# STRUCTURE GEOTECHNICAL REPORT
# RETAINING WALL 12
# PROPOSED SN 016-1801
# F.A.I. ROUTE 290
# SECTION 2013-00BR, CONTRACT No. 60X76
# IDOT PTB 163-001
# COOK COUNTY, ILLINOIS

**for**


**AECOM**

**303 East Wacker Drive**

**Chicago, IL 60601**

**(312) 938-0300**


**submitted by**


**Wang Engineering, Inc.**

**1145 North Main Street**

**Lombard, IL 60148**

**(630) 953-9928**



**Original: August 11, 2016**
**Revised: January 20, 2017**

Technical Report Documentation Page

| 1. Title and Subtitle<br>Structure Geotechnical Report<br>Retaining Wall 12 | | 2. Report Date<br>January 20, 2017<br>3. Report Type ☒ SGR ☐ RGR<br>☐ Draft ☒ Final ☒ Revised |
|---|---|---|
| 4. Route / Section / County<br>FAI 290/2013-00BR/ Cook | | 5. IDOT Job No./Contract<br>D-91-227-13/60X76 |
| 6. PTB / Item No.<br>163/001 | 7. Existing Structure Number(s)<br>NA | 8. Proposed Structure Number(s)<br>016-1801 |
| 9. Prepared by<br>Wang Engineering, Inc.<br>1145 N Main Street<br>Lombard, IL 60148 | Contributor(s)<br>Author: Mohammed Kothawala, P.E., D.GE<br>QC/QA: Corina T. Farez., P.E., P.G. | Author Phone Number/Email Address<br>(630) 953-9928 Ext 36<br>mkothawala@wangeng.com |
| 10. Prepared for<br>AECOM<br>303 East Wacker Drive<br>Chicago, IL 60601 | Structural Engineer<br>Amish Bhatt, S.E.<br>AECOM | Contact Phone Number<br>(708) 236-0900 |

11. Abstract

A new retaining wall will be constructed as part of the widening of the southbound I-90/94 expressway. The proposed retaining wall is 561’-3” in length with maximum retained height of 23’-0”. This report provides geotechnical recommendations for the design of the proposed retaining wall.

Below up to 20.5 feet mostly granular fill, the foundation soils consists of up to 39 feet of very soft to medium stiff clay to silty clay lake bottom deposits, 25 to 45 feet of stiff to hard silty clay to silty loam diamicton with up to 8 feet of silty loam, silt, loam, sand and gravely sand interbeds, 13.5 feet of dense to very dense hardpan, and 10 feet of very dense sandy gravel outwash. The site classifies in the Seismic Class D.

The retaining wall is basically a cut wall. Evaluations of different types of walls are discussed in the report. Design recommendations for the drilled soldier pile and tangent pile walls are included in the report.

12. Path to archived file

S:\Netprojects\11000401\Report\RPT_Wang_MAK_11000401_SGRFinalRW12_20170120.pdf

# TABLE OF CONTENTS

Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

# STRUCTURE GEOTECHNICAL REPORT
# RETAINING WALL 12
# I-290 EB TAYLOR STREET EXIT
# PROPOSED SN 016-1801
# IDOT PTB 163-001
# COOK COUNTY, ILLINOIS

**FOR**
**AECOM**

## 1.0 INTRODUCTION

This report presents the results of Wang Engineering, Inc. (Wang) subsurface investigation, laboratory testing, and geotechnical engineering evaluations for the proposed wall SN 016-1801 (Retaining Wall 12) along Eastbound I-290 (Eisenhower Expressway) Taylor Street exit in connection with the Circle Interchange Reconstruction program in the City of Chicago, Cook County, Illinois. A *Site Location Map* is presented as Exhibit 1.

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

### 1.1 Project Description

The Circle Interchange Reconstruction project is along Interstate 90/94 (I-90/94) from south of Roosevelt Road to north of Lake Street, along Interstate 290 (I-290) from Loomis Street to the Circle Interchange; and along Congress Parkway from the Circle Interchange to Canal Street/Old Post Office. The routes typically have three lanes of traffic in each direction with mostly one lane ramp at the interchanges. Locally, the north leg is known as the Kennedy Expressway, the south leg as the Dan Ryan Expressway and the west leg as the Eisenhower Expressway. Within the project area, there are several cross street bridges over I-90/94 and I-290 considered for reconstruction. Along I-90/94, from south to north, the cross street overpasses include Taylor Street, Van Buren Street, Jackson Boulevard, and Adams Street. Along I-290, from west to east, the cross street overpasses include Morgan Street, Peoria Street, and Halsted Street.

The proposed improvements include additional through lanes in each direction on I-90/94. The horizontal alignments and vertical profiles throughout the interchange will be improved. A new two-lane flyover will be constructed to carry I-90/94 northbound traffic to I-290 westbound. Cross street bridges including, Morgan Street, Harrison Street, Halsted Street, Peoria Street, Taylor Street, Adams Street, Jackson Boulevard, and Van Buren Street will be reconstructed. Various existing ramps will be realigned and reconstructed and up to 50 new retaining walls will be constructed.

