STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHANGE
EASTBOUND INTERSTATE 290 BRIDGE
OVER INTERSTATE 90/94
EXISTING SN 016-1029, PROPOSED SN 016-1704
SECTION 2014-001 R&B
IDOT D-91-189-14, PTB 163/ITEM 001
COOK COUNTY, ILLINOIS

for

AECOM

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11. Abstract

The existing, seven-span bridge carrying Eastbound Interstate 290 over Interstate 90/94 will be removed and replaced with a new, four-span structure. The bridge will have a back-to-back length of approximately 506.3 feet and an out-to-out width of 45.2 and 57.7 feet at the west and east ends, respectively.

Below 3.0 to 10.5 feet of mostly cohesive fill, the borings encountered up to 36 feet of very soft to medium stiff clay and silty clay. Deeper foundation soils include stiff to hard silty clay loam and dense to very dense silty loam and sandy gravel resting on top of strong, fair rock quality dolostone. The bedrock was encountered at an average elevation of about 480.0. The site classifies in the Seismic Class D and is in the Seismic Performance Zone 1.

Wang understands the profile grade will be slightly changed; thus, we anticipate negligible settlements and suitable global stability. We provide recommendations for drilled shafts into very dense silty loam or socketed into the bedrock. The shafts in the silty loam have estimated factored resistances of about 200 to 580 kips for 3- to 5-foot diameter bases and rock sockets have factored resistances of about 850 to 1,505 kips for 3- to 4-foot diameter socket bases. The selection of foundation type for the substructures should be based on the estimated loads and construction costs.

A number of temporary excavations will likely be required to remove existing facilities and construct the new bridge abutment. The design of these excavation 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 reconstruction of Eastbound Interstate 290 (EB I-290) over Interstate 90/94 (I-90/94) within the Circle Interchange in Chicago, Cook County, Illinois. The proposed structure consists of one abutment (west abutment) and four piers (Pier 1 through 3 and C1). A separate report will be issued for the design of foundations east of Pier C1. A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands AECOM envisions a new, four-span structure supporting the EB I-290 bridge over both directions of I-90/94. The bridge will have a back-to-back length of approximately 506.3 feet; from west to east the spans will measure 133.0, 134.0, 118.5, and 118.5 feet. The out-to-out bridge width will measure 45.2 feet at the west end and 57.7 feet at the east end.

The west abutment will be located slightly behind the existing one. Structure Number 016-1714 will connect to the bridge at Pier 2. Pier C1 of Structure Number 016-1704 will be shared with Structure Number 016-0461 at Station 5016+64.53.

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

Structure Number 016-1029 consists of a seven-span bridge caring the EB I-290 over the Interstate I-90/94. The original structure was built in 1958 and has an overall length of approximately 502.0 feet and out-to-out deck width varies from 57.5 to 79.8 feet. The existing substructure consists of reinforced concrete abutment and multi-column piers supported on drilled shafts. The existing structure is to be removed and replaced.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project area is located within the City of Chicago limits. On the USGS *Chicago Loop 7.5 Minute Series* map, the bridge is located in the NW ¼ of Section 16, Tier 39 N, Range 14 E of the Third 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 general topography of the project area slopes gently southeast toward Lake Michigan. The bridge is situated within the Chicago Lake Plain Physiographic Subsection. The area is largely made up of groundmoraine till covered by thin and discontinuous lacustrine silt and clay.

The bridge carrying the EB I-290 over I-90/94 starts from approximate elevation of 592.1 feet at west abutment to elevation of 609.3 feet at the east end (Pier C1). The ground elevation along the bridge ranges from 575 feet at west end to 585 feet at east end.

2.2 Surficial Cover

The project area was shaped during the Wisconsinan-age glaciation, and more than 75-foot thick 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 underlain by the pebbly silty clay loam to silty loam diamicton of the Yorkville Member of the Lemont Formation, known informally as the Chicago "hardpan."

From a geotechnical viewpoint, the Equality Formation is characterized by low strength, medium to high plasticity, and medium to high moisture content, whereas the 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 (hardpan) 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 unconformably rest over approximately 350-foot thick Silurian-age dolostone (Leetaru et al, 2004). The top of bedrock may be encountered at 475 to 500 feet elevation 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.

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 ranging from 93.0 to 103.5 feet bgs or 480.0 to 488.0 feet elevation, within 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 in October 2013, consisted of four structure borings, designated as 1704-B-01 through 1704-B04. To supplement this report, Boring 21-RWB-05 drilled for a nearby structure was included. The borings were drilled from the shoulder and median areas of the

existing interchange from elevations of 575.2 to 589.0 feet to depths of 93.0 to 113.5 feet bgs. Northings, eastings, and elevations were surveyed by Dynasty Group, whereas stations and offsets were provided by AECOM. The boring locations are presented in the *Boring Logs* (Appendix A) and in the *Boring Location Plan* (Exhibit 3).

Truck- mounted drilling rigs, equipped with hollow stem augers and mud rotary equipment, were 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 Borehole 1704-B-04 in a10-foot run.

Field boring logs, prepared and maintained by a Wang engineer, 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 pavement sections include either 12.0 inches of concrete pavement, or 4 inches of asphalt pavement over 8-inch thick concrete base. The borings drilled off the roadways encountered 5 to 18 inches of crushed stone or gray gravelly loam.

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

(1) Man-made ground (fill)

The existing fill is made up of about 3.0 to 10.5 feet of mostly very stiff to hard, brown to dark gray clay loam to silty clay loam. The fill has unconfined compressive strength (Qu) values of 2.9 to 6.6 tsf with an average of 5.0 tsf and moisture content values of 15 to 18% with an average of 16%.

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

At elevations of about 565.0 to 579.2 feet, the fill rests on top of 21.3- to 36.3-foot thick, very soft to medium stiff, gray clay to silty clay. Field unconfined compressive strength tests show Qu values of 0.08 to 0.90 tsf with an average of 0.45 tsf. N-values vary between 0 and 11 blows/foot with an average of 3 blows/foot. Moisture contents range from 18 to 37% and average 25%. Laboratory index testing on samples of this material shows liquid limit (L_L) values of 31 to 37% and plastic limit (P_L) values of 17 to 18%. The soil classifies as A-6 (9) to A-6 (16).

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

The very soft to medium stiff clay to silty clay is underlain by stiff to hard, gray silty loam to silty clay loam. The unit measures 20.0 to 37.5 feet in thickness, and its top lies at 31.7 to 46.7 feet bgs or 541.0 to 543.8 feet elevation. Qu values range between 1.0 to 7.1 tsf with an average of 4.4 tsf, and N-values vary from 6 to 56 blows/foot with an average of 29 blows/foot. Water content ranges between 10 and 25% and averages 17%. The L_L values measures between 25 and 35%, and P_L values measures between 16% and 19%. The soil classifies as A-4 (6) to A-6 (14). Up to 5.0-foot thick intercalations of medium dense silty loam to fine sand with SPT N-values of 10 to 45 blows/foot were encountered. Some of the granular soil was encountered in a wet or saturated state. Advancing uncased drilled shaft foundation through this water-bearing soil might be problematic.

(4) Dense to very dense silty loam

At depths of 61.7 to 84.2 feet bgs or 504.7 to 523.0 feet elevation, the borings encountered up to 38.2-foot thick, dense to very dense, gray silty loam with trace gravel (hardpan), and intercalation of silty clay loam. Hard drilling condition was observed while drilling in this layer. Sampling through the very dense soil resulted primarily in spoon refusal. SPT testing shows N-values of 31 to 85 blows/foot. The samples that could be tested for Qu values show up to 9.0 tsf and moisture content values generally below 15%. The low plasticity silty soil classifies as A-4 (0).

(5) Very dense gravelly sand

At elevations of 497.2 to 501.6 feet (82 to 87 feet bgs), Borings 1704-B-04 and 21-RWB-05 advanced through up to 15 feet of gray, very dense sandy gravel to sandy loam with N-values of more than 50 blows/foot and moisture content values of 7 to 13%.

(6) Strong, fair rock quality dolostone

Boring 1704-B-04 encountered sound bedrock at elevation of 481.2 feet with 10-foot long bedrock core. Coring uncovered a strong dolostone of fair rock quality having an RQD value of 69%. We estimated a Rock Mass Rating (RMR) of 62 for this rock. Unconfined compressive strength testing on cores from Borings 1705-B-06A and 1705-B-08 measured an average of 8,800 psi.

4.2 Groundwater Conditions

Groundwater may be perched within the granular fill. Water-bearing silt and gravel lenses may also be present at deeper levels, and this possibility should be accounted for during the design and construction of the foundations.

4.3 Seismic Design Considerations

The seismic site class is dependent on the type of foundation chosen due to the fixity considerations included in 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 1.21 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 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. It is understood the design will be based on 2012 AASHTO LRFD Bridge Design Specification or IDOT 2012 Bridge Manual.

5.1 Approach Embankments and Slabs

Wang understands the profile grade along EB I-290 will not be significantly changed; therefore, we anticipate negligible settlements for the approach embankments and approach slabs. If the geometry of the end slope of the abutment will remain the same, we anticipate the global stability will meet the IDOT-required factor of safety (FOS).

5.1.1 Settlement

We understand the profile grade along EB I-290 behind the west abutment will be slightly changed; therefore we anticipate negligible settlements. The fill material encountered within the initial 5 to 10 feet below the proposed slab represents appropriate bearing materials for the slab. If a 5-foot or greater change in the profile grade is proposed, the evaluations should be revisited.

5.1.2 Global Stability

Since the new abutment will be located slightly behind the existing abutment and the end slope will remain the same, we estimate the global stability will meet the IDOT requirements.

5.2 Structure Foundations

Wang recommends supporting the abutment and piers on drilled shafts. The shafts could be supported within the hardpan or socketed into bedrock. Due to noise and vibration concerns, we do not recommend the use of driven piles. Based on TSL plan, Piers 1 through 3 and Pier C1 will be constructed adjacent to the existing CTA tunnel. Prior to construction, coordination with the CTA will be required to established clearances and to discuss specific construction requirements.

Preliminary factored loads for the substructures were provided by AECOM on April 3, 2014 and are summarized in Table 2.

Table 2: Summary of Total Factored Loads on Foundations

Substructure ID	$R_{FACTORED}$ (kips)
West Abutment	1,479
Pier 1	4,059
Pier 2	4,735
Pier 3	5,017
Pier C1	3,777

5.2.1 Drilled Shafts

The foundations for the abutment and piers could be supported on drilled shafts. The borings encountered 20 feet or more of hard silty clay loam or very dense silty loam (hardpan) below 510 to 500 feet elevation. We estimate the shafts could be established within this material. Alternatively, the shafts could be socketed into the bedrock that was encountered at an average elevation of about 480.0. Shafts established within the silty clay loam or silty loam should be temporarily cased to a maximum elevation of 510 feet to avoid construction issues associated with the groundwater encountered in the granular soil intercalations (**Layer 3**). As an alternative, a slurry method of excavation will be required.

Shafts bearing on silty and clayey soils (hardpan) should be designed for an end bearing resistance factor (ϕ_{stat}) of 0.55 in accordance with AASHTO (2012). The hardpan soil encountered above the bedrock has N60 values of more than 50 blows per foot and may be considered an Intermediate Geo Materaial (IGM) as per AASHTO (2012). We estimate the shafts will have a nominal unit base resistance in the very dense silty loam of 54 ksf and a factored unit base resistance of 30 ksf,

respectively. The R_F, R_N, and estimated base elevations are summarized below in Table 3 for 3-, 4-, and 5-foot diameter shafts. We estimate the settlement of the shafts will be less than 0.5 inch.

Table 3: Estimated Resistances and Base Elevations for Shafts

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)
West Abutment (1704-B-01)	582	54	3	380	209	80	502
			4	680	374	80	502
			5	1060	583	80	502
Pier 1 (1704-B-02)	574	54	3	380	209	64	510
			4	680	374	64	510
			5	1060	583	64	510
Pier 2 (1704-B-03)	574	54	3	380	209	66	508
			4	680	374	66	508
			5	1060	583	66	508
Pier 3 (1704-B-04)	579	54	3	380	209	69	510
			4	680	374	69	510
			5	1060	583	69	510
Pier C1 (21-RWB-05)	579	54	3	380	209	69	510
			4	680	374	69	510
			5	1060	583	69	510

If the estimated bearing resistances for shafts established within the "hardpan" do not meet the loading criteria, the shafts will require rock sockets. The bedrock cores show uniform, fair rock quality conditions. We estimate the rock sockets will have diameters of 3.0 or 4.0 feet. Above the bedrock, the shafts should have diameters 6 inches larger than the sockets. Due to the possible presence of water-bearing granular materials above the bedrock, the shafts should include casings extending to the top of the rock. We recommend designing the rock sockets based on the methods outlined in the 2012 AASHTO LRFD *Bridge Design Specifications*, which indicate the sockets should be designed for a geotechnical unit base resistance factor (ϕ_{stat}) 0.50 (AASHTO 2012). 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 4. We estimate the settlement of the rock sockets will be less than 0.5 inch.

As per 2012 IDOT Bridge Manual drilled shafts extending into rock, in most cases, should be designed utilizing only end bearing or side resistance in rock, whichever is larger. For shafts socketed into the bedrock less than 10 feet long, we estimate the end bearing will give more capacity than the side resistance. Therefore, we recommend considering only the end bearing resistance.

Table 4: Estimated Resistances and Base Elevations for Rock Socket Shafts

Structure Unit	Shaft Cap Base Elevation (feet)	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)
West Abutment (1704-B-01)	582	484 (estimated from nearby borings)	3.0	240	1700	850	3.0	101
			3.5	240	2310	1,155	3.0	101
			4.0	240	3010	1,505	3.0	101
Pier 1 (1704-B-02)	574	482	3.0	240	1700	850	3.0	95
			3.5	240	2310	1,155	3.0	95
			4.0	240	3010	1,505	3.0	95
Pier 2 (1704-B-03)	574	480	3.0	240	1700	850	3.0	97
			3.5	240	2310	1,155	3.0	97
			4.0	240	3010	1,505	3.0	97

Structure Unit	Shaft Cap Base Elevation (feet)	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)
Pier 3 (1704-B-04)	579	481	3.0	240	1700	850	3.0	101
			3.5	240	2310	1,155	3.0	101
			4.0	240	3010	1,505	3.0	101
Pier 4 (21-RWB-05)	579	481	3.0	240	1700	850	3.0	101
			3.5	240	2310	1,155	3.0	101
			4.0	240	3010	1,505	3.0	101

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 5 and rock parameters are included in Table 6. The parameters for the soft silty clay (**Layer 2**) were obtained from vane shear testing conducted along SN 016-1705 in Boring 1705-B-08. Information on the vane shear testing is provided in the boring log.

Table 5: Recommended Soil Parameters for Lateral Load Analysis

Soil Type (Layer)	Moist 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} (%)
V. Stiff to hard SILTY CLAY LOAM FILL (1)	120	4000	0	1400	0.45
V. Soft to Soft CLAY(2) EL 580 to 556 feet	115	450	0	100	1.5
Soft to Medium Stiff CLAY(2) EL 556 to 541 feet	115	650	0	100	1.0
Stiff to Hard SILTY LOAM (3)	120	4000	0	1400	0.45

Soil Type (Layer)	Moist 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} (%)
Dense and V. Dense SILTY LOAM and SANDY GRAVEL (4)	130	0	36	90	--

Table6: 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 Quality DOLOSTONE	135	2,500	8.8	65	0.0005

5.3 Stage Construction Design Recommendations

Stage construction is indicated on the TSL plan, and the removal of the existing substructures and foundations will require temporary shoring of the surrounding soils, including the support of soft silty clay. We estimate temporary shoring of these excavations based on the charts included in *Design Guide 3.13.1* (IDOT 2012a) will not be feasible, and a *Temporary Soil Retention Systems* should be designed.

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. The exposed subgrade should be proofrolled. To aid in locating unstable and unsuitable materials, the proofrolling should be observed by a qualified engineer. Any unstable or unsuitable materials should be removed and replaced with compacted structural fill as described in Section 6.3.

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.

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 2012b). 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 2012b). 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* (IDOT 2012b). Backfill material should be placed and compacted in accordance with the Special Provision. Estimated design parameters for granular structural backfill materials are presented in Table 7.

Table 7: Estimated Granular Backfill Parameters

Soil Description	Porous Granular Material Backfill
Unit Weight	125 lbs/ft^3
Angle of Effective Internal Friction	32 degrees
Active Earth Pressure Coefficient	0.31
Passive Earth Pressure Coefficient	3.26
At-Rest Earth Pressure Coefficient	0.5

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 (a) above the hard silty clay and/or (b) immediately atop of bedrock may present challenges. For the first case, the Contractor should be prepared to install casing or provide drilling fluid at each shaft location if the groundwater is encountered, most likely at about 520 to 510 feet elevation. Installing casing along the sides of the excavation will add uncertainty to the evaluation of mobilized skin friction; therefore, the shafts should be designed for end bearing only. For the second case, 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 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.

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.

Andri A. Kurnia, P.E.
Geotechnical Engineer

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

REFERENCES

AASHTO, 2012, LRFD Bridge Design Specifications: 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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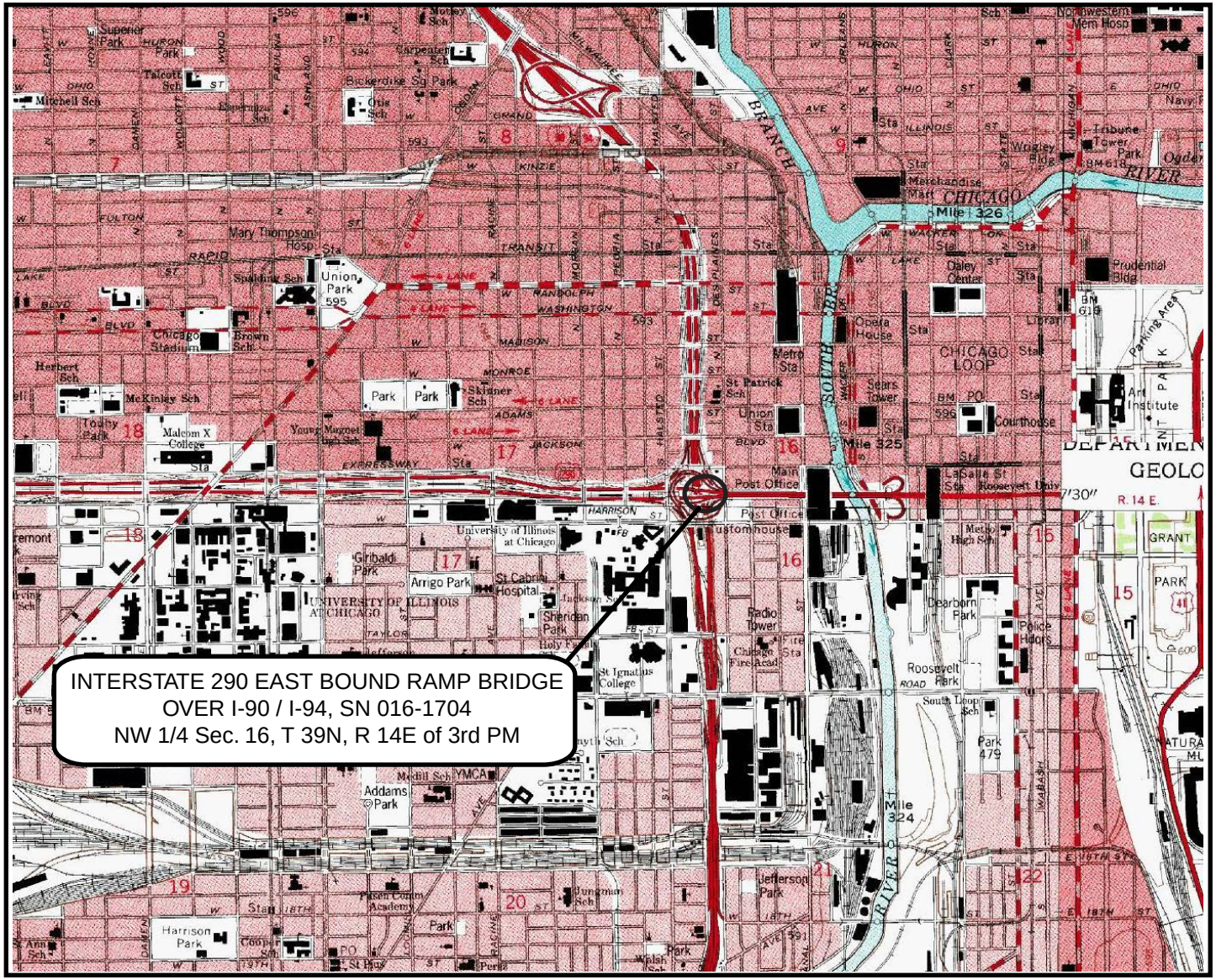
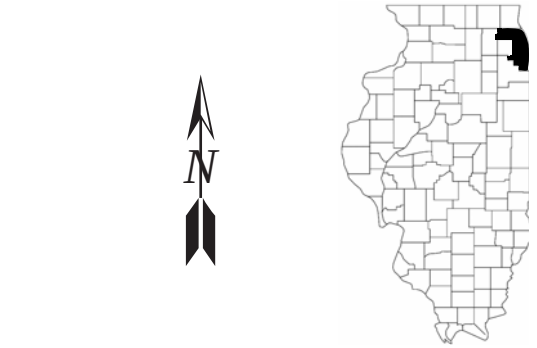
LEETARU, H.E., SARGENT, M.L., and KOLATA, D.R., 2004, Geologic Atlas of Cook County for Planning Purposes, Open File Series 2004-12, Illinois State Geological Survey, p. 30.

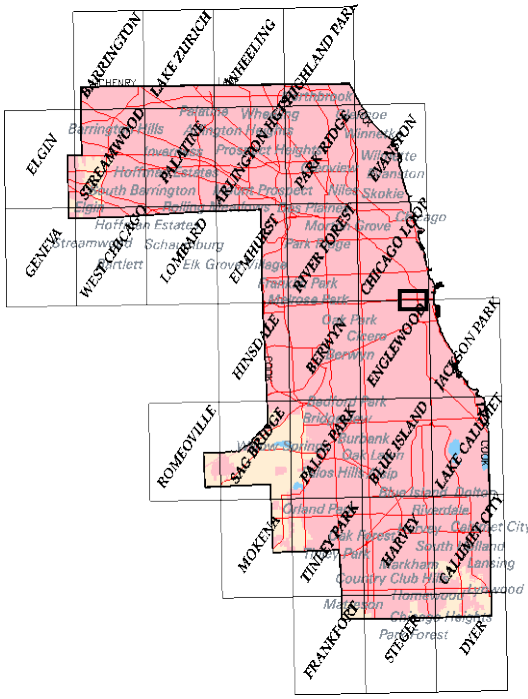
PECK, R.B., and REED, W.C., 1954, Engineering Properties of Chicago Subsoils: University of Illinois Engineering Experiment Station Bulletin No. 423: Urbana, University of Illinois, 62 p.

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
I-290 BRIDGE OVER I-90/94, SN 016-1704, 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

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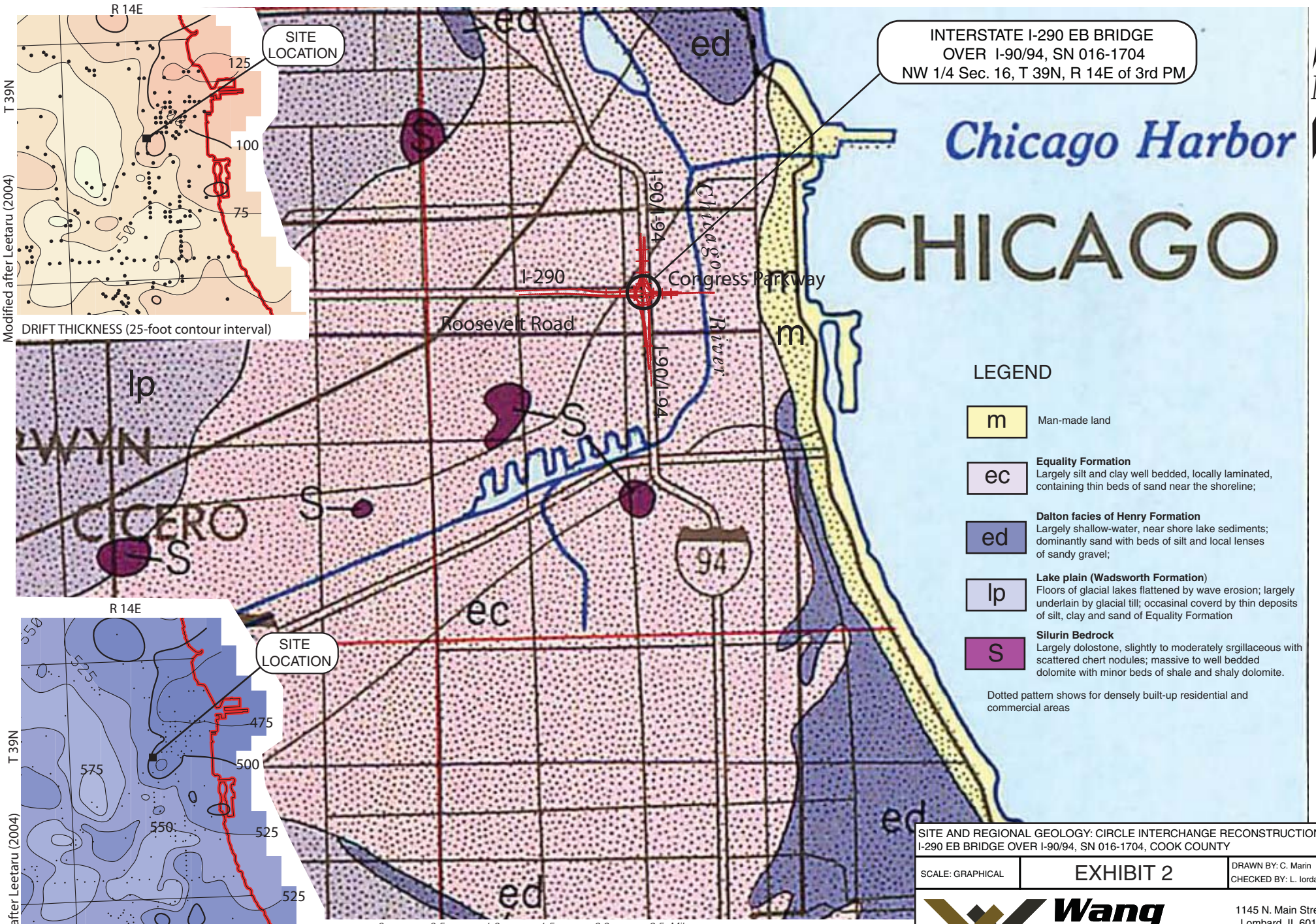

SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION
I-290 EB BRIDGE OVER I-90/94, SN 016-1704, COOK COUNTY

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: C. Marin CHECKED BY: L. Iordache

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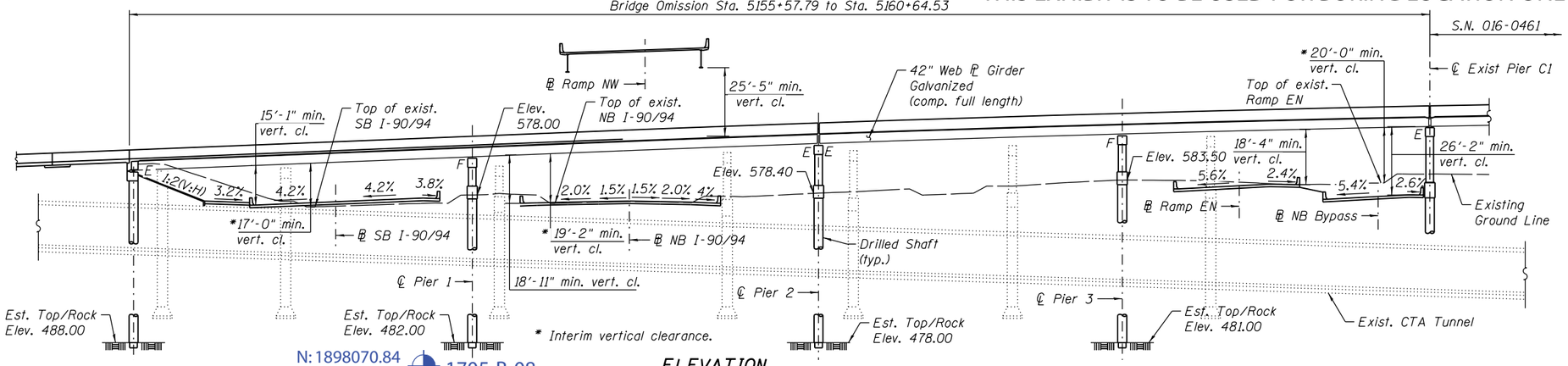
FOR AECOM	1100-04-01

Bench Mark: Square cut at center of door entrance to 707 W. Harrison St: South side of Harrison St. ±90' west of west line of Des Plaines. Elevation 597.47.
A t cut in the SE anchor bolt at the 11th street light N. of Roosevelt on the W. side of Halsted. Elev. = 594.06

Existing Structure: S.N. 016-1029 was built in 1958 and carries EB I-290 traffic over I-90/94. The existing seven-span structure has an overall length of approx. 502'-0" and out-to-out deck width varies from 57'-6" to 79'-10". The existing superstructure consists of simple span concrete tee (Span 1 only) and wide-flange beams with 7½" thick concrete deck and 1½" overlay. The existing substructure consists of reinforced concrete abutment and multi-column piers. Substructure units are supported on caissons. Existing structure to be removed and replaced. Traffic to be maintained utilizing stage construction.

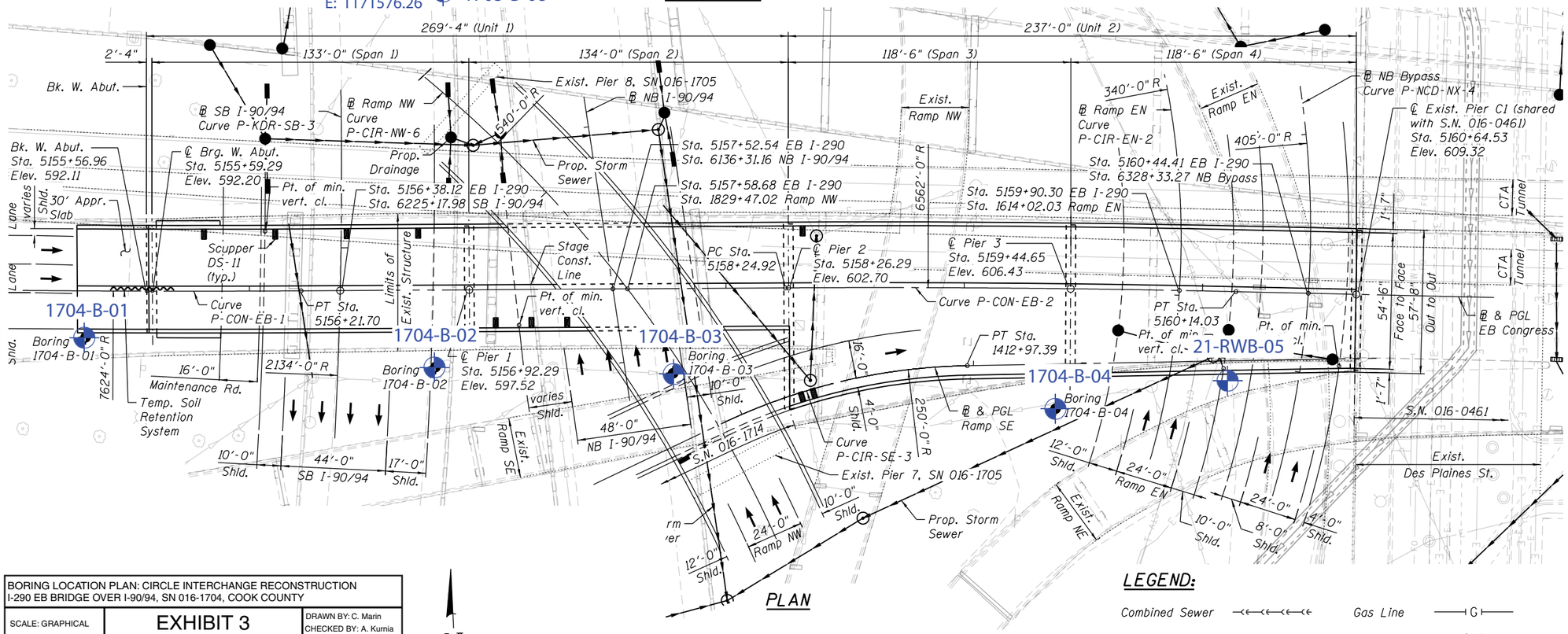
No salvage.

THIS EXHIBIT IS TO BE USED FOR BORING LOCATION ONLY



N: 1898070.84
E: 1171576.26
1705-B-08

ELEVATION



PLAN

N: 1897749.883
E: 1171805.177
1705-B-06A

DESIGN SPECIFICATIONS

2012 AASHTO LRFD Bridge Design Specifications
6th Edition with 2013 Interim Revisions

LOADING HL-93

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

DESIGN STRESSES

FIELD UNITS

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

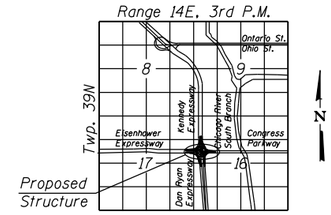
SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.085g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.144g
Soil Site Class = D

Notes:
1. All structural steel shall be hot-dip galvanized.

DS-11 SCUPPER LOCATION

Station	Offset
5155+80.95	26.0' LT
5156+10.95	26.0' LT
5156+40.95	26.0' LT
5156+70.95	26.0' LT
5157+03.29	16.0' RT
5157+18.29	16.0' RT
5157+33.29	16.0' RT
5158+32.29	26.0' LT
5158+32.29	47.8' RT
5158+37.29	46.3' RT
5159+50.65	35.3' RT



LEGEND:

Combined Sewer		Gas Line	G
Electric	E	Fire Hydrant	
Fiber Optic	FO	Light Pole	
Storm Sewer		Soil Boring	
Water Line	W		

GENERAL PLAN & ELEVATION
EB CONGRESS OVER I-90/94
F.A.I. RTE. 90/94/290
SECTION 2014-001 R&B
COOK COUNTY
STATION 5156+97.29
STRUCTURE NO. 016-1704

BORING LOCATION PLAN: CIRCLE INTERCHANGE RECONSTRUCTION
I-290 EB BRIDGE OVER I-90/94, SN 016-1704, COOK COUNTY

SCALE: GRAPHICAL	EXHIBIT 3	DRAWN BY: C. Marin CHECKED BY: A. Kurnia

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FOR AECOM | 1100-04-01

AECOM

USER NAME = HeJ1	DESIGNED - JXH	REVISED	
	CHECKED - EJO	REVISED	
PLOT SCALE = N.T.S.	DRAWN - GF	REVISED	
PLOT DATE = 2/4/2014	DATE - 02/07/2014	REVISED	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

STRUCTURE NO. 016-1704
SHEET NO. 1 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-001 R&B	COOK		
		CONTRACT NO. 60X75		
		ILLINOIS FED. AID PROJECT		

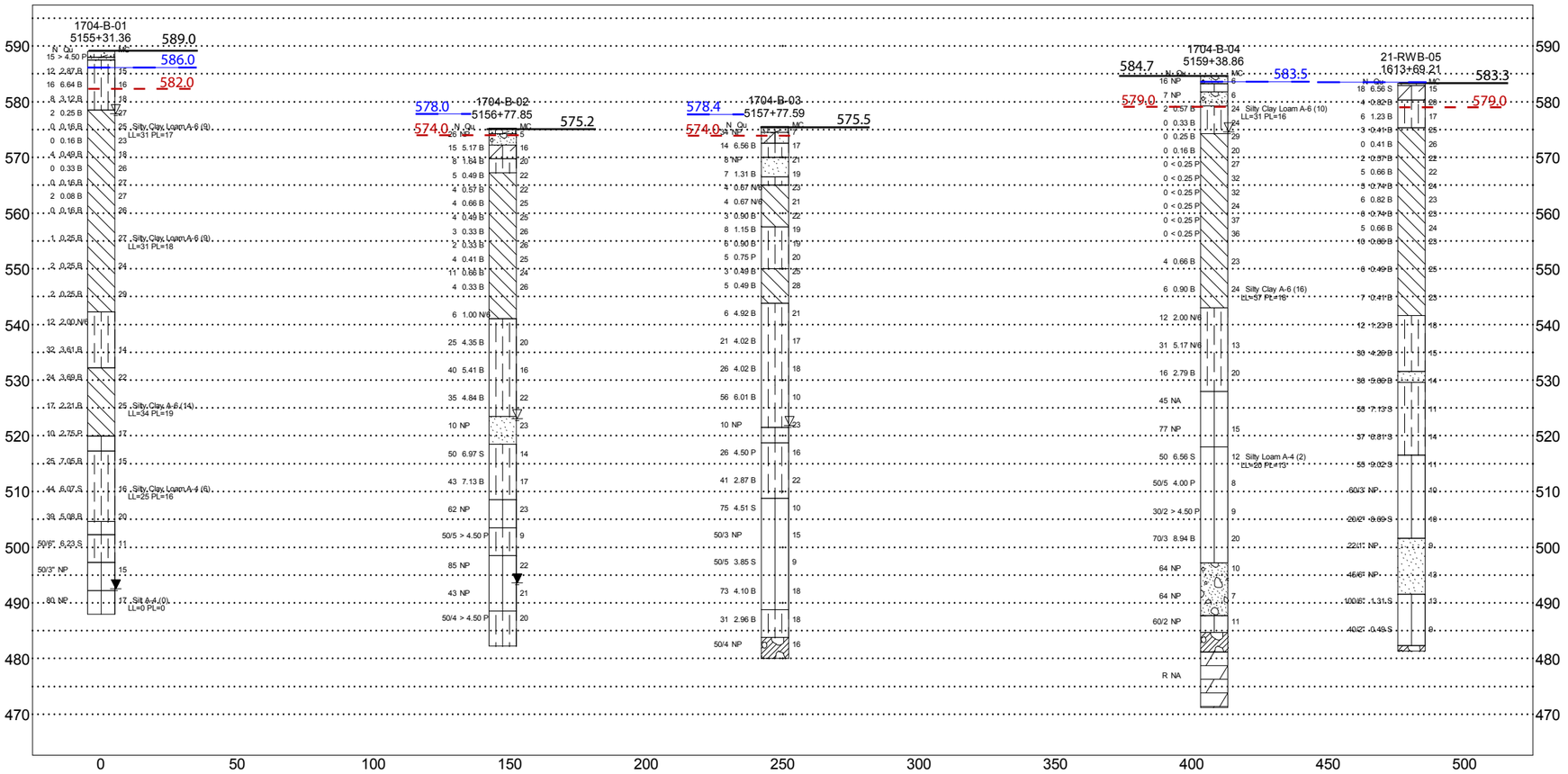
016-1704-CIRCLEI00-SHT-ACM-ST-TSL-001

◄ W

West Abutment | Pier 1 | Pier 2 | Pier 3 | Pier C1

E ►

N



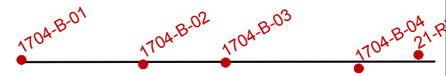
Lithology Graphics

- Pavement
- Crushed stone
- IDH Silty Clay, Silty Clay Loam
- IDH Clay
- IDH Silt, Silty Loam
- Gravelly sand, sandy gravel
- IDH Clay Loam
- IDH Sand, Sandy Loam
- IDH Loam
- Weathered bedrock
- Dolomite or Dolomitic Limestone

Existing Grade

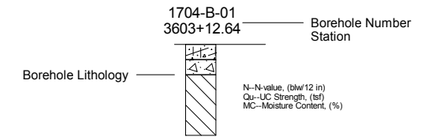
Proposed Grade

Bottom of Substructure



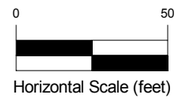
Site Map Scale 1 inch equals 185 feet

Explanation:



Water Level Reading at time of drilling.

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



Vertical Exaggeration: 2x

Wang Engineering, Inc.
1145 N Main Street
Lombard, IL 60148

Soil Profile
S.N. 016-1704

WEI SINCE 1982

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

JOB NUMBER	PLATE NUMBER
1100-04-01	EXHIBIT 4

WEI 11X17 1100401.GPJ WANGENG.GDT 4/4/14

APPENDIX A

Wang Engineering
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BORING LOG 1704-B-01

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 588.98 ft
North: 1897913.67 ft
East: 1171434.80 ft
Station: 5155+31.36
Offset: 19.5036 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	588.0	4-inch thick ASPHALT over 8-inch thick CONCRETE --PAVEMENT--						
	587.5	6-inch thick CRUSHED STONE --BASE COURSE--						
		Very stiff to hard, gray SILTY CLAY LOAM, trace to little gravel, glass, cinders and brick --FILL--	5		1	3 6 9	> 4.50 P	
					2	8 7 5	2.87 B	15
					3	4 7 9	6.64 B	16
			10		4	3 4 4	3.12 B	18
	578.5	Very soft to soft, gray CLAY to SILTY CLAY LOAM, trace gravel --2" coarse SAND--->			5	2 1 1	0.25 B	27
		--L_L(%)=31, P_L(%)=17-- --%Gravel=4.1-- --%Sand=20.5-- --%Silt=49.6-- --%Clay=25.9-- --A-6(9)--	15		6	0 0 0	0.16 B	25
					7	0 0 0	0.16 B	23
			20		8	2 2 2	0.49 B	18
					9	0 0 0	0.33 B	26
			25		10	0 0 0	0.16 B	27
			30		11	0 1 1	0.08 B	27
					12	0 0 0	0.16 B	26
		--L_L(%)=31, P_L(%)=18-- --%Gravel=4.1-- --%Sand=15.7-- --%Silt=52.9-- --%Clay=27.3-- --A-6(9)--	35		13	0 0 1	0.25 B	27
			40		14	0 0 2	0.25 B	24
	542.2	Very stiff, gray SILTY CLAY, trace gravel	45		15	0 0 2	0.25 B	29
			50		16	2 4 8	2.00 N/6	

GENERAL NOTES

Begin Drilling: **10-09-2013** Complete Drilling: **10-09-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&R** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **11.50 ft**
At Completion of Drilling: **96.75 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 4/4/14

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BORING LOG 1704-B-01

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 588.98 ft
North: 1897913.67 ft
East: 1171434.80 ft
Station: 5155+31.36
Offset: 19.5036 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			55		17	10 14 18	3.61 B	14
	532.2	Very stiff, gray CLAY to SILTY CLAY, trace gravel						
			60		18	5 9 15	3.69 B	22
		--HARD DRILLING-- --Possible Cobbles--						
		--L_L(%)=34, P_L(%)=19-- --%Gravel=1.4-- --%Sand=5.0-- --%Silt=50.7-- --%Clay=42.9-- --A-6(14)--	65		19	6 7 10	2.21 B	25
	520.0	Medium dense, gray SILTY LOAM, trace gravel	70		20	5 5 5	2.75 P	17
	517.2	Hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel						
		--1" SILT--	75		21	4 9 16	7.05 B	15
		--L_L(%)=25, P_L(%)=16-- --%Gravel=1.9-- --%Sand=9.9-- --%Silt=66.6-- --%Clay=21.6-- --A-4(6)-- --HARD DRILLING-- --Possible Cobbles--	80		22	12 19 25	6.07 S	16
	504.7	Dense, gray SILTY LOAM, trace gravel	85		23	16 18 21	5.08 B	20
	502.2	--HARD DRILLING-- Hard, gray SILTY CLAY LOAM, trace gravel						
			90		24	19 50/6"	6.23 S	11
	497.2	Very dense, gray SILTY LOAM, trace gravel						
			95		25	35 50/3"	NP	15
	492.2	Very dense, gray SILT, trace CLAY lamination --Saturated-- --%Gravel=0.0-- --%Sand=0.7-- --%Silt=87.7--	100		26	23 33 47	NP	17

GENERAL NOTES

Begin Drilling: **10-09-2013** Complete Drilling: **10-09-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&R** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **11.50 ft**
At Completion of Drilling: **96.75 ft**
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 1704-B-01

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 588.98 ft
North: 1897913.67 ft
East: 1171434.80 ft
Station: 5155+31.36
Offset: 19.5036 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	488.0	--%Clay=11.5-- --A-4(0)-- --ROLLER BIT REFUSAL-- --Possible BEDROCK-- Boring terminated at 101.00 ft	105 110 115 120 125					

GENERAL NOTES

Begin Drilling **10-09-2013** Complete Drilling **10-09-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&R** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **11.50 ft**
At Completion of Drilling ▼ **96.75 ft**
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 1704-B-02

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 575.24 ft
North: 1897908.23 ft
East: 1171582.03 ft
Station: 5156+77.85
Offset: 32.3584 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	574.2	12-inch thick ASPHALT --PAVEMENT--						
		Medium dense, brown SANDY GRAVEL --FILL--			1	17 16 10	NP	5
	572.2	Hard, dark gray CLAY LOAM, trace gravel, brick fragments, and cinders --FILL--	5		2	5 7 8	5.17 B	16
	569.7	Medium stiff to stiff, gray SILTY CLAY, trace gravel			3	3 4 4	1.64 B	20
	567.2	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel	10		4	2 2 3	0.49 B	22
					5	0 2 2	0.57 B	22
			15		6	0 2 2	0.66 B	25
					7	0 2 2	0.49 B	25
			20		8	0 1 2	0.33 B	26
					9	0 0 2	0.33 B	26
			25		10	0 1 3	0.41 B	25
			30		11	3 5 6	0.66 B	24
					12	1 2 2	0.33 B	26
	541.0	Hard, gray SILTY CLAY, trace gravel	35		13	2 3 3	1.00 N/6	
			40		14	6 9 16	4.35 B	20
			45		15	7 14 26	5.41 B	16
			50		16	9 17 18	4.84 B	22

GENERAL NOTES

Begin Drilling: **10-17-2013** Complete Drilling: **10-17-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&N** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **52.50 ft**
At Completion of Drilling: **82.00 ft**
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 1704-B-02

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 575.24 ft
North: 1897908.23 ft
East: 1171582.03 ft
Station: 5156+77.85
Offset: 32.3584 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	523.5							
		Medium dense, gray, fine SAND --Saturated--						
			55		17	1 3 7	NP	23
	518.5							
		Hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel						
			60		18	12 20 30	6.97 S	14
			65		19	11 16 27	7.13 B	17
	508.5							
		Very dense, gray SILT --Saturated--						
			70		20	15 19 43	NP	23
	503.5							
		Hard, gray SILTY CLAY LOAM, trace gravel						
			75		21	42 50/5	> 4.50 P	9
	498.5							
		Dense to very dense, gray SILT to SILTY LOAM --Saturated--						
			80		22	21 37 48	NP	22
			85		23	17 20 23	NP	21
	488.5							
		Hard, gray SILTY CLAY, trace gravel						
			90		24	50/4	> 4.50 P	20
		--ROLLER BIT REFUSAL-- --Possible BEDROCK--						
	482.2							
		Boring terminated at 93.00 ft						
			95					
			100					

GENERAL NOTES

Begin Drilling: **10-17-2013** Complete Drilling: **10-17-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
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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 1704-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: 575.52 ft
North: 1897910.46 ft
East: 1171681.80 ft
Station: 5157+77.59
Offset: 35.5253 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	574.5	12-inch thick ASPHALT --SHOULDER PAVEMENT--						
		Dense, gray and white LOAM, trace gravel --FILL--			1	17 18 16	NP	7
	572.5	Hard, dark brown SILTY CLAY LOAM, trace to little gravel --FILL--	5		2	5 6 8	6.56 B	17
	570.0	Loose, black to brown SANDY LOAM, trace gravel --FILL--			3	3 4 4	NP	21
	566.5	Stiff, brown and gray SILTY CLAY, trace gravel	10		4	2 3 4	1.31 B	19
	565.0	Medium stiff, gray CLAY to SILTY CLAY, trace gravel			5	2 2 2	0.67 N/6	23
			15		6	1 2 2	0.67 N/6	21
					7	1 1 2	0.90 B	22
	557.5	Medium stiff, to stiff, gray SILTY CLAY LOAM, trace gravel						
			20		8	3 4 4	1.15 B	19
					9	2 3 3	0.90 B	19
			25		10	1 2 3	0.75 P	20
	550.0	Soft, gray CLAY to SILTY CLAY, trace gravel			11	2 1 2	0.49 B	25
			30		12	2 2 3	0.49 B	28
	543.8	Hard, gray SILTY CLAY LOAM, trace gravel						
		--1" SILT; moist--->	35		13	5 3 3	4.92 B	21
			40		14	8 9 12	4.02 B	17
			45		15	10 12 14	4.02 B	18
			50		16	19 34 22	6.01 B	10

GENERAL NOTES

Begin Drilling: **10-21-2013** Complete Drilling: **10-21-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **54.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1704-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: 575.52 ft
North: 1897910.46 ft
East: 1171681.80 ft
Station: 5157+77.59
Offset: 35.5253 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	521.5	Medium dense, gray SILTY LOAM, trace gravel --Wet--	55		17	4 4 6	NP	23
	518.8	Very stiff to hard, gray SILTY CLAY LOAM, trace gravel	60		18	16 12 14	4.50 P	16
			65		19	11 15 26	2.87 B	22
	508.8	Very dense, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel	70		20	24 38 37	4.51 S	10
			75		21	15 44 50/3	NP	15
			80		22	28 50/5	3.85 S	9
			85		23	32 35 38	4.10 B	18
	488.8	Very stiff, gray SILTY CLAY LOAM, trace gravel	90		24	16 13 18	2.96 B	18
	483.8	Very dense, gray GRAVELLY SAND --WEATHERED BEDROCK-- --HARD DRILLING-- --Possible Cobbles--	95		25	50/4	NP	16
	480.0	--ROLLER BIT REFUSAL-- Boring terminated at 95.50 ft	100					

GENERAL NOTES

Begin Drilling: **10-21-2013** Complete Drilling: **10-21-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **54.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1704-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: 584.72 ft
North: 1897903.29 ft
East: 1171842.81 ft
Station: 5159+38.86
Offset: 50.4076 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	583.2	Medium dense, gray GRAVELLY LOAM, trace brick fragments --FILL--			1	14 10 6	NP	6
	581.7	Medium dense, brown and black SILTY LOAM. trace plants --FILL--						
		Loose, gray GRAVEL --FILL--	5		2	7 4 3	NP	6
	579.2	Soft to medium stiff gray SILTY CLAY LOAM, trace gravel --L_L(%)=31, P_L(%)=16-- --%Gravel=2.9-- --%Sand=19.5-- --%Silt=49.6-- --%Clay=28.0-- --A-6(10)--			3	2 1 1	0.57 B	24
			10		4	0 0 0	0.33 B	24
	574.2	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			5	0 0 0	0.25 B	29
			15		6	0 0 0	0.16 B	20
					7	0 0 0	< 0.25 P	27
			20		8	0 0 0	< 0.25 P	32
					9	0 0 0	< 0.25 P	32
			25		10	0 0 0	< 0.25 P	24
			30		11	0 0 0	< 0.25 P	37
					12	0 0 0	< 0.25 P	36
			35		13	0 1 3	0.66 B	23
		--L_L(%)=37, P_L(%)=18-- --%Gravel=3.1-- --%Sand=11.1-- --%Silt=49.9-- --%Clay=35.9-- --A-6(16)--	40		14	0 2 4	0.90 B	24
	543.0	Very stiff to hard, gray SILTY CLAY, trace gravel						
			45		15	4 5 7	2.00 N/6	
		--Coarse gravel and cobbles-->						
			50		16	12 13 18	5.17 N/6	13

GENERAL NOTES

Begin Drilling: **10-02-2013** Complete Drilling: **10-03-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&R** Logger: **A. Tomaras** Checked by: **C. Marin**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **10.50 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1704-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: 584.72 ft
North: 1897903.29 ft
East: 1171842.81 ft
Station: 5159+38.86
Offset: 50.4076 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			55		17	7 6 10	2.79 B	20
	528.0	Very dense, gray SILT						
			60		18	16 20 25	NA	
			65		19	26 34 43	NP	15
	518.0	Very dense, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel --L_L(%)=20, P_L(%)=13-- --%Gravel=8.3-- --%Sand=24.4-- --%Silt=57.2-- --%Clay=10.1-- --A-4(2)--	70		20	22 22 28	6.56 S	12
			75		21	11 30 50/5	4.00 P	8
	497.2	Very dense, gray SANDY GRAVEL --Saturated--	80		22	21 50 30/2	> 4.50 P	9
			85		23	33 70/3	8.94 B	20
			90		24	39 33 31	NP	10
	487.7	Very dense, gray GRAVELLY SILTY LOAM, some cobbles and boulders --AUGER REFUSAL--	95		25	45 37 27	NP	7
	484.7		100		26	39 60/2	NP	11

GENERAL NOTES

Begin Drilling: **10-02-2013** Complete Drilling: **10-03-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&R** Logger: **A. Tomaras** Checked by: **C. Marin**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **10.50 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1704-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: 584.72 ft
North: 1897903.29 ft
East: 1171842.81 ft
Station: 5159+38.86
Offset: 50.4076 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--WEATHERED BEDROCK--						
	481.2	--ROLLER BIT REFUSAL--						
		Strong, light gray, fair rock mass quality, bedded fresh DOLOSTONE, up to 24-inch beds, 1 to 24-inch spaced joints, horizontal and oblique joints with less than 0.2-inch infilling, hard joint wall, with stylolitic surfaces, and moderately vuggy porosity.	105			CORE		
		--Run 1 - RECOVERY=94%-- --RQD=69%--			1			
		--Highly fragmented--->	110					
	471.2	Boring terminated at 113.50 ft	115					
			120					
			125					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

Begin Drilling **10-02-2013** Complete Drilling **10-03-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&R** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **10.50 ft**
At Completion of Drilling ▼ **NA**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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BORING LOG 21-RWB-05

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 583.32 ft
North: 1897919.78 ft
East: 1171915.09 ft
Station: 1613+69.21
Offset: 25.0245 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	582.9	5-inch thick, white CRUSHED STONE						
		--FILL--						
		Hard, gray and brown CLAY LOAM, trace gravel			1	6 9 9	6.56 S	15
	580.3	--FILL--						
		Medium stiff to stiff, gray SILTY CLAY, trace gravel	5		2	2 2 2	0.82 B	20
					3	1 3 3	1.23 B	17
	575.3	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel						
			10		4	0 2 1	0.41 B	25
					5	0 0 0	0.41 B	26
			15		6	0 0 2	0.57 B	22
					7	2 3 2	0.66 B	22
			20		8	0 2 3	0.74 B	24
					9	2 2 4	0.82 B	23
			25		10	2 3 3	0.74 B	23
			30		11	2 2 3	0.66 B	24
					12	3 4 6	0.66 B	23
			35		13	2 3 3	0.49 B	25
			40		14	3 3 4	0.41 B	23
	541.6	Stiff to hard, gray SILTY CLAY LOAM, trace gravel						
			45		15	2 4 8	1.23 B	18
			50		16	6 12 18	4.26 B	15

GENERAL NOTES

Begin Drilling: **09-24-2013** Complete Drilling: **09-25-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

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

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BORING LOG 21-RWB-05

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 583.32 ft
North: 1897919.78 ft
East: 1171915.09 ft
Station: 1613+69.21
Offset: 25.0245 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	531.6	Gray, coarse SAND						
	529.6	Hard, gray SILTY CLAY LOAM, trace gravel	55		17	13 15 21	5.66 B	14
			60		18	16 24 31	7.13 S	11
			65		19	10 16 21	6.81 S	14
	516.6	Very dense, gray SILTY LOAM, trace to some gravel	70		20	15 25 30	9.02 S	11
			75		21	41 60/3"	NP	10
			80		22	34 45 20/2"	8.69 S	10
	501.6	Very dense, gray SANDY LOAM, trace gravel	85		23	78/6" 22/1"	NP	9
		--HARD DRILLING-- --Possible Cobbles--	90		24	64 45/6"	NP	13
	491.6	Very dense, gray GRAVELLY SILTY LOAM, trace to some cobbles	95		25	100/6"	1.31 S	13
		--HARD DRILLING-- --Possible Cobbles--	100		26	64 40/2"	0.49 S	9

GENERAL NOTES

Begin Drilling: **09-24-2013** Complete Drilling: **09-25-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

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

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BORING LOG 21-RWB-05

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 583.32 ft
North: 1897919.78 ft
East: 1171915.09 ft
Station: 1613+69.21
Offset: 25.0245 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	482.3							
		--WEATHERED BEDROCK--						
	481.3	--ROLLER BIT REFUSAL--						
		Boring terminated at 102.00 ft						
			105					
			110					
			115					
			120					
			125					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

Begin Drilling **09-24-2013** Complete Drilling **09-25-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **L. Iordache**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **MUD**
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-06A

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 591.98 ft
North: 1897749.88 ft
East: 1171805.18 ft
Station: 1827+13.77
Offset: 38.2558 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	591.5	6-inch thick, black SILTY LOAM --TOPSOIL--						
		Medium dense to dense, brown LOAM, little gravel and brick fragments --FILL--			1	9 17 13	NP	6
			5		2	2 15 9	NP	14
	586.5							
		Very stiff, gray SILTY CLAY LOAM, trace gravel			3	2 3 4	2.95 B	17
			10		4	2 4 4	2.54 B	22
	581.5							
		Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			5	3 3 3	< 0.25 P	21
			15		6	0 2 2	0.41 B	24
					7	0 1 1	0.25 B	22
			20		8	0 0 2	0.41 B	26
					9	0 0 1	0.08 B	26
			25		10	0 0 2	0.25 B	26
			30		11	0 0 3	0.25 B	28
					12	0 1 2	0.57 B	23
			35		13	0 1 2	0.50 P	21
			40		14	0 3 2	0.49 B	24
			45		15	0 2 2	0.41 B	25
			50		16	1 1 2	0.33 B	25

GENERAL NOTES

Begin Drilling: **07-25-2013** Complete Drilling: **07-26-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A. Tomaras** 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-06A

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 591.98 ft
North: 1897749.88 ft
East: 1171805.18 ft
Station: 1827+13.77
Offset: 38.2558 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	540.2	Very stiff to hard, gray SILTY CLAY, trace gravel	55		17	6 7 13	3.36 B	19
			60		18	13 18 21	4.84 B	14
			65		19	10 12 19	4.92 B	18
	525.2	Very stiff, gray CLAY, trace gravel						
		--L_L(%)=41, P_L(%)=18-- --%Gravel=0.1-- --%Sand=3.0-- --%Silt=46.6-- --%Clay=50.3-- --A-7-6 (23)--	70		20	6 9 10	2.54 B	24
	518.2	Loose, gray SILT --Wet--	75		21	2 4 5	NP	19
	515.2	Hard, gray SILTY CLAY, trace gravel	80		22	13 20 28	8.94 S	13
	510.2	Very dense to hard, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel	85		23	33 46 50/6	> 4.50 P	10
			90		24	13 20 26	8.61 S	11
		--HARD DRILLING-- --Possible Cobbles--						
	499.0	Very dense, SANDY GRAVEL, with rock fragments	95		25	21 24 29	NP	11
		--HARD DRILLING-- --Possible Cobbles--	100					

GENERAL NOTES

Begin Drilling: **07-25-2013** Complete Drilling: **07-26-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A. Tomaras** 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-06A

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 591.98 ft
North: 1897749.88 ft
East: 1171805.18 ft
Station: 1827+13.77
Offset: 38.2558 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
					26	60/6	NP	17
	490.0							
		Strong, fair to good rock quality, light gray, fresh, joint breaks with little to no infill, slightly vuggy DOLOSTONE with stylolites				CORE		
		--Run 1 - RECOVERY=100%--	105					
		--RQD (top 5ft)=45%--						
		--RQD= (10ft)=62%--			1		NP	
			110					
	480.0							
		Boring terminated at 112.00 ft						
			115					
			120					
			125					

GENERAL NOTES

Begin Drilling **07-25-2013** Complete Drilling **07-26-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** 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-08

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 573.57 ft
North: 1898070.84 ft
East: 1171576.26 ft
Station: 1830+90.17
Offset: 36.1195 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	573.2	5-inch thick ASPHALT --PAVEMENT--						
	572.4	9-inch thick CONCRETE --PAVEMENT--			1	9 9 12	NP	6
	570.6	Medium dense, brown, CRUSHED STONE --BASE COURSE--						
		Stiff, gray SILTY CLAY, trace gravel	5		2	6 5 5	1.39 B	18
	568.1	Very soft to soft, gray CLAY to SILTY CLAY, trace gravel			3	2 1 1	0.41 B	24
		--In-Situ Vane Shear, 10.5 feet-- --$S_{u\ undis}$ = 414.4 psf-- --$S_{u\ remold}$ = 284.9 psf-- --Sensitivity = 1.45--	10		4	1 1 2	0.16 B	26
					1			
		--In-Situ Vane Shear, 13 feet-- --$S_{u\ undis}$ = 466.2 psf-- --$S_{u\ remold}$ = 233.1 psf-- --Sensitivity = 2.00--			5	1 1 2	0.16 B	26
					2			
		--In-Situ Vane Shear, 15.5 feet-- --$S_{u\ undis}$ = 518.0 psf-- --$S_{u\ remold}$ = 310.8 psf-- --Sensitivity = 1.66--	15		6	2 2 2	0.16 B	27
					3			
		--In-Situ Vane Shear, 18.0 feet-- --$S_{u\ undis}$ = 984.2 psf-- --$S_{u\ remold}$ = 310.8 psf-- --Sensitivity = 3.16--			7	2 2 3	0.25 B	27
					4			
		--In-Situ Vane Shear, 20.5 feet-- --$S_{u\ undis}$ = 984.2 psf-- --$S_{u\ remold}$ = 543.9 psf-- --Sensitivity = 1.81--	20		8	3 4 4	0.25 B	23
					5			
		--In-Situ Vane Shear, 23.0 feet-- --$S_{u\ undis}$ = 1320.9 psf-- --$S_{u\ remold}$ = 725.2 psf-- --Sensitivity = 1.82--			9	3 4 5	0.25 B	24
					6			
		--In-Situ Vane Shear, 25.5 feet-- --$S_{u\ undis}$ = 725.2 psf--	25		10	4 5 5	0.49 B	25
		--$S_{u\ remold}$ = 414.4 psf-- --Sensitivity = 1.75--			7			
		--In-Situ Vane Shear, 28.0 feet-- --$S_{u\ undis}$ = 595.7 psf-- --$S_{u\ remold}$ = 284.9 psf-- --Sensitivity = 2.09--			11	3 4 4	0.33 B	26
					8			
	544.6	Medium dense, gray LOAM, trace gravel	30		12	3 6 10	NP	11
	541.8	Very stiff to hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel			13	3 6 9	2.05 B	20
			35					
			40		14	9 13 18	3.85 B	13
			45		15	11 17 25	5.33 S	16
	526.8	Very dense, gray SILTY LOAM, trace gravel						
			50		16	25 27 32	NP	11

GENERAL NOTES

Begin Drilling: **09-08-2013** Complete Drilling: **09-10-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-25 ATV**
Driller: **P&N** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **2.25" HSA 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-08

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 573.57 ft
North: 1898070.84 ft
East: 1171576.26 ft
Station: 1830+90.17
Offset: 36.1195 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	521.8	Very dense, gray SILT with sand lenses						
			55		17	18 25 37	NP	20
	518.8	Hard, gray SILTY CLAY, trace gravel						
			60		18	16 24 39	8.12 B	16
	511.8	Very dense, gray SILT --Wet--						
			65		19	20 27 41	NP	22
	506.8	Very dense, gray SILTY LOAM, trace gravel						
			70		20	50/6"	NP	14
			75		21	50/6"	NP	12
	496.8	Very dense, gray SILT						
		--%Gravel=0.0-- --%Sand=1.5-- --%Silt=86.1-- --%Clay=12.4-- --A-4 (0)--	80		22	36 50/6"	NP	21
			85		23	22 50/5"	NP	17
	487.6	DOLOSTONE boulders --Run 1 - RECOVERY= 66%-- --RQD= 47%-- 89.0ft-Qu=8880 psi --->	90		1	CORE		
		--3-inch thick SILTY LOAM, trace gravel--						
	479.1	Strong, fair rock quality, light gray, fresh, joint breaks with little to no infill, slightly vuggy DOLOSTONE 95.5ft-Qu=9380 psi --->--Run 2 - RECOVERY= 94%-- --RQD= 72%-- 98.5ft-Qu=9080 psi --->	95		2	CORE		
			100					

GENERAL NOTES

Begin Drilling: **09-08-2013** Complete Drilling: **09-10-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-25 ATV**
Driller: **P&N** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **2.25" HSA 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-08

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 573.57 ft
North: 1898070.84 ft
East: 1171576.26 ft
Station: 1830+90.17
Offset: 36.1195 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		102.5ft-Qu=9750 psi --->						
		--Run 3 - RECOVERY= 100%--				CORE		
		--RQD= 65%--	105		3			
		106.5ft-Qu=7500 psi --->						
	465.1	Boring terminated at 108.50 ft						
			110					
			115					
			120					
			125					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

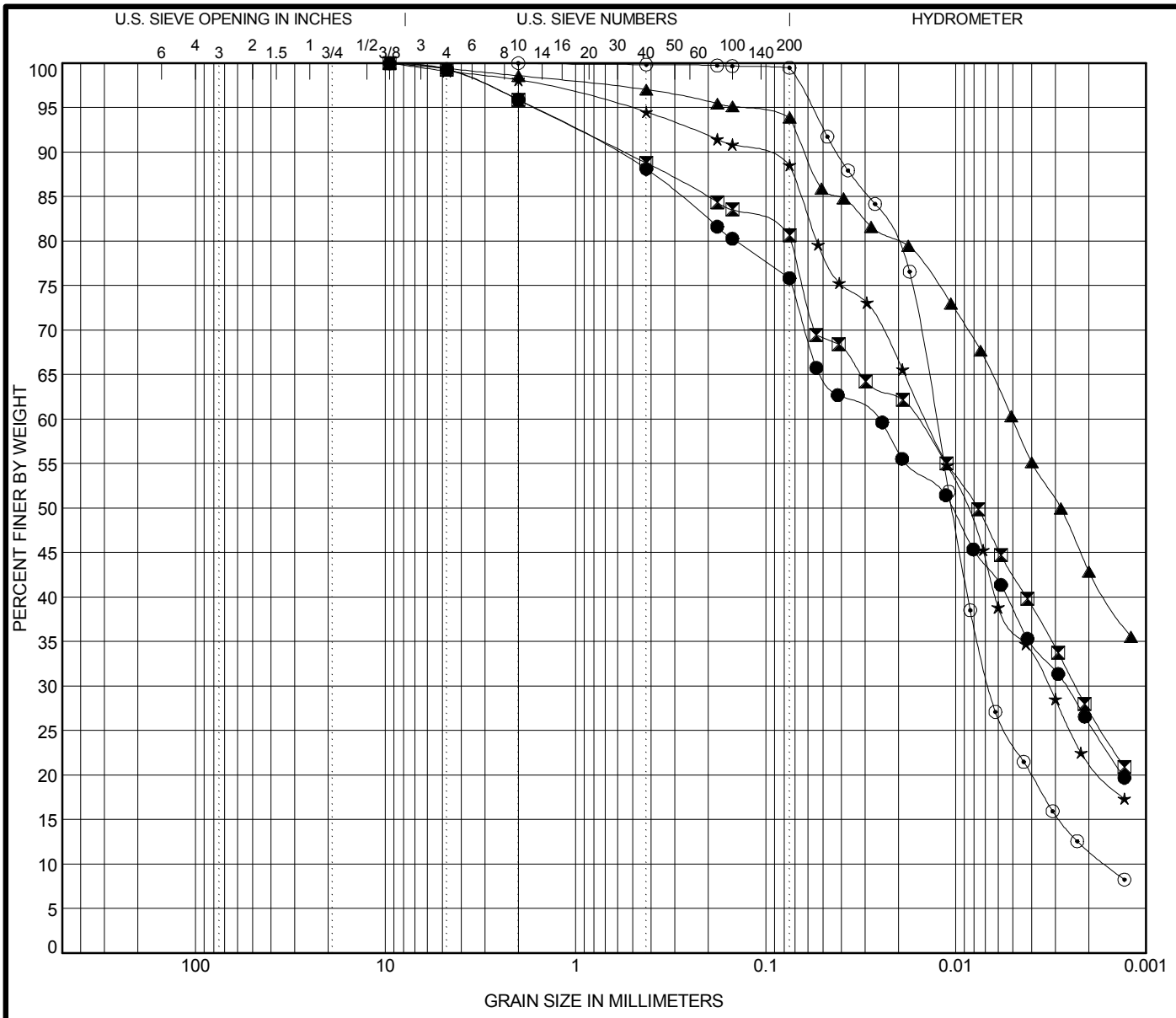
Begin Drilling **09-08-2013** Complete Drilling **09-10-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV**
Driller **P&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

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.

APPENDIX B



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
● 1704-B-01#6	13.5 ft	**Silty Clay Loam**	**31**	**17**	**14**		
⊠ 1704-B-01#13	33.5 ft	**Silty Clay Loam**	**31**	**18**	**13**		
▲ 1704-B-01#19	63.5 ft	**Silty Clay**	**34**	**19**	**15**		
★ 1704-B-01#22	78.5 ft	**Silty Clay Loam**	**25**	**16**	**9**		
⊙ 1704-B-01#26	98.5 ft	**Silt**	**NP**	**NP**	**NP**	**2.15**	**7.78**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 1704-B-01#6	13.5 ft	**9.5**	**0.026**	**0.003**		**4.1**	**20.5**	**49.6**	**25.9**
⊠ 1704-B-01#13	33.5 ft	**9.5**	**0.016**	**0.002**		**4.1**	**15.7**	**52.9**	**27.3**
▲ 1704-B-01#19	63.5 ft	**9.5**	**0.005**			**1.4**	**5.0**	**50.7**	**42.9**
★ 1704-B-01#22	78.5 ft	**9.5**	**0.014**	**0.003**		**1.9**	**9.9**	**66.6**	**21.6**
⊙ 1704-B-01#26	98.5 ft	**2**	**0.013**	**0.007**	**0.002**	**0.0**	**0.7**	**87.7**	**11.5**

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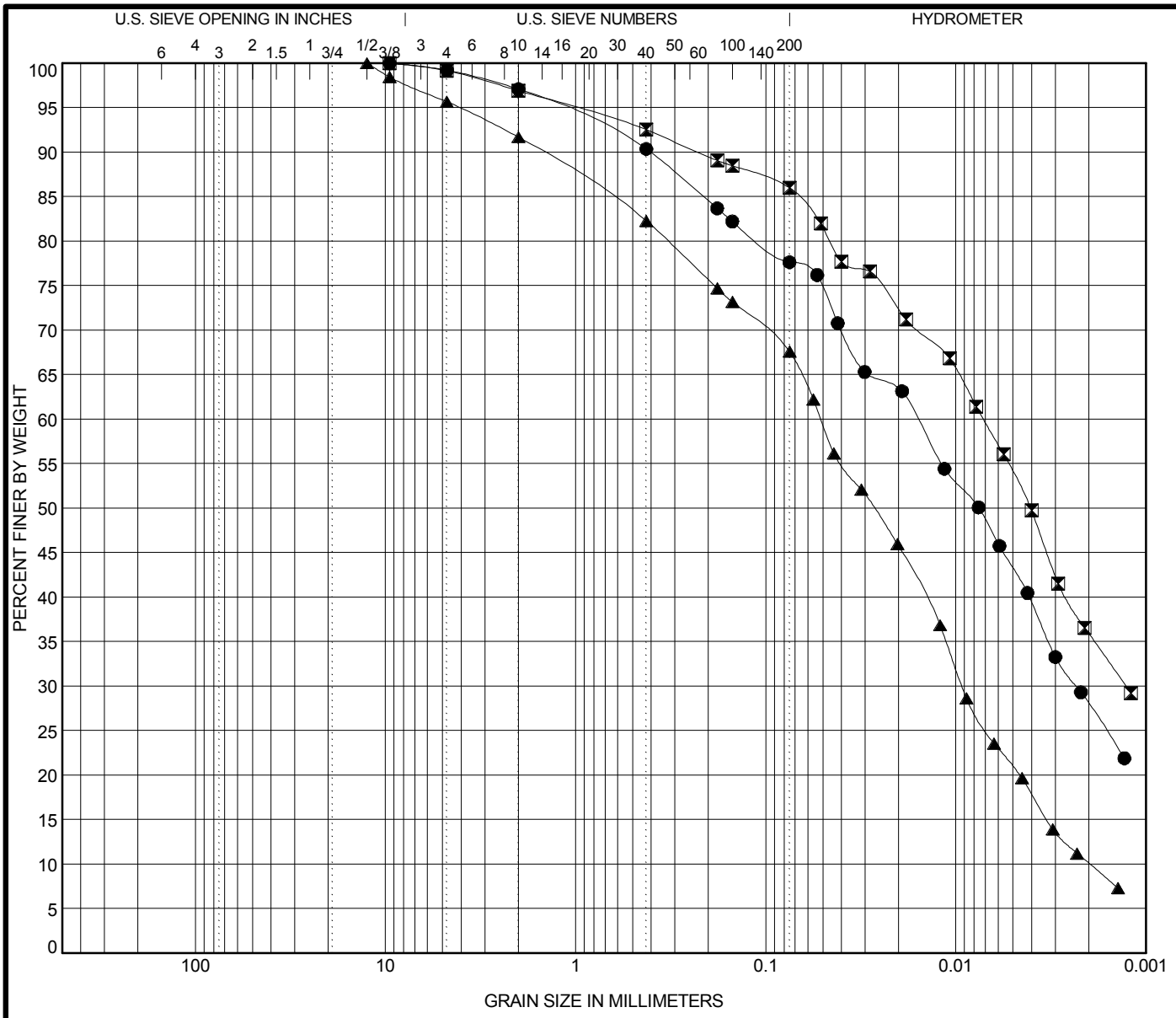
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

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

Number: 1100-04-01



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	1704-B-04#3	6.0 ft	**Silty Clay Loam**	**31**	**16**	**15**		
⊠	1704-B-04#14	38.5 ft	**Silty Clay**	**37**	**18**	**19**		
▲	1704-B-04#20	68.5 ft	**Silty Loam**	**20**	**13**	**7**	**0.85**	**25.95**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1704-B-04#3	6.0 ft	**9.5**	**0.016**	**0.002**		**2.9**	**19.5**	**49.6**	**28.0**
⊠	1704-B-04#14	38.5 ft	**9.5**	**0.007**	**0.001**		**3.1**	**11.1**	**49.9**	**35.9**
▲	1704-B-04#20	68.5 ft	**12.5**	**0.051**	**0.009**	**0.002**	**8.3**	**24.4**	**57.2**	**10.1**

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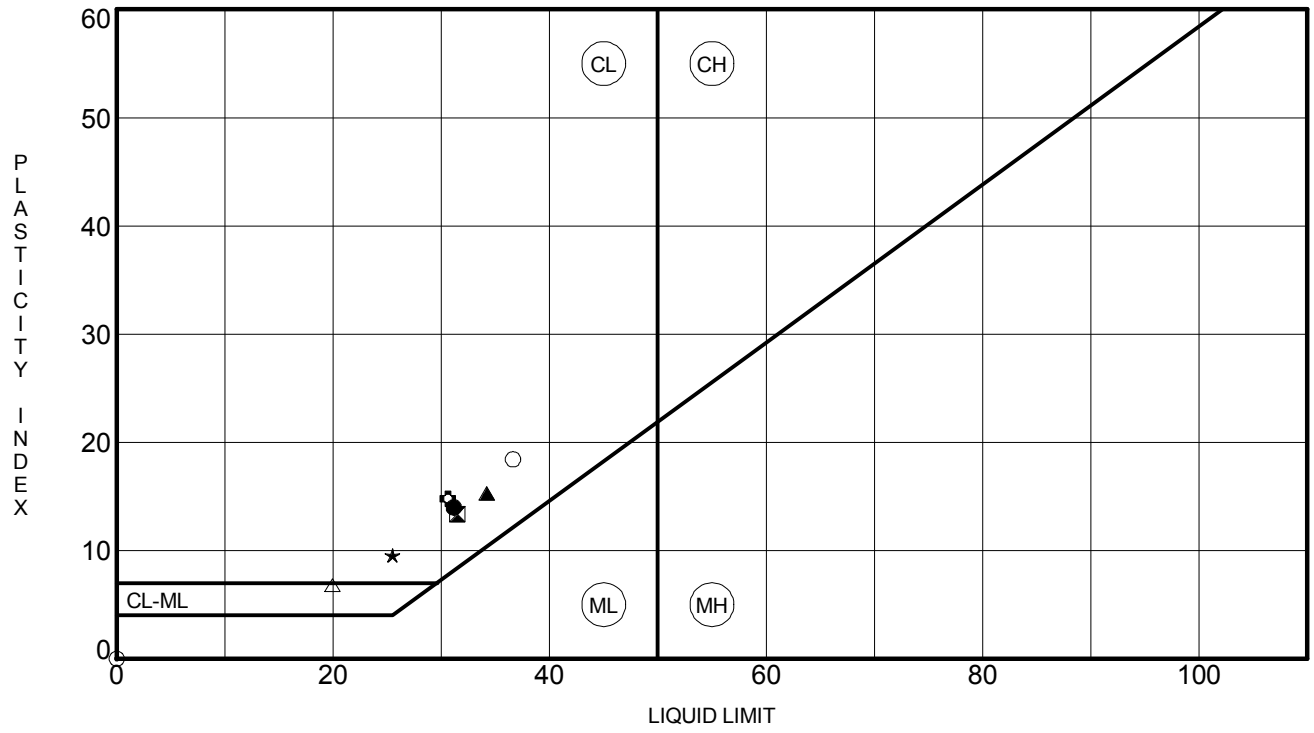
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

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

Number: 1100-04-01



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	1704-B-01#6	13.5 ft	31	17	14	76	Silty Clay Loam
⧓	1704-B-01#13	33.5 ft	31	18	13	81	Silty Clay Loam
▲	1704-B-01#19	63.5 ft	34	19	15	94	Silty Clay
★	1704-B-01#22	78.5 ft	25	16	9	89	Silty Clay Loam
⊙	1704-B-01#26	98.5 ft	NP	NP	NP	99	Silt
✿	1704-B-04#3	6.0 ft	31	16	15	78	Silty Clay Loam
○	1704-B-04#14	38.5 ft	37	18	19	86	Silty Clay
△	1704-B-04#20	68.5 ft	20	13	7	68	Silty Loam

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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

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	Location	Length (in)			Diameter (in)	Total Load (lbs)	Total Pressure (psi)	Fracture Type*	Break Date	Tested By	Area (in^2)
				Total Core	Before Capping	After Capping							
1705-B-08(1)	7159	89.0	Flyover Ramp	N/A	3.88	3.97	2.05	29310	8880	3	9/12/2013	AM	3.30
1705-B-08(2)	7160	95.5	Flyover Ramp	N/A	3.94	4.07	2.05	30970	9380	3	9/12/2013	AM	3.30
1705-B-08(3)	7161	98.5	Flyover Ramp	N/A	3.80	3.92	2.05	29950	9080	3	9/12/2013	AM	3.30
1705-B-08(4)	7162	102.5	Flyover Ramp	N/A	3.91	4.01	2.05	32160	9750	3	9/12/2013	AM	3.30
1705-B-08(5)	7163	106.5	Flyover Ramp	N/A	3.91	4.03	2.05	24750	7500	3	9/12/2013	AM	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: G. Nam

Checked by: 9/16/13

WANG ENGINEERING, INC.
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Wang Engineering

Unconfined Compressive Strength of Intact Rock Core Specimens

Project: Circle Interchange

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	Location	Length (in)			Diameter (in)	Total Load (lbs)	Total Pressure (psi)	Fracture Type*	Break Date	Tested By	Area (in^2)
				Total Core	Before Capping	After Capping							
1705-B-02 (1)	117	89.0	Flyover Ramp	N/A	4.14	4.32	2.05	38290	11600	3	8/26/2013	RG	3.30
1705-B-02 (2)	118	92.0	Flyover Ramp	N/A	4.03	4.22	2.05	49050	14860	3	8/26/2013	RG	3.30
1705-B-02 (3)	119	94.5	Flyover Ramp	N/A	4.08	4.22	2.05	34470	10450	3	8/26/2013	RG	3.30
1705-B-04 (1)	120	88.5	Flyover Ramp	N/A	4.08	4.17	2.05	28260	8560	3	8/26/2013	RG	3.30
1705-B-04 (2)	121	91.5	Flyover Ramp	N/A	4.06	4.17	2.05	27900	8450	3	8/26/2013	RG	3.30
1705-B-06 (1)	122	103.5	Flyover Ramp	N/A	4.03	4.14	2.05	32280	9780	3	8/26/2013	RG	3.30
1705-B-06 (2)	123	110.5	Flyover Ramp	N/A	4.07	4.18	2.05	23980	7270	3	8/26/2013	RG	3.30
1705-B-10 (1)	124	112.5	Flyover Ramp	N/A	3.88	3.97	2.05	24670	7480	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: G Wang

Checked by: [signature] 8/28/13

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APPENDIX C

Run #1

0 3 6 9 12 inches

Boring 1704-B-04:
Run 1, 103.5' to 113.5', RECOVERY = 94%, RQD = 69%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION
STRUCTURE SN 016-1704 , CHICAGO, IL

SCALE : GRAPHIC	APPENDIX C	DRAWN BY: M. de los Reyes CHECKED BY: C. Marin

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FOR AECOM	1100-04-01