STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHAGE RECONSTRUCTION
TAYLOR STREET BYPASS RAMP
BRIDGE OVER INTERSTATE 290
PROPOSED SN 016-1718
FAI 90/94/290, SECTION 2014-013R&B-R
IDOT D-91-227-13, PTB 163/ITEM 001
COOK COUNTY, ILLINOIS

for

AECOM

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Technical Report Documentation Page

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11. Abstract

A new, two-span structure will be constructed as a bypass ramp from Southbound I-90/94 to Taylor Street extending over both directions of I-290. The Taylor Street Bypass will have a stub-type north abutment with two solid wall piers; Pier 11 is shared with the WS Ramp Bridge (SN 016-1715). The back-to-back length will measure 151.2 feet and the out-to-out width will measure 29.2 feet.

Fill materials encountered at the bridge site are made up of medium dense granular soils. Beneath the fill, the borings encountered about 30 to 40 feet of very soft to medium stiff clay overlying stiff to hard silty clay. The deeper foundation soils include medium dense silt, hard silty clay loam and very dense silty loam resting on top of strong, good quality dolostone, which was encountered about 90 to 100 feet below existing grade. The site classifies in the Seismic Class D and is in Seismic Performance Zone 1.

New MSE retaining walls will be constructed to support the north approach embankment behind the abutment. The approach pavement settlement and global stability will depend on the type, height, and geometry of these new retaining walls; these issues will be discussed in separate retaining wall SGRs.

The proposed abutment and piers could be supported on drilled shafts founded in the hard silty clay loam, very dense silty loam, or socketed into the bedrock. For shafts founded in the silty clay loam or silty loam, we estimate factored resistance of 400 to 1700 kips for 3 to 4-foot diameter bases. For rock sockets, we estimate factored resistance of 2,20 to 4,000 kips. Minor downdrag loads should be added to the factored loads at the north abutment shafts due to the relatively large anticipated settlement of the approach and retaining walls.

A number of temporary excavations will likely be required to remove existing facilities and construct the new bridge abutment and piers. The design of temporary support systems should include the pay item *Temporary Soil Retention System*.

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1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations for the design and construction of the new Taylor Street Bypass Ramp Bridge linking Southbound Interstate 90/94 with the West-South (WS) Connector Ramp from Westbound Interstate 290 (WB I-290) to Southbound Interstate 90/94 (SB I-90/94) within the Circle Interchange in Chicago, Cook County, Illinois. A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands AECOM envisions a new, two-span structure supporting the bypass ramp. The structure will have an abutment at the north end as it exits SB I-90/94 and will connect to the WS Ramp (SN 016-1715) at Pier 11. The structure will have a stub type abutment and two solid wall piers, supported on deep foundations. The bridge will have a back-to-back length of 151.2 feet; from north to south, the spans will measure 62.8 and 83.9 feet. The out-to-out bridge width will measure 29.2 feet to accommodate one 16-foot wide lane, one 6-foot wide shoulder, one 4-foot wide shoulder, and two barriers.

The abutment will be constructed atop a new approach embankment supported on each side by mechanically-stabilized earth (MSE) walls. Based on the TSL plan, we estimate the approach embankment and associated walls will have maximum exposed heights of about 18 to 20 feet measured from the existing ground surface at an elevation of approximately 579 feet to the top of the proposed abutment at approximately 599 feet. Temporary excavations will require *Temporary Soil Retention Systems* for support.

The purpose of our investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and construction of the foundations.

1.2 Existing Structure

The proposed structure is part of the Circle Interchange reconstruction and will be a new bypass; there is no existing Taylor Street Bypass structure. The Circle Interchange is currently a system of numerous ramps, embankments, and expressways that are scheduled for complete renovation.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The site is located within the City of Chicago. On the USGS *Chicago Loop 7.5 Minute Series* map, the bridge is located in the NW¼ of Section 16, Tier 39 N, Range 14 E of the 3rd Principal Meridian.

The following review of published geologic data, with emphasis on factors that might influence the design and construction of the proposed engineering works, is meant to place the project area within a geological framework and confirm the dependability and consistency of the present subsurface investigation results. For the study of the regional geologic framework, Wang considered northeastern Illinois in general and Cook County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

2.1 Physiography

The site is situated within the northern section of the Chicago/Calumet lacustrine plain (Chrzatowsky and Thompson 1992). The flat, lakeward-sloping surface is a wave-scoured groundmoraine covered by thin and discontinuous offshore lacustrine silt and clay (Willman 1971).

At the proposed bridge location, a number of existing ramps cross the alignment, converging and diverging with I-90/94 while crossing over I-290. The elevation along the existing ground surface adjacent to I-290 varies between about 578 to 582 feet, whereas I-90/94 immediately to the east was constructed within a minor cut. The existing CTA facilities also run between the two directions of I-290 and sit about 10 to 20 feet below the I-290 elevation. This area is supported on both sides by concrete cantilever retaining walls immediately adjacent to I-290.

2.2 Surficial Cover

Within the project area, a more than 75-foot thick, Wisconsinan-age glacial drift covers the bedrock (Leetaru et al. 2004). The glacial cover is made up of clay and silt of the Equality Formation of the Mason Group and diamictons of the Wadsworth and Lemont Formations of the Wedron Group (Hansel and Johnson 1996). The Equality Formation is made up of bedded silt and clay, locally laminated, with lenses and/or thin beds of sand and gravel. The Wadsworth Formation consists of relatively homogenous, massive, gray till with clay to silty clay matrix, with dolostone and shale clasts and occasional lenses of sorted and stratified silt. The Wadsworth Formation is underlined by the pebbly silty clay loam to silty loam diamicton of the Yorkville Member of the Lemont Formation, known informally as the Chicago "hardpan."

The Equality Formation is characterized by low strength, medium to high plasticity, and medium to high moisture content. The underlying Wadsworth Formation is characterized by low plasticity, medium to low moisture content, medium to very stiff consistency, poor permeability, and low compressibility. The Yorkville Member is characterized by low plasticity, high blow counts, and low moisture content (Bauer et al. 1991; Peck and Reed 1954).

2.3 Bedrock

In the project area, the glacigenic deposits rest unconformably over a 350-foot thick Silurian-age dolostone. The top of bedrock may be encountered at elevations lower than 500 feet or 75 to 100 feet below ground surface (bgs). The Silurian dolostone dips gently eastward at a pace of 15 feet per mile. Only inactive faults are known in the area, and the seismic risk is minimal (Leetaru et al. 2004; Willman 1971). There are no records of mining activity in the area, but deep tunnel excavations are known to exist throughout the Circle Interchange area.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed the native sediments consist of clay to silty clay diamicton of the Wadsworth Formation resting on top of more competent silty clay loam diamicton (hardpan) of the Lemont Formation, which in turn is underlain by bedrock. Sound dolostone bedrock was sampled or inferred at depths deeper than 90.0 feet bgs or an elevation of 488 feet, within or close to the range predicted based on published geological data.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations performed by Wang.

3.1 Subsurface Investigation

The subsurface investigation, performed by Wang between March and July 2013, consists of three structure borings, designated as 1705-B-11, 2081-B-03, and 2081-B-04. The borings were drilled from elevations of 578.7 to 581.4 feet to depths of 85 to 104 feet bgs. The as-drilled northings, eastings, and elevations were surveyed by Dynasty Group, with stations, and offsets provided by AECOM. The boring locations are presented in the *Boring Logs* (Appendix A) and in the *Boring Location Plan* (Exhibit 3).

A truck-mounted drilling rig, equipped with solid stem augers and mud rotary equipment, was used to advance and maintain an open borehole. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils*." The soil was sampled at 2.5-foot intervals to 30 feet bgs and at 5-foot intervals thereafter. Samples collected from each interval were placed in sealed jars for further examination and testing. NWD4-size bedrock cores were collected from Boreholes 1705-B-11 and 2081-B-03 in 10-foot runs.

Field boring logs, prepared and maintained by a Wang geologist, include lithological descriptions, visual-manual soil classifications (IDH Textural Classification), results of Rimac and/or pocket penetrometer unconfined compressive strength tests, and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration. The bedrock cores were described and measured for recovery and Rock Quality Designation (RQD).

Groundwater observations were made during and at the end of drilling operations. The boreholes were grouted immediately upon completion.

3.2 Laboratory Testing

Soil samples were tested in the laboratory for moisture content (AASHTO T-265). Atterberg limits (AASHTO T 89/T 90) and particle size (AASHTO T 88) analyses were performed to classify selected samples. Field visual descriptions of the soil samples were verified in the laboratory and the tested samples were classified in accordance with the IDH Textural Classification chart. Laboratory test results are shown in the *Boring Logs* (Appendix A) and in the *Laboratory Test Results* (Appendix B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 4). Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

4.1 Soil Conditions

The borings were drilled adjacent to and through the existing I-290 shoulders. The pavement sections include 14 inches of asphalt pavement overlying either 11 inches of concrete or 4 inches of crushed stone aggregate. The boring drilled off the shoulder encountered 8 inches of crushed stone aggregate along the surface.

In descending order, the general lithological succession encountered beneath the pavement or aggregate surface includes 1) man-made ground (fill); 2) very soft to medium stiff clay to silty clay; 3) stiff to hard silty clay and silty clay loam; 4) medium dense silt; 5) hard silty clay loam and very dense silty loam; 6) very dense gravelly sandy loam; and 7) strong, good quality dolostone.

(1) Man-made ground (fill)

The existing embankments are made up of 5 to 15 feet of loose to medium dense, gray and light brown aggregate and gravelly sand. The fill has N-values of 8 to 30 blows per foot and moisture content values of 5 to 14%. The fill material is about 7 to 10 feet deeper at Boring 2081-B-04 due to a likely removal and replacement of poor soil during the construction of either eastbound I-290 or the Halsted Street Bridge.

(2) Very soft to medium stiff clay to silty clay

At elevations ranging from 571 to 576 feet, the fill rests on top of about 30 to 40 feet of very soft to medium stiff, gray clay to silty clay. The top 10 to 15 feet of this layer has an average unconfined compressive strength (Q_u) value of about 0.5 tsf and moisture content values averaging 19%. The middle 15 feet is very soft, with Q_u averaging less than 0.3 tsf and moisture content values averaging 27%. The bottom 10 feet grades back to medium stiff, with an average Qu value of 0.7 tsf and moisture content value of about 21%.

(3) Stiff to hard silty clay to silty clay loam

The very soft to medium stiff clay to silty clay is underlain by 15 to 20 feet of stiff to hard, gray silty clay to silty clay loam. The Q_u values range between 1.0 and 6.0 tsf with an average of about 3.0 tsf and moisture content values range from 13 to 21% with an average of 17%. Laboratory testing on a sample of this soil layer from Boring 1705-B-11 shows a liquid limit (L_L) value of 37% and a plastic limit (P_L) value of 17%.

(4) Medium dense silt

At elevations ranging from 522 to 524 feet, the borings encountered a thin, 5-foot thick layer of medium dense, gray silt. This soil has an N-value of 9 to 27 blows per foot and a moisture content of 17 to 29%. Due to the decreased strength and increased moisture of this layer relative to the silty clay and silty clay loam above, we recommend advancing deep foundations through this soil layer to the material below.

(5) Hard silty clay loam and very dense silty loam

Beginning at elevations of about 517 to 519 feet, the borings advanced through hard, gray silty clay and very dense silty loam. The clayey soils in this layer measured N-values of 51 to 62 blows per foot, Q_u values greater than 6.0 tsf, and moisture content values of 15 to 23%. The silty loam has noticeably higher N-values, generally encountering spoon refusals, and has lower moisture content values of 10 to 15%.

(6) Very dense gravelly sandy loam

Immediately above the bedrock, Borings 2018-B-03 and 1705-B-11 both encountered very dense, gray gravelly sandy loam with dolostone fragments and cobbles. Sampling resulted in spoon refusals after 3 to 6 inches.

(7) Strong, good quality dolostone

Borings 2018-B-03 and 1705-B-11 confirmed the top of sound bedrock at elevations of 487 and 489 feet with 10-foot long bedrock cores. The coring revealed strong dolostone of good rock quality having RQD values of 72 to 82%. Strength testing on cores from Boring 1705-B-11 measured uniaxial compressive strength values of 8,400 to 9,700 psi.

4.2 Groundwater Conditions

Groundwater was encountered during drilling within the gravelly sand below an elevation of about 525 feet. At the completion of drilling, the groundwater levels measured as low as 500 feet and as high as 575 feet. For design purposes, the gravelly sand and any other granular materials encountered below 525 feet, should be considered water-bearing and should be accounted for during the design and construction of the foundations. One piezometer test conducted near the structure, designated as 1703-PZ-01, shows an average water table elevation at 553.0 feet.

4.3 Seismic Design Considerations

The seismic site class has been determined in accordance with the IDOT *All Geotechnical Manual Users (AGMU) 9.1* method of analysis. The soils within the top 100 feet have a weighted average S_u of 1.42 ksf (AASHTO 2012; Method C controlling), and the results classify the site in the Seismic Site Class D in accordance with the IDOT method. The analysis has been performed for shaft foundations with minimum diameters of 36 inches. Smaller diameter shafts or driven piles may have more conservative seismic design parameters. The project location belongs to the Seismic Performance Zone 1. The seismic spectral acceleration parameters recommended for design in accordance with AASHTO (2012) are summarized in Table 1. The factor of safety (FOS) against liquefaction for the bridge site is greater than the AASHTO-required value of 1.

Table 1: Seismic Design Parameters

Spectral Acceleration Period (sec)	Spectral Acceleration Coefficient[1)] (% g)	Site Class Factors	Design Spectrum for Site Class D[2)] (% g)
0.0	PGA = 4.2	F_{pga} = 1.6	**A_s = 6.6**
0.2	S_S = 9.0	F_a = 1.6	**S_{DS} = 14.4**
1.0	S_1 = 3.6	F_v = 2.4	**S_{D1} = 8.5**

1) Base spectral acceleration coefficients from AASHTO (2012)

2) Site Class D values to be presented on plans ($A_s = PGA*F_{pga}$; $S_{DS}= S_S*F_a$; $S_{D1}= S_1*F_v$)

5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Geotechnical evaluations and recommendations for the approach embankment, approach slab, and structure foundations are included in the following sections. A new, north stub abutment is shown on the current TSL plan, dated July 17, 2017. The abutment will be constructed above and behind new MSE walls on each side with maximum heights of about 20 feet. This structure shares Pier 11 with the proposed West-South (WS) Ramp Bridge, SN 016-1715. We recommend supporting the abutment and piers on drilled shafts.

5.1 Approach Embankments and Slabs

Wang will address settlement and global stability for the north approach embankment and approach slabs in the individual retaining wall SGRs. We anticipate the 20-foot fill section required along the wall will undergo long-term consolidation settlements and the foundation soils will require ground improvement to meet the IDOT-required factor of safety (FOS) for global stability.

5.1.1 Settlement

The ramp grading behind the abutments will include significant changes by both cut and fill sections. We anticipate fill heights could reach as high as 25 feet above existing grade, and would induce long-term consolidation settlement on the order of 6 to 10 inches. At the north abutment the settlement will induce negative skin friction along the sides of the drilled shafts through the length of the very soft to medium stiff silty clay (**Layer 2**); these structural losses are discussed in in Section 5.2. We anticipate the foundation soils will require improvement prior to fill placement; alternatively, lightweight fill and deep foundation options will also be explored. These evaluations will be provided in SGRs for the individual retaining walls.

5.1.2 Global Stability

The retaining walls proposed along the approach embankments will likely require ground improvement to achieve an FOS of 1.5 against global instability. When updated ramp wall geometries are available, the slope stability analysis will be performed and the evaluations provided in the retaining wall SGRs.

5.2 Structure Foundations

Wang recommends supporting the abutment and piers on drilled shafts. The shafts could be supported within the very dense silty loam or socketed into the bedrock. Due to noise and vibration concerns, we do not recommend the use of driven piles.

Preliminary structure loads, provided by HBM Engineering Group, show a total north abutment factored load of 801 kips, a total Pier 1 factored load of 1697 kips and a total Pier 11 load of 1012 kips. The Pier 11 loading does not include the loading from SN 016-1715, which shares Pier 11 to the east.

5.2.1 Drilled Shafts

The foundations for the abutments and piers could be supported on drilled shafts. The borings encountered 15 feet or more of very dense silty loam at elevations below 515 feet. We estimate the shafts could be established within this soil layer (**Layer 5**). Alternatively, the shafts could be socketed into the bedrock encountered at an average elevation of about 488 feet.

Shafts bearing on intermediate geomaterials with either N-values greater than 50 blows per 6-inches of penetration or Q_u values greater than 5.0 tsf should be designed for an end bearing resistance factor (ϕ_{stat}) of 0.55 (AASHTO 2014). We estimate the abutment and Pier 1 shafts established within the low moisture, very dense silty loam should be designed based on a nominal unit base resistance of 60 ksf and a factored unit base resistance of 33 ksf. The Pier 11 shafts should be designed based on a nominal unit base resistance of 45 ksf and a factored base resistance of 25 ksf. The R_F, R_N, and estimated base elevations are summarized below in Table 2 for 3-, 4-, and 6-foot diameter base.

We estimate the settlement of the shafts will be less than 0.5 inch; however the settlement of the north approach and retaining walls may induce some downdrag loading along the sides of those shafts. The use of the temporary casing, required to prevent the possibility of shaft squeeze (Section 6.5), will remold the soft clayey soils along the shaft wall and makes assessing the resulting friction highly variable and unpredictable. To evaluate the potential downdrag loading along the shaft we assume the full, average Q_u value of the layer. Furthermore, the shaft capacities provided in Table 2 are calculated for end bearing only and, therefore, there is no geotechnical resistance loss. To account for the potential downdrag, we recommend adding an additional 110 kips of factored load to the structural load of 3-foot diameter north abutment shafts, 127 kips to 3.5-foot diameter shafts, and 145 kips to 4-foot diameter shafts.

Table 2: Estimated Resistances and Base Elevations for Shafts in Very Dense Silty Loam

Structure Unit	Shaft Cap Base Elevations (feet)	Nominal Unit Base Resistance (ksf)	Base Diameter (feet)	Nominal Shaft Resistance, R_N (kips)	Factored Resistance Available, R_F (kips)	Total Shaft Length (feet)	Estimated Shaft Base Elevation (feet)
North Abutment (1705-B-11)	591	60	3	424	233	82	509
			4	754	415	82	509
			6	1696	933	82	509

Structure Unit	Shaft Cap Base Elevations (feet)	Nominal Unit Base Resistance (ksf)	Base Diameter (feet)	Nominal Shaft Resistance, R_N (kips)	Factored Resistance Available, R_F (kips)	Total Shaft Length (feet)	Estimated Shaft Base Elevation (feet)
Pier 1 (2081-B-03)	577	60	3	424	233	68	509
			4	754	415	68	509
			6	1696	933	68	509
Pier 11 (2081-B-04)	574	45	3	320	176	66	508
			4	565	311	66	508
			6	1272	700	66	508

If the estimated bearing resistances for drilled shafts established within the silty loam and silty clay loam do not meet the loading criteria, the shafts will require rock sockets. The bedrock cores shows uniform, good rock quality conditions, with sound, unfractured bedrock beginning about 4 feet below the top. We estimate the rock sockets will have diameters of 3.0 to 4.0 feet. Above the bedrock, the shafts should have diameters 6 inches larger than the sockets. Due to the possibility of water-bearing granular soil layers immediately above the bedrock, the shafts should include casing extending to the top of the rock. We recommend designing the rock sockets based on the methods outlined in the 2014 AASHTO LRFD *Bridge Design Specifications*, which indicate the sockets should be designed for a geotechnical unit base resistance factor (ϕ_{stat}) 0.50 (AASHTO 2014). GSI values were determined considering the rock mass structure and surface conditions of discontinuities of rock cores taken from soil borings GSI values ranged from 50 to 60. Based on this criterion, the R_F, R_N, and estimated base elevations for 3.0-, 3.5-, and 4.0- foot diameter sockets are summarized below in Table 3.

We estimate the settlement of the rock sockets will be less than 0.5 inch. Installing and removing casing from the shafts above the bedrock will reduce the side friction in the soil and render it highly variable and unpredictable; therefore, side friction within the soil is not considered in the design. The north abutment shafts, however, should have the same factored downdrag loads added to the factored structural loads discussed above (110 kips of factored load to the structural load of 3-foot diameter north abutment shafts, 127 kips to 3.5-foot diameter shafts, and 145 kips to 4-foot diameter shafts.)

Table 3: Estimated Resistances and Base Elevations for Rock Socket Shafts

Structure Unit	Top of Bedrock Elevation (feet)	Socket Diameter (feet)	Nominal Unit Socket Resistance (ksf)	Nominal Socket Resistance, R_N (kips)	Factored Resistance Available, R_F (kips)	Total Socket Length (feet)	Estimated Total Shaft Length (feet)
North Abutment (1705-B-11)	487	3.0	650	4590	2295	4.0	108
		3.5	650	6250	3125	4.0	108
		4.0	650	8160	4080	4.0	108
Pier 1 (2081-B-03)	489	3.0	650	4590	2295	4.0	91
		3.5	650	6250	3125	4.0	91
		4.0	650	8160	4080	4.0	91
Pier 11 (2081-B-04)	489	3.0	650	4590	2295	4.0	88
		3.5	650	6250	3125	4.0	88
		4.0	650	8160	4080	4.0	88

We understand Pier 11 may incorporate some of the existing drilled shafts from existing west-south ramp SN 016-2450 into the new pier. Design drawings for the existing structure indicate the shafts were designed to terminate and bell at an elevation of -50.0 feet, City of Chicago Datum, or an elevation of about 530 feet, NAVD88, and the bells had diameters of 6.5 to 7.5 feet. The plan set also, however, includes notes that A) the shafts termination depth is to be determined in the field at the time of construction and B) the shaft bearing capacity is 12 ksi. At an elevation of 530 feet, Boring 1705-B-04 shows very stiff silty clay with a Q_u value of 2.1 tsf. We estimate this material has a factored bearing resistance of only 7 ksf based on AASHTO and a clay resistance factor of 0.40 (2014). The shafts would have to have been extended deeper to achieve the required capacity of 12 ksi.

5.2.2 Lateral Loading

Lateral loads on piles and shafts should be analyzed for maximum moments and lateral deflections. Recommended lateral soil modulus and strain parameters required for analysis via the p-y curve method are included in Table 4 and rock parameters are included in Table 5. The incremental parameters for the soft silty clay (**Layer 2**) were obtained from vane shear testing conducted in Boring VST-06 located at the southwest corner of W. Van Buren Street and S Des Plaines Street . Information on the vane shear testing in Boring VST-06 are provided in Appendix A for reference.

Table 4: Recommended Soil Parameters for Lateral Load Analysis

Soil Type (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength, c_u (psf)	Estimated Friction Angle, ϕ (°)	Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50} (%)
M Stiff to V Stiff SILTY CLAY (2) Surface to EL 565 feet	125	1000	0	500	0.7
Soft to M Stiff CLAY (2) EL 565 to 553 feet	115	670	0	100	1.0
Soft to M Stiff CLAY (2) EL 553 to 542 feet	115	840	0	100	1.0
Stiff to Hard SILTY CLAY (3) EL 542 to 525 feet	125	3500	0	2000	0.5
M Dense SILT (4) EL 525 to 520 feet	120	0	32	60	--
Hard SILTY CLAY LOAM (5) EL 520 to 495 feet (B-04) EL 520 to 505 feet (B-03)	125	4500	0	3000	0.5
V. Dense SILTY LOAM (5) EL 520 to 492 feet (B-11)	125	4500	0	3000	0.3
V. Dense SANDY LOAM (5) EL 505 to TOR (B-03) EL 492 to TOR (B-11)	125	0	40	120	--

Table 5: Recommended Rock Parameters for Lateral Load Analysis

Rock Type	Total Unit Weight, γ (pcf)	Young's Modulus (ksi)	Uniaxial Comp. Strength (ksi)	RQD (%)	Lateral Rock Modulus Parameter
Fair to Good Quality DOLOSTONE	135	2,500	8.4	72	0.0005

5.3 Stage Construction Design Recommendations

Construction of the abutment will require embankment fill sections adjacent to the existing SB I-90/94 and WB I-290 roadways. Stage construction will not be required during construction. We estimate temporary shoring of the pier excavations will be required and we understand driven sheet piling will be not be utilized throughout the Circle Interchange Project. Therefore, the pier excavations should be supported by *Temporary Soil Retention Systems* designed by the Contractor and approved by IDOT prior to construction.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

All vegetation, surface topsoil, existing pavement, and debris should be cleared and stripped where foundations and structural fills will be placed. For the new MSE walls surrounding the abutment, the leveling pad may be installed within very soft clay. To establish a working platform, we recommend excavating 12 inches below the proposed leveling pad elevations, placing a geotextile fabric, and backfilling to the base elevation with aggregate of IDOT gradation CA-1 or CA-6 (2016).

6.2 Excavation

Foundation excavations should be performed in accordance with local, state, and federal regulations. The potential effect of ground movements upon nearby utilities should be considered during construction.

The TSL plan shows the construction of both piers immediately adjacent to the existing CTA cut walls. These walls are shown as reinforced concrete cantilever (RCC) walls on deep foundations and will support excavations for the pier caps. The walls are shown in the TSL plan without heals; this distinction should be confirmed prior to final design, as the existence of RCC heals will prevent construction of the pier shafts immediately adjacent to the walls, as shown in the plan.

6.3 Filling and Backfilling

Fill material required to attain the final design elevations should be structural fill material and should be pre-approved prior to placement. Compacted cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (IDOT 2016). The fill material should be free of organic matter and debris. Structural fill should be placed in lifts and compacted according to IDOT Section 205, *Embankment* (IDOT 2016). The onsite fill materials could be considered as new fill material assuming it has an organic content lower than 10%.

Backfill materials must be pre-approved by the Resident Engineer. To backfill the abutment and piers we recommend the porous granular material conforming to the requirements specified in the IDOT Special Provision, *Granular Backfill for Structures*. Backfill material should be placed and compacted in accordance with the Special Provision.

6.4 Earthwork Operations

The required earthwork can be accomplished with conventional construction equipment. Moisture and traffic will cause deterioration of exposed subgrade soils. Precautions should be taken by the contractor to prevent water erosion of the exposed subgrade. A compacted subgrade will minimize water runoff erosion.

Earth moving operations should be scheduled to not coincide with excessive cold or wet weather (early spring, late fall, or winter). Any soil allowed to freeze or soften due to the standing water should be removed. Wet weather can cause problems with subgrade compaction.

It is recommended that an experienced geotechnical engineer be retained to inspect the exposed subgrade, monitor earthwork operations, and provide material inspection services during the construction phase of this project.

6.5 Drilled Shafts

The installation of drilled shafts through the water-bearing sand and gravelly sand frequently occurring above the hard silty clay and/or immediately atop of bedrock may present challenges. We expect the shaft excavations will encounter groundwater in granular layer shown in borings and the

Contractor should be prepared to install casing and provide drilling fluid at each shaft location. For shafts socketed into the underlying bedrock, casing extending to the top of bedrock elevation will be required to seal the excavation for coring. Failure to anticipate the challenges posed by the groundwater at this depth will result in caving or heaving sand and complicate bedrock coring operations. Prior to coring the bedrock, casing should be firmly seated into the top of the rock, and any drilling fluid removed to prevent caking of mud on the sides of the bedrock sockets. The shafts should be designed 6 inches larger in diameter than the proposed sockets.

The soft soil layer with Qu less than 0.5 tsf (500 ksf cohesion) is prone to squeeze if left open for long period of time (Budiman et al 2005). Therefore, to minimize the squeeze potential, casing should be provided. The designer should add the following note on the plans, per IDOT:

> "Based on the high squeeze potential of the clay soils, the use of temporary casing will be required in order to properly construct the drilled shafts. Casing may be pulled or left in place, as determined by the contractor at no cost to the department."

The shafts should be constructed in accordance with FHWA Publication NHI-10-016, *Drilled Shafts: Construction Procedures and LRFD Design Methods* (Brown et al. 2010).

In the event that permanent casing is not designed for the construction of drilled shaft socketed into bedrock, shafts structural integrity should be verified by Crosshole Sonic Logging (CSL). IDOT special provision "Crosshole Sonic Logging" dated March 9, 2010 or latest edition should be included in the specifications for inspection and testing of drilled shaft socketed into bedrock. Wang recommends providing CSL structural integrity testing for at least one drilled shaft per substructure.

The TSL plan shows the shafts for Piers 1 and 11 advanced immediately adjacent to retaining walls housing CTA facilities. The augering of the shafts should be positioned such that there is not contact between the walls and the excavation equipment. We recommend a clear zone of at least 2 to 5 feet be provided for this purpose. The designer should consider the potential effects of these open excavations adjacent to the walls and provide proper temporary casing if it is estimated that open shafts will present structural issues for the integrity of the walls.

7.0 QUALIFICATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 3. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of the bridge are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist AECOM and the Illinois Department of Transportation on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

WANG ENGINEERING, INC.

Mickey L. Snider, P.E.
Senior Geotechnical Engineer

Jerry W.H. Wang, Ph.D., P.E.
QA/QC Reviewer

MICKEY L. SNIDER
STATE OF ILLINOIS
062-058045
11/2017
PROFESSIONAL ENGINEER

REFERENCES

AASHTO (2014) LRFD Bridge Design Specifications, 7th Edition: Washington, D.C., American Association of State Highway and Transportation Officials.

BAUER, R.A., CURRY, B.B., GRAESE, A.M., VAIDEN, R.C., SU, W.J., and HASEK, M.J. (1991) Geotechnical Properties of Selected Pleistocene, Silurian, and Ordovician Deposits of Northeastern Illinois: Environmental Geology 139, Illinois State Geological Survey, 69 p.

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CHRZATOWSKY, M.J., and THOMPSON, T.A. (1992) Late Wisconsinan and Holocene coastal evolution of the southern shore of Lake Michigan, *in* Fletcher, C.H., III, and Wehmiller, J.F., eds., Quaternary Coasts of the United States: Marine and Lacustrine Systems: SEPM Special Publication No.48: Tulsa, Oklahoma, Society for Sedimentary Geology, p. 397-413.

HANSEL, A.K., and JOHNSON, W.H. (1996) Wedron and Mason Groups: Lithostratigraphic Reclassification of the Wisconsin Episode, Lake Michigan Lobe Area: ISGS Bulletin 104: Champaign, Illinois State Geological Survey, 116 p.

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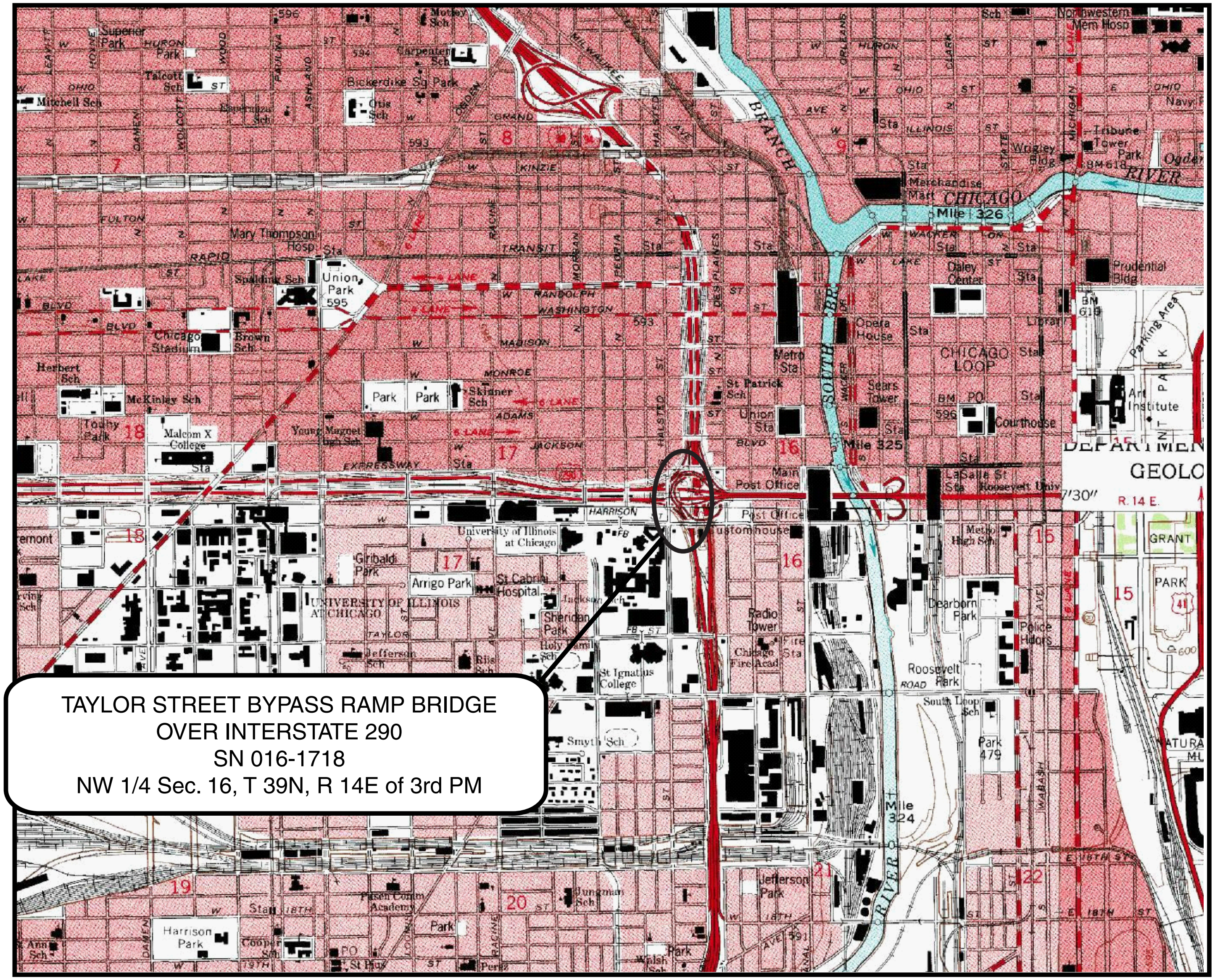
IDOT (2016) Standard Specifications for Road and Bridge Construction, Illinois Department of Transportation, 1160p.

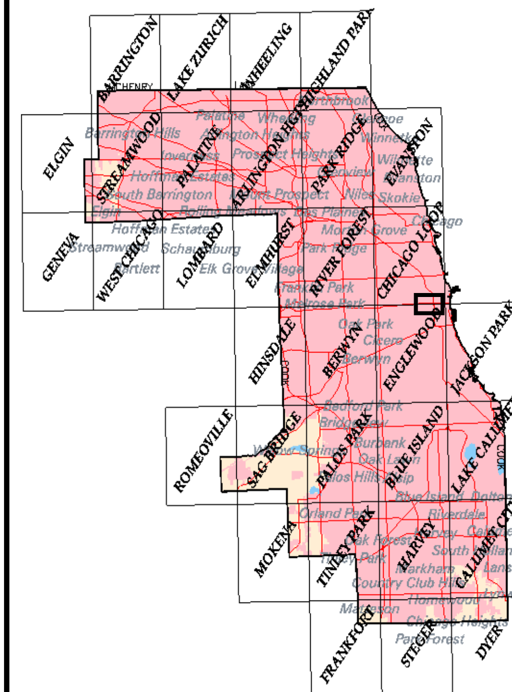
LEETARU, H.E., SARGENT, M.L., and KOLATA, D.R. (2004) Geologic Atlas of Cook County for Planning Purposes, Open File Series 2004-12, Illinois State Geological Survey, p. 30.

PECK, R.B., and REED, W.C. (1954) Engineering Properties of Chicago Subsoils: University of Illinois Engineering Experiment Station Bulletin No. 423: Urbana, University of Illinois, 62

WILLMAN, H.B. (1971) Summary of the Geology of the Chicago Area, ISGS Circular C460: Urbana, Illinois State Geological Survey, p. 77.

EXHIBITS





Cook County

0 0.25 0.5 Mile

SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION
TAYLOR BYPASS RAMP BRIDGE, SN 016-1718, COOK COUNTY

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: M. de los Reyes CHECKED BY: M. Snider

Wang Engineering

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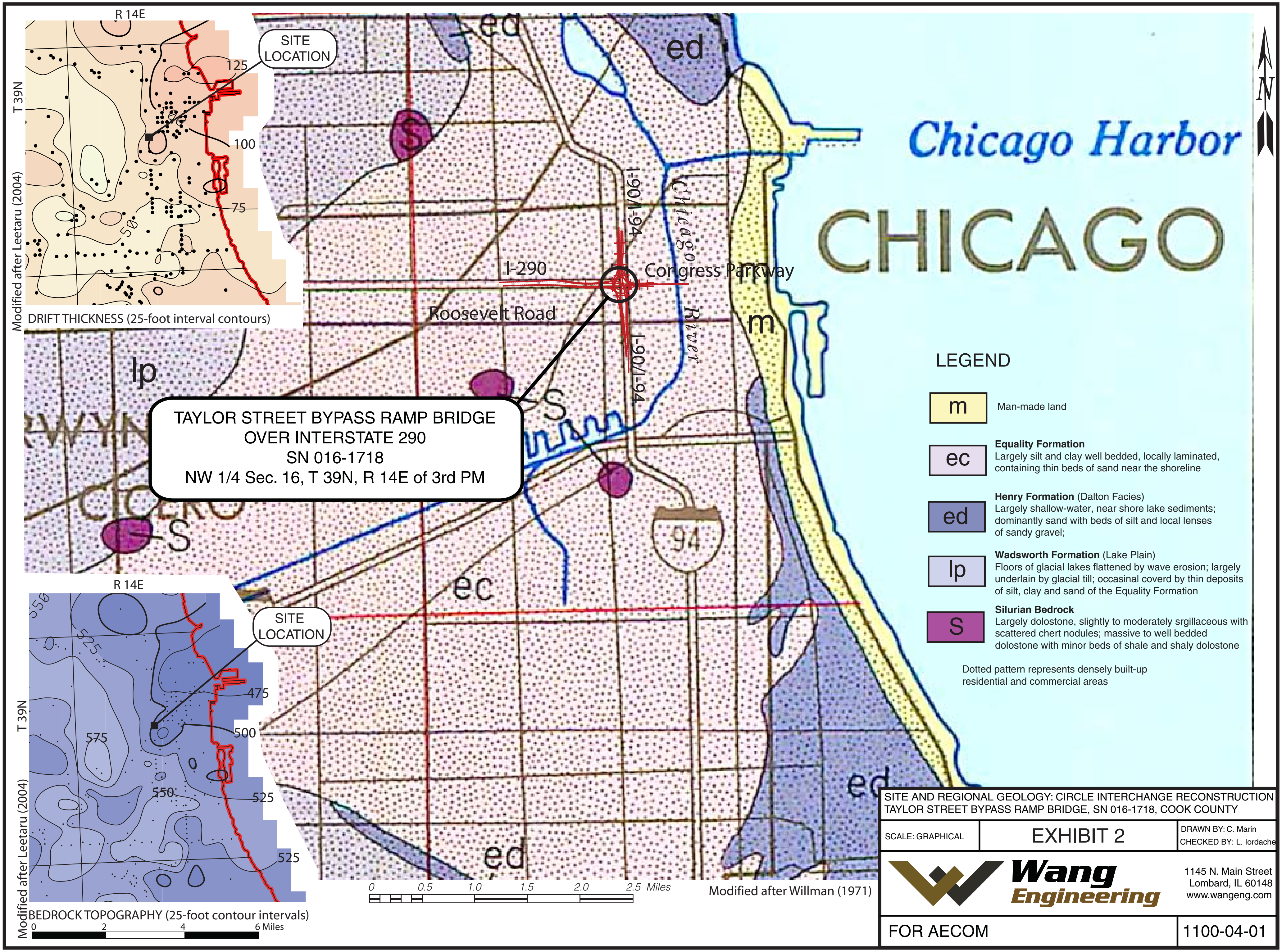
Lombard, IL 60148
www.wangeng.com

FOR AECOM	1100-04-01

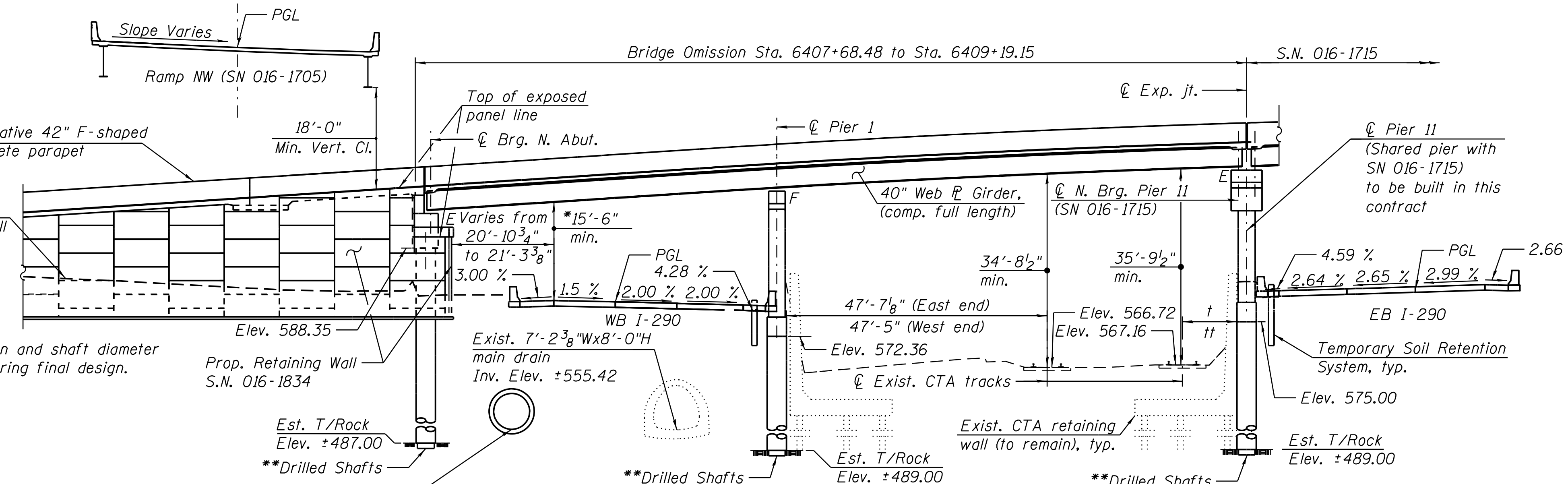


SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION
TAYLOR STREET BYPASS RAMP BRIDGE, SN 016-1718, COOK COUNTY

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: C. Marin CHECKED BY: L. Iordache
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01

Benchmark: Cut square at southeast corner of Van Buren St. and Halsted St., on northeast corner of first step of decorative pillar. Elevation 594.00.

Existing Structure: None



ELEVATION

* Final Min. Vert. Cl.

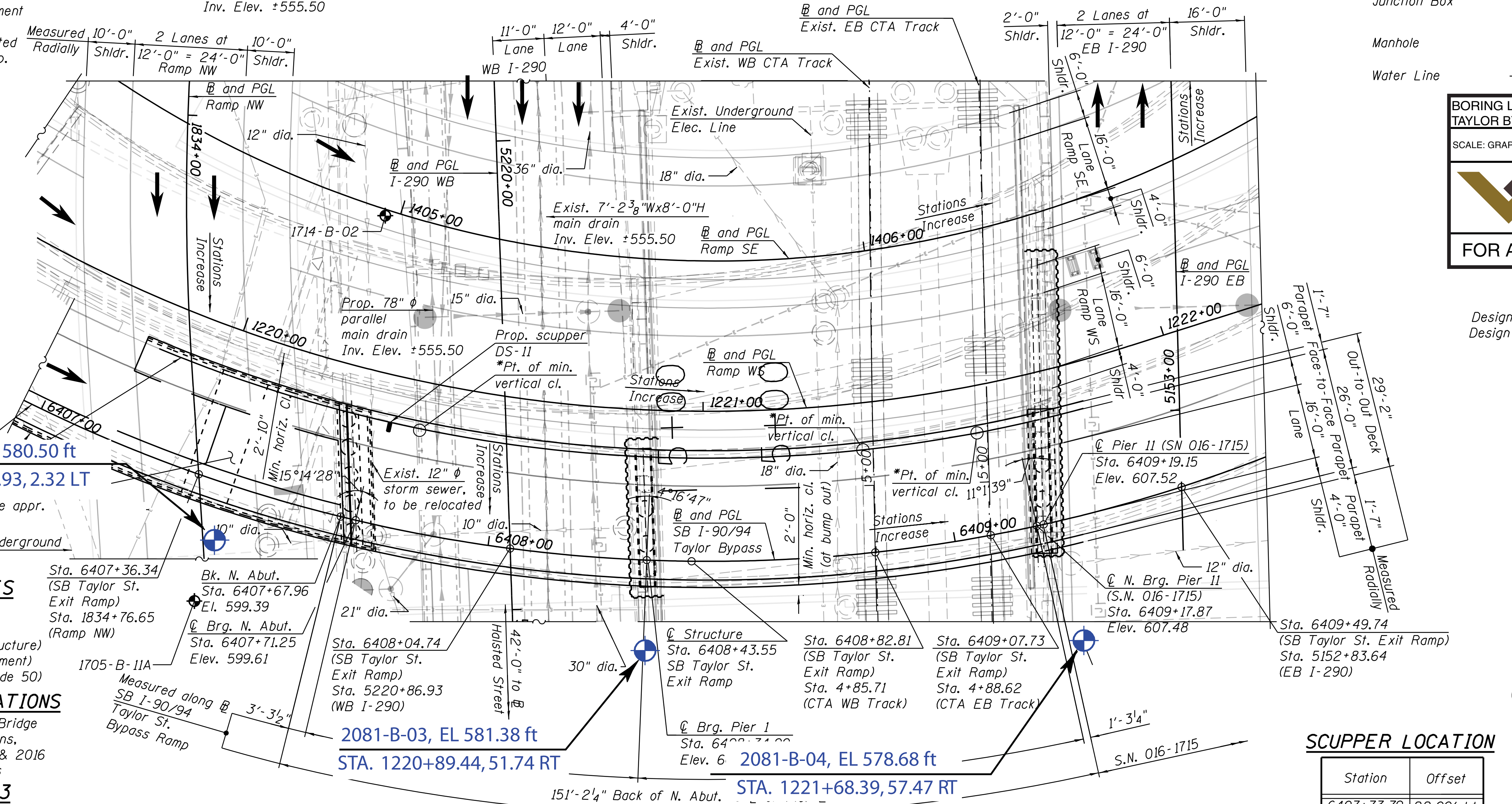
** Spacing, tip elevation and shaft diameter to be determined during final design.

t = 9'-5⅞" (East end)

tt = 8'-9¾" (West end)

NOTES:

1. The existing drainage manholes at the northwest corner of the prop. abutment and Ret. Wall 47 (SN 016-1834) shall be relocated to avoid conflict with prop. construction.
2. For additional Notes, see Sheet 2 of 3.



PLAN

N

HIGHWAY CLASSIFICATION

Ramp SE
Functional Class: Interstate
ADT: 4,600 (2010); 5,000 (2040)
ADTT: 123 (2012); 134 (2040)
DHV: 440 (2040)
Design Speed: 25 m.p.h.
Posted Speed: 25 m.p.h.
One-Way Traffic
Directional Distribution: NA

SB I-90/94 Taylor St. Bypass Ramp
Functional Class: Interstate
ADT: NA (2012); 8,000 (2040)
ADTT: NA (2012); 240 (2040)
DHV: 590 (2040)
Design Speed: 25 m.p.h.
Posted Speed: NA
One-Way Traffic
Directional Distribution: 100%

Ramp WS
Functional Class: Interstate
ADT: 7,200 (2012); 8,000 (2040)
ADTT: 114 (2012); 127 (2040)
DHV: 710 (2040)
Design Speed: 25 m.p.h.
Posted Speed: 25 m.p.h.
One-Way Traffic
Directional Distribution: NA

Ramp NW
Functional Class: Interstate
ADT: 32,500 (2012); 36,000 (2040)
ADTT: 2,483 (2012); 2,750 (2040)
DHV: 2,790 (2040)
Design Speed: 35 m.p.h.
Posted Speed: 35 m.p.h.
One-Way Traffic
Directional Distribution: 100%

LEGEND:

Soil Boring		Combined Sewer	
Temporary Soil Retention System		Electric	E
Junction Box		Fiber Optic	FO
Manhole		Exist. Storm Sewer	
Water Line	W	Prop. Storm Sewer	
		Telephone	T

BORING LOCATION PLAN: CIRCLE INTERCHANGE RECONSTRUCTION
TAYLOR BYPASS RAMP BRIDGE, SN 016-1718, COOK COUNTY

SCALE: GRAPHICAL	EXHIBIT 3	DRAWN BY: RKC CHECKED BY: A. Kurnia

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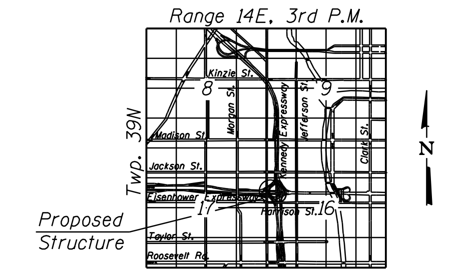
SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.085g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.144g
Soil Site Class = D



LOCATION SKETCH

DESIGN STRESSES

FIELD UNITS

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

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition, with 2015 & 2016 Interim Revisions

LOADING HL-93

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

SCUPPER LOCATION

Station	Offset
6407+73.79	22.00' Lt.

GENERAL PLAN AND ELEVATION
SB TAYLOR ST. EXIT RAMP
OVER F.A.I. RTE 290
(EISENHOWER EXPRESSWAY) AND CTA
F.A.I. RTE 90/94/290
SECTION 2014-013R&B-R
COOK COUNTY
STATION 6408+43.55
STRUCTURE NO. 016-1718

AECOM

USER NAME = floresg	DESIGNED - JXH	REVISED -	
	DRAWN - GF	REVISED -	
PLOT SCALE = 20.00 ' / in.	CHECKED - ATB	REVISED -	
PLOT DATE = 7/17/2017	DATE - 07/14/2017	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

STRUCTURE NO. 016-1718

SCALE: | SHEET 1 OF 3 SHEETS | STA. | TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-013R&B-R	COOK	3	1

CONTRACT NO. 60X93

ILLINOIS FED. AID PROJECT

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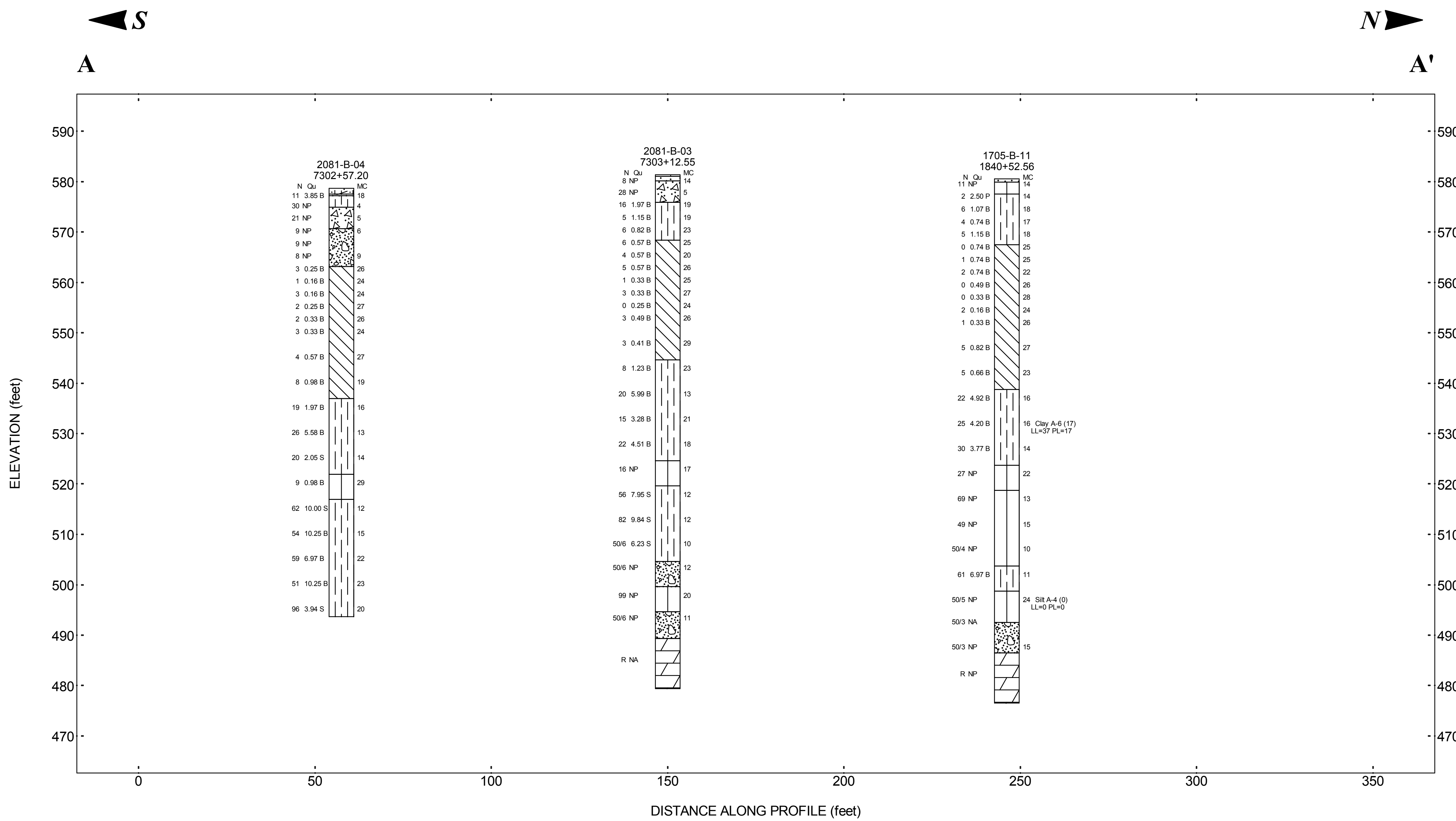
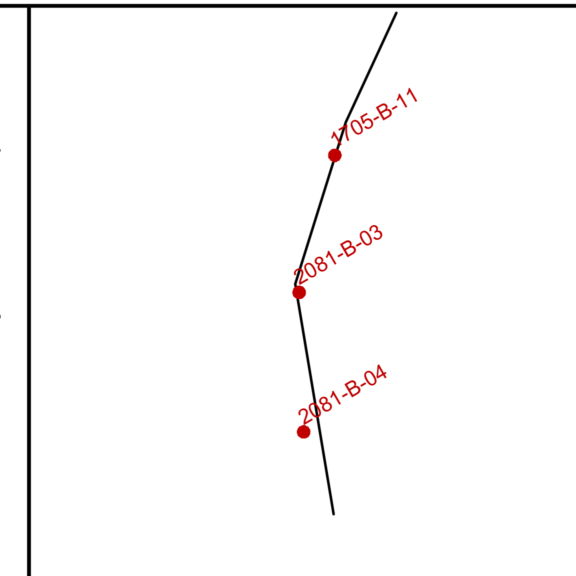


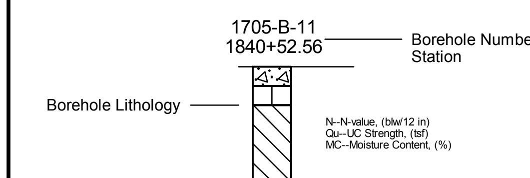
Lithology Graphics

Crushed stone	IDH Silt, Silty Loam	IDH Silty Clay, Silty Clay Loam	IDH Clay
Gravelly sand, sandy gravel	Dolomite or Dolomitic Limestone	Pavement	Concrete



Site Map Scale 1 inch equals 130 feet

Explanation:



Water Level Reading at time of drilling.

Water Level Reading 24-hr after drilling or at end of drilling

0 35

Horizontal Scale (feet)

Vertical Exaggeration: 1.5x

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Soil Profile A-A'
Taylor Bypass Ramp Bridge over I -290, SN 016-1718

WEI SINCE 1982

Circle Interchange Reconstruction
Section 17, T39N, R14E of 3rd PM

JOB NUMBER	PLATE NUMBER
1100-04-01	EXHIBIT 4

WEI 11X17 11000401.GPJ WANGENG.GDT 1/6/14

APPENDIX A

Wang Engineering
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BORING LOG 1705-B-11

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 580.50 ft
North: 1898132.10 ft
East: 1171174.95 ft
Station: 1840+52.56
Offset: 43.2853 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	8-inch thick CRUSHED STONE					
579.8	Medium dense, brown SILTY LOAM, trace gravel and pieces of cinders --FILL--		1	4 5 6	NP	14
577.5	Medium stiff to very stiff, brown SILTY CLAY LOAM, trace gravel, pockets of fine sand	5	2	2 1 1	2.50 P	14
			3	2 3 3	1.07 B	18
		10	4	2 1 3	0.74 B	17
			5	0 2 3	1.15 B	18
567.5	Very soft to medium stiff, gray and brown CLAY to SILTY CLAY, trace gravel	15	6	0 0 0	0.74 B	25
			7	0 0 1	0.74 B	25
		20	8	0 0 2	0.74 B	22
			9	0 0 0	0.49 B	26
		25	10	0 0 0	0.33 B	28
			11	0 0 2	0.16 B	24
		30	12	0 0 1	0.33 B	26
		35	13	0 2 3	0.82 B	27
		40	14	2 2 3	0.66 B	23

GENERAL NOTES

Begin Drilling **07-28-2013** Complete Drilling **07-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **NA**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 1705-B-11

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 580.50 ft
North: 1898132.10 ft
East: 1171174.95 ft
Station: 1840+52.56
Offset: 43.2853 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
538.8	Very stiff to hard, gray CLAY to SILTY CLAY , trace gravel						
		45		15	5 9 13	4.92 B	16
	--L_L(%)=37, P_L(%)=17-- --%Gravel=1.9-- --%Sand=11.6-- --%Silt=47.1-- --%Clay=39.5-- --A-6 (17)--	50		16	7 10 15	4.20 B	16
		55		17	6 12 18	3.77 B	14
523.8	Medium dense, gray SILT --Moist--						
		60		18	8 11 16	NP	22
518.8	Dense to very dense, gray SILTY LOAM, trace gravel						
		65		19	20 27 42	NP	13
		70		20	14 20 29	NP	15
		75		21	29 45 50/4	NP	10
	--HARD DRILLING-- --Possible Cobbles--						
503.8	Hard, gray SILTY CLAY LOAM, trace gravel						
		80		22	12 25 36	6.97 B	11

GENERAL NOTES

Begin Drilling **07-28-2013** Complete Drilling **07-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **NA**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG 1705-B-11

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 580.50 ft
North: 1898132.10 ft
East: 1171174.95 ft
Station: 1840+52.56
Offset: 43.2853 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
498.8	Very dense, gray SILT, trace gravel						
	--%Gravel=1.0-- --%Sand=1.5-- --%Silt=92.3-- --%Clay=5.2-- --A-4 (0)--	85		23	26 46 50/5	NP	24
492.5	Very dense, GRAVEL, trace cobbles			24	50/3	NA	
		90					
	--HARD DRILLING to 94'-- --Possible Cobbles--						
				25	50/3	NP	15
486.5	Strong, fair rock quality, light gray, fresh, vertical and horizontal joints, joint breaks with little to no infill, horizontal stylolites, slightly vuggy DOLOSTONE	95			CORE		
	--Run 1 - RECOVERY=100%-- --RQD (top 5ft)=70%-- --RQD (10ft)=82%--						
						NP	
		100					
476.5	Boring terminated at 104.00 ft						
		105					
		110					
		115					
		120					

GENERAL NOTES

Begin Drilling **07-28-2013** Complete Drilling **07-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **NA**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG 2081-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 581.38 ft
North: 1898040.36 ft
East: 1171151.03 ft
Station: 7303+12.55
Offset: 17.3004 RT

Elevation (ft)	Soil and Rock Description	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
581.1	4-inch thick ASPHALT --PAVEMENT--					
580.1	11-inch thick CONCRETE --PAVEMENT--					
	Loose to medium dense, gray CRUSHED STONE --FILL--		1	2 3 5	NP	14
		5	2	7 16 12	NP	5
575.9	Medium stiff to stiff, gray SILTY CLAY, trace gravel		3	5 8 8	1.97 B	19
		10	4	2 2 3	1.15 B	19
			5	2 3 3	0.82 B	23
568.4	Soft to medium stiff, gray CLAY	15	6	2 3 3	0.57 B	25
			7	0 2 2	0.57 B	20
		20	8	0 2 3	0.57 B	26
			9	0 0 1	0.33 B	25
		25	10	0 1 2	0.33 B	27
			11	0 0 0	0.25 B	24
		30	12	0 1 2	0.49 B	26
		35	13	0 1 2	0.41 B	29
544.6	Stiff to hard, gray SILTY CLAY, trace gravel					
		40	14	1 4 4	1.23 B	23

GENERAL NOTES

Begin Drilling: **03-28-2013** Complete Drilling: **03-29-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B-57 TMR**
Driller: **P&N** Logger: **D. Wind** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 8.5', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **NA**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 2081-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 581.38 ft
North: 1898040.36 ft
East: 1171151.03 ft
Station: 7303+12.55
Offset: 17.3004 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		45	15	7 8 12	5.99 B	13
		50	16	5 5 10	3.28 B	21
		55	17	4 9 13	4.51 B	18
524.6	Medium dense, gray SILT					
		60	18	4 7 9	NP	17
519.6	Hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel					
		65	19	18 24 32	7.95 S	12
		70	20	16 32 50	9.84 S	12
		75	21	35 50/6	6.23 S	10
504.6	Very dense, gray GRAVELLY SANDY LOAM					
		80	22	50/6	NP	12

GENERAL NOTES

Begin Drilling **03-28-2013** Complete Drilling **03-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR**
Driller **P&N** Logger **D. Wind** Checked by **C. Marin**
Drilling Method **3.25" HSA to 8.5', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **NA**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 2081-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 581.38 ft
North: 1898040.36 ft
East: 1171151.03 ft
Station: 7303+12.55
Offset: 17.3004 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
499.6	Very dense, gray SILT --MOIST--						
		85		23	39 49 50	NP	20
494.6	Very dense, gray GRAVELLY SANDY LOAM						
				24	50/6	NP	11
		90					
489.4	Strong, very poor rock quality 92'-94', light gray, highly fractured, slightly vuggy DOLOSTONE Run 1 = 92' to 102' --RECOVERY=100% --RQD=72% -Strong, good rock quality 94'-102' , light gray, fresh, slightly fractured, joint breaks with little to no infill, slightly vuggy DOLOSTONE ROCK MASS RATING: Strength of rock material = 12 Drill core quality RQD = 13 Spacing of joints = 10 Condition of joints =12	95		1	CORE		
		100					
	Groundwater condition =10						
479.4	Boring terminated at 102.00 ft						
		105					
		110					
		115					
		120					

GENERAL NOTES

Begin Drilling **03-28-2013** Complete Drilling **03-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR**
Driller **P&N** Logger **D. Wind** Checked by **C. Marin**
Drilling Method **3.25" HSA to 8.5', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **NA**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 2081-B-04

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 578.68 ft
North: 1897947.00 ft
East: 1171154.08 ft
Station: 7302+57.20
Offset: 44.0821 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	14-inch thick ASPHALT --PAVEMENT--					
577.5						
577.2	4-inch thick CRUSHED STONE --BASE COURSE--					
	Very stiff, brown and gray SILTY CLAY LOAM, trace gravel --FILL--		1	4 5 6	3.85 B	18
574.9	Medium dense CRUSHED STONE --FILL--	5	2	11 16 14	NP	4
			3	10 12 9	NP	5
570.7	Loose, light brown GRAVELLY SAND --FILL--	10	4	6 5 4	NP	6
			5	10 5 4	NP	
		15	6	8 4 4	NP	9
563.2	Very soft to medium stiff, gray CLAY, trace gravel		7	0 1 2	0.25 B	26
		20	8	0 0 1	0.16 B	24

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			9	1 2 1	0.16 B	24
		25	10	0 0 2	0.25 B	27
			11	0 0 2	0.33 B	26
		30	12	0 1 2	0.33 B	24
		35	13	1 1 3	0.57 B	27
		40	14	2 4 4	0.98 B	19

GENERAL NOTES

Begin Drilling **04-01-2013** Complete Drilling **04-01-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG 2081-B-04

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 578.68 ft
North: 1897947.00 ft
East: 1171154.08 ft
Station: 7302+57.20
Offset: 44.0821 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
536.9	Stiff to hard, gray SILTY CLAY LOAM, trace gravel					
		45	15	7 8 11	1.97 B	16
		50	16	9 13 13	5.58 B	13
		55	17	8 9 11	2.05 S	14
521.9	Medium stiff, gray SILTY LOAM, trace silt and sand seams					
		60	18	4 4 5	0.98 B	29
516.9	Hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel					
		65	19	15 30 32	10.00 S	12
		70	20	14 23 31	10.25 B	15
		75	21	11 19 40	6.97 B	22
		80	22	14 20 31	10.25 B	23

GENERAL NOTES

Begin Drilling **04-01-2013** Complete Drilling **04-01-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG 2081-B-04

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 578.68 ft
North: 1897947.00 ft
East: 1171154.08 ft
Station: 7302+57.20
Offset: 44.0821 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
					23	23 49 47	3.94 S	20
	493.7		85					
		Boring terminated at 85.00 ft						
			90					
			95					
			100					

GENERAL NOTES

Begin Drilling **04-01-2013** Complete Drilling **04-01-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **NA**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG VST-06

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 585.69 ft
North: 1898109.29 ft
East: 1171902.18 ft
Station: 1211+74.65
Offset: 35.3599 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	Hard, brown SILTY CLAY LOAM, trace gravel --FILL--					
		5	1	7 6 6	> 4.50 P	16
580.2	Soft, gray SILTY CLAY LOAM					
			2	1 2 3	0.41 B	23
576.7						
		10				
	--In-Situ Vane Shear, 10.5 feet-- --$S_{u\ undis}$ = 972.0 psf-- --$S_{u\ remold}$ = 611.6 psf-- --Sensitivity = 1.6--		1	VS		
	--In-Situ Vane Shear, 13.0 feet-- --$S_{u\ undis}$ = 982.9 psf-- --$S_{u\ remold}$ = 589.7 psf-- --Sensitivity = 1.7--	15	2	VS		
	--In-Situ Vane Shear, 15.5 feet-- --$S_{u\ undis}$ = 873.7 psf-- --$S_{u\ remold}$ = 513.3 psf-- --Sensitivity = 1.7--		3	VS		
	--In-Situ Vane Shear, 18.0 feet-- --$S_{u\ undis}$ = 928.3 psf-- --$S_{u\ remold}$ = 360.4 psf-- --Sensitivity = 2.6--	20	4	VS		
	--In-Situ Vane Shear, 20.5 feet-- --$S_{u\ undis}$ = 775.4 psf-- --$S_{u\ remold}$ = 360.4 psf-- --Sensitivity = 2.2--		5	VS		
	--In-Situ Vane Shear, 23.0 feet-- --$S_{u\ undis}$ = 600.6 psf-- --$S_{u\ remold}$ = 305.8 psf-- --Sensitivity = 2.0--	25	6	VS		
	--In-Situ Vane Shear, 25.5 feet-- --$S_{u\ undis}$ = 578.8 psf-- --$S_{u\ remold}$ = 316.7 psf-- --Sensitivity = 1.8--		7	VS		
	--In-Situ Vane Shear, 28.0 feet-- --$S_{u\ undis}$ = 611.6 psf-- --$S_{u\ remold}$ = 338.5 psf-- --Sensitivity = 1.8--	30	8	VS		
	--In-Situ Vane Shear, 30.5 feet-- --$S_{u\ undis}$ = 786.3 psf-- --$S_{u\ remold}$ = 382.2 psf-- --Sensitivity = 2.1--		9	VS		
	--In-Situ Vane Shear, 33.0 feet-- --$S_{u\ undis}$ = 698.9 psf-- --$S_{u\ remold}$ = 404.1 psf-- --Sensitivity = 1.7--	35	10	VS		
	--In-Situ Vane Shear, 35.5 feet-- --$S_{u\ undis}$ = 808.1 psf-- --$S_{u\ remold}$ = 502.4 psf-- --Sensitivity = 1.6--		11	VS		
	--In-Situ Vane Shear, 38.0 feet-- --$S_{u\ undis}$ = 982.9 psf-- --$S_{u\ remold}$ = 546.0 psf-- --Sensitivity = 1.8--	40	12	VS		
	--In-Situ Vane Shear, 40.5 feet-- --$S_{u\ undis}$ = 906.4 psf-- --$S_{u\ remold}$ = 524.2 psf-- --Sensitivity = 1.7--		13	VS		
542.2	--In-Situ Vane Shear, 43.0 feet-- --$S_{u\ undis}$ = 677.1 psf-- --$S_{u\ remold}$ = 393.1 psf-- --Sensitivity = 1.7--	45	14	VS		
	Boring terminated at 43.50 ft					
		50				

GENERAL NOTES

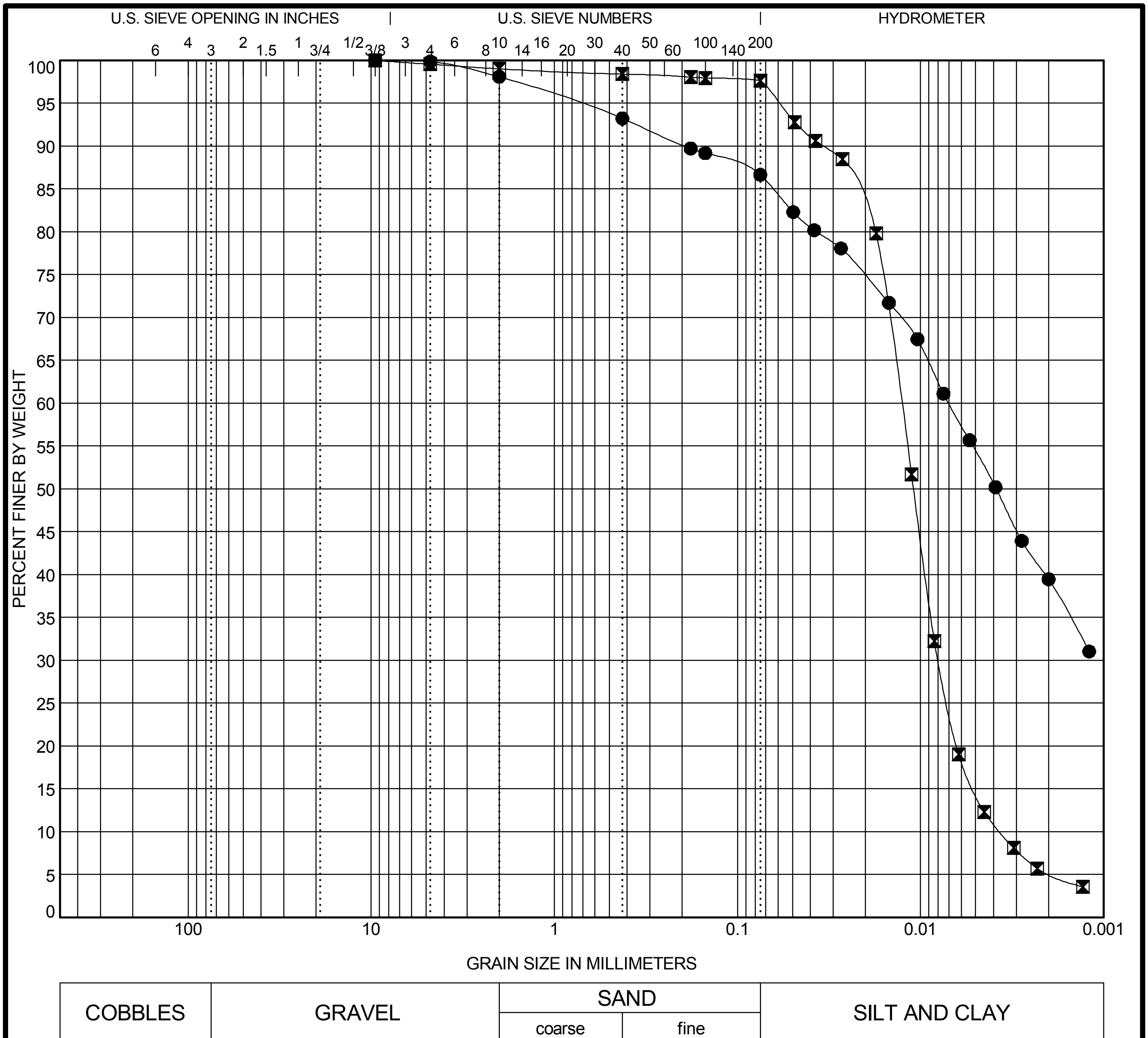
Begin Drilling **12-09-2015** Complete Drilling **12-14-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
At Completion of Drilling **mud in the borehole**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

APPENDIX B



	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	**1705-B-11#16**	**48.5 ft**	**Clay**	**37**	**17**	**20**		
⧗	**1705-B-11#23**	**83.5 ft**	**Silt**	**NP**	**NP**	**NP**	**1.36**	**3.48**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**1705-B-11#16**	**48.5 ft**	**9.5**	**0.007**			**1.9**	**11.6**	**47.1**	**39.5**
⧗	**1705-B-11#23**	**83.5 ft**	**9.5**	**0.013**	**0.008**	**0.004**	**1.0**	**1.5**	**92.3**	**5.2**

WEI GRAIN SIZE IDH 11000401.GPJ US LAB.GDT 1/6/14

WEI
SINCE 1982

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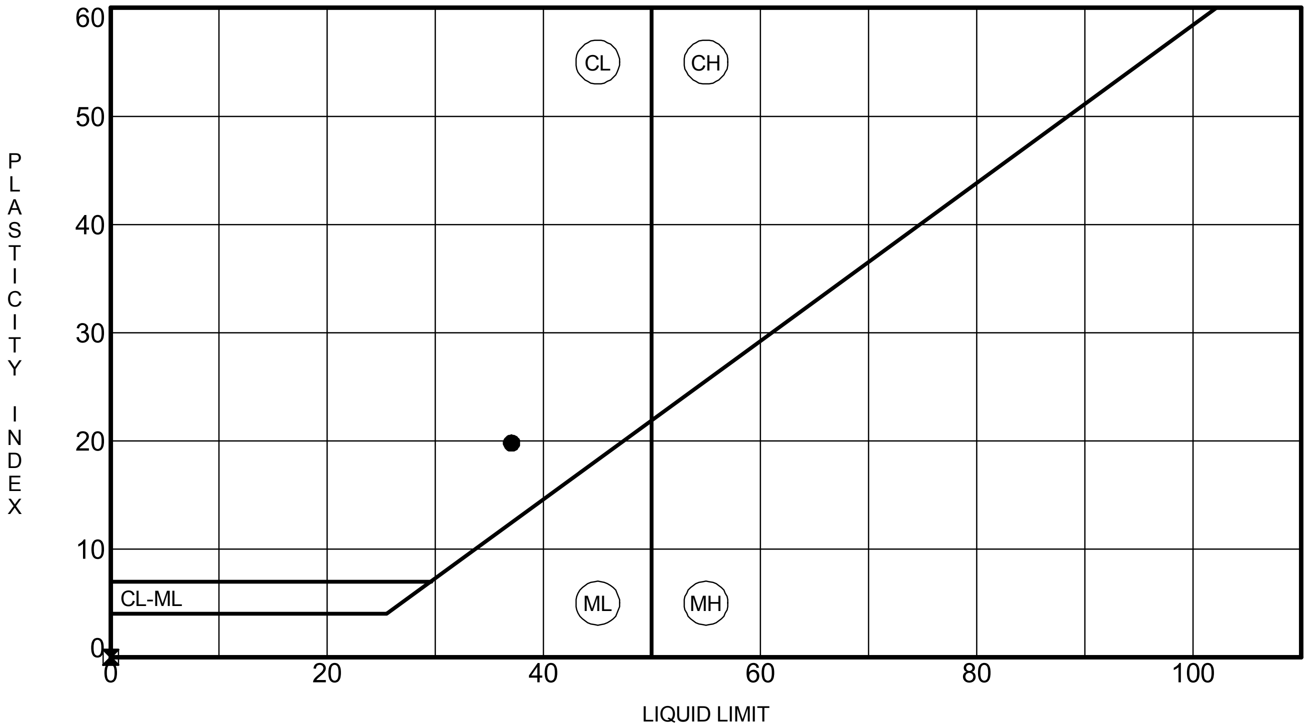
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	**1705-B-11#16**	**48.5 ft**	**37**	**17**	**20**	**87**	**Clay**
⧗	**1705-B-11#23**	**83.5 ft**	**NP**	**NP**	**NP**	**98**	**Silt**

WEI SINCE 1982

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ATTERBERG LIMITS' RESULTS

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01

Wang Engineering

Unconfined Compressive Strength of Intact Rock Core Specimens

Project: Circle Interchange Reconstruction

Client: AECOM

WEI Job No.: 1100-04-01

Note: The specimens were sulphur capped for a more uniform break

Field Sample ID	Lab Specimen ID	Depth (feet)	Location	Length (in) Total Core	Length (in) Before Capping	Length (in) After Capping	Diameter (in)	Total Load (lbs)	Total Pressure (psi)	Fracture Type*	Break Date	Tested By	Area (in^2)
1705-B-11, Core #1	126	99.0	Taylor Street Bypass (SN 016-1718)	N/A	4.13	4.21	2.05	32040	**9710**	3	8/26/2013	RG	3.30
1705-B-11, Core #1	127	103.0	Taylor Street Bypass (SN 016-1718)	N/A	4.11	4.17	2.05	27780	**8420**	3	8/26/2013	RG	3.30

*** Fracture Types:**

Type 1 - Reasonably well-formed cones on both ends, less than 1 in. [25 mm] of cracking through caps;
Type 2 - Well-formed cone on one end, vertical cracks running through caps, no well defined cone on other end;
Type 3 - Columnar vertical cracking through both ends, no well-formed cones;
Type 4 - Diagonal fracture with no cracking through ends; tap with hammer to distinguish from Type 1;
Type 5 - Side fractures at top or bottom (occur commonly with unbonded caps);
Type 6 - Similar to Type 5 but end of cylinder is pointed.

Prepared by:______________________________

Checked by: ______________________________

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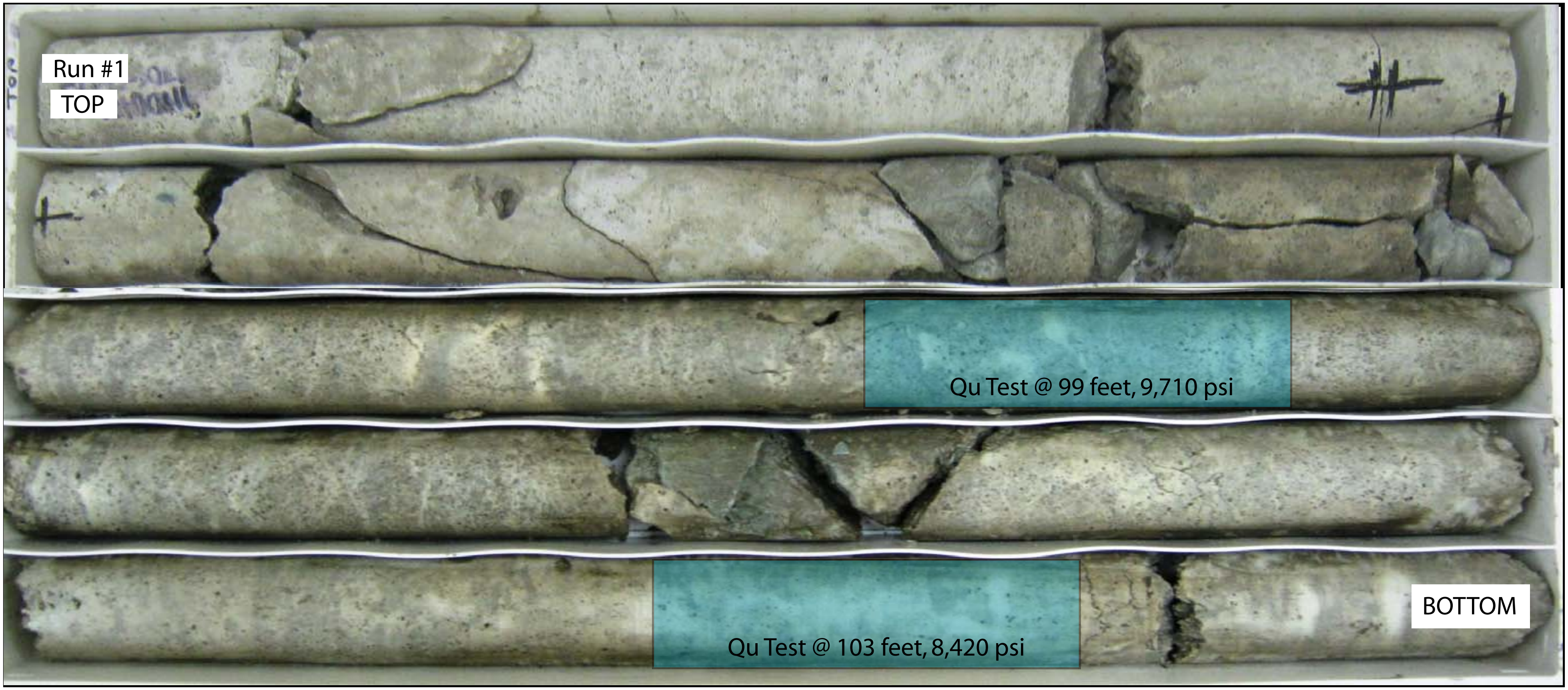
APPENDIX C



0 3 6 9 12 inches

Boring 1705-B-11
Run #1: 94 to 104 feet
RECOVERY = 100%
RQD = 82%
Qu = 9,710 psi @ 99 feet
Qu = 8,420 psi @ 103 feet

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION TAYLOR STREET BYPASS RAMP, SN 016-1718, COOK COUNTY		
SCALE : GRAPHIC	APPENDIX C-1	DRAWN BY: B. Wilson CHECKED BY: C. Marin
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01

0 3 6 9 12 inches

Boring 2081-B-03
Run #1: 92 to 102 feet
RECOVERY = 100%
RQD = 72%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION TAYLOR STREET BYPASS RAMP, SN 016-1718, COOK COUNTY		
SCALE : GRAPHIC	APPENDIX C-2	DRAWN BY: A. Tomaras CHECKED BY: C. Marin
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01