### 1.2 Proposed Structure

The proposed retaining wall is basically a cut wall proposed along the I-290 Eastbound Taylor Street exit ramp. The proposed retaining wall is 561'-3" long measured along the wall's front face from Station 7306+24.54 (Ramp ES baseline) to Station 7300+58.92 (Taylor Street Ramp baseline) and the maximum retained height is 23'-0". Along the alignment Station 7305+30.00 is equal to Station 1506+61.99. The wall starts at the Peoria Street south abutment on the east side and ends at the north side of the Halsted Street west abutment. The *In-Progress Type, Size, and Location (TSL) Plan* prepared by TranSystems Corporation (TSC) dated August 11, 2016 is included in Appendix F.

### 1.3 Existing Structure

The existing retaining wall constructed in 1955 and located north of the proposed wall is a reinforced concrete structure with an attached guardrail and steel fence. A crashwall is located near the base of retaining wall along the roadway. The length of the existing wall is 532'-9' and the height varies from approximately 17'-6" to 17'-7" (measured from grade at front face of wall). The wall is supported on three and four rows of driven timber piles. Special piles were used near water main riser box. Pile spacing varies between 3'-0" and 5'-0". Piles capacities are unknown. The existing wall 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 retaining wall is located in the NE¼ of Section 17, Tier 39 N, Range 14 E of the Third Principal Meridian. A *Site Location Map* is presented as Exhibit 1.

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 retaining wall is situated within the Chicago Lake Plain Physiographic Subsection. In general the area is characterized by a flat surface, underlain largely by till, which slopes gently toward the lake. The wall runs along the south side of the I-290 exit ramp to Southbound I-90/94 SB between Peoria Street and Halsted Street. The existing grade elevation along the proposed wall alignment is approximately 595 feet.

### 2.2 Surficial Cover

Within the project area, a 95-foot thick or more, 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, known informally as the “Chicago Blue Clay”, 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”.

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 a 350-foot thick Silurian-age dolostone (Leetaru et al 2004) at depths ranging from 85 to 100 feet below ground surface (bgs). Only inactive faults are known in the area and the seismic risk to the proposed structure from the existing faults is minimal (Leetaru et al. 2004; Willman 1971). There are no records of mining activity in the area.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed that 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. The borings indicate that the bedrock may be encountered at or below 499 feet elevation.

## 3.0 EXISTING GEOTECHNICAL DATA

Existing data consists of Boring 2081-B-06 performed by Wang for the Halsted Street south abutment and Boring 2082-B-03 performed by Wang for the Peoria Street south abutment. Borings 2081-B-06 and 2082-B-03 were performed in March 2013 to a depth of 97 and 100 feet bgs respectively. The *Boring Logs* are included in Appendix A and their locations are shown on the *Boring Location Plan* (Exhibit 3).

## 4.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations performed by Wang specifically for Retaining Wall 12.

### 4.1 Subsurface Investigation

For the proposed wall, the subsurface investigation consisted of nine borings, designated as 12-RWB-01 through 12-RWB-09. The borings were drilled in July 2013 and October 2014 to depths ranging from 48.0 to 115.0 feet bgs. The as-drilled boring locations for the borings drilled in 2013 were surveyed by Dynasty Group, Inc. and station and offset information for each boring were provided by AECOM and the as-drilled boring location for borings drilled in 2014 were surveyed by Wang and AECOM provided elevation, and station and offset information. Boring location data are included in the *Boring Logs* (Appendix A) and the as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 3).

Truck-mounted drilling rigs equipped with hollow and/or solid stem augers, were used to advance and maintain an open borehole to 8 to 20 feet and mud rotary was used thereafter to the termination depth or bedrock. 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 to boring termination depth or bedrock. Samples collected from each interval were placed in sealed jars and transported to Wang's Geotechnical Laboratory in Lombard, Illinois for further examination and laboratory testing. NWD4-size bedrock cores were collected from boreholes 12-RWB-02, 12-RWB-04, 12-RWB-06, and 12-RWB-08 in 10-foot runs.

Field boring logs, prepared and maintained by a Wang engineer or geologist, include lithological descriptions, visual-manual soil classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests, and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration. The SPT N value, shown on the *Subsurface Soil Data Profile* (Exhibit 4), is the sum of the second and third blows per 6 inches. The soils were described and classified according to the Illinois Division of Highways (IDH) Textural Classification system. The field logs were finalized by an experienced engineering geologist after verifying the field visual classifications and laboratory test results.

Wang performed vane shear tests in Borings 12-RWB-03, 12-RWB-03A, 12-RWB-05, 12-RWB-07, and 12-RWB-09. Two additional vane shear tests were performed in the vicinity of the borings, designated as Borings 12-VST-01 and 12-VST-02, in October 2014. An additional vane shear test boring, designated as VST-01, and performed in December 2015 was used to supplement our investigation. The tests were performed using an Acker Vane Shear Test in undisturbed and remolded conditions. In general, the vane shear values were significantly higher than the corresponding Rimac values. Vane shear test results were used for analyses. Additionally, one TEXAM Pressuremeter test was performed in Boring 12-PMT-01 and the results are shown in the *Laboratory Test Results* (Appendix B).

Groundwater observations were made during and at the end of drilling operations. Due to safety considerations the boreholes were backