drilled Shaft							
1	625.5	3603	1802	TIP	--	--	0.814
2	624.5	4097	2067	SIDE + TIP	307	0.026	0.767
3	623.5	4393	2223	SIDE + TIP	501	0.045	0.746
4	622.5	4683	2376	SIDE + TIP	683	0.059	0.722
5	621.5	4966	2525	SIDE + TIP	864	0.070	0.694
6	620.5	6919	3520	SIDE + TIP	943	0.070	0.948
7	619.5	7447	3796	SIDE + TIP	1027	0.071	0.982
8	618.5	16486	8391	SIDE + TIP	1115	0.072	2.184
9	617.5	16677	8503	SIDE + TIP	1205	0.074	2.133
10	616.5	17316	8658	TIP	--	--	2.693
11	615.5	3945	2170	SIDE	895	0.073	2.453
12	614.5	4384	2411	SIDE	1005	0.076	2.347
13	613.5	4823	2653	SIDE	1117	0.079	2.264
14	612.5	5262	2894	SIDE	1229	0.081	2.199
15	611.5	5701	3136	SIDE	1342	0.084	2.146
16	610.5	6141	3377	SIDE	1457	0.087	2.103
17	609.5	6580	3619	SIDE	1572	0.090	2.067
18	608.5	7019	3860	SIDE	1688	0.093	2.036
19	607.5	7458	4102	SIDE	1806	0.096	2.011
20	606.5	7897	4343	SIDE	1924	0.099	1.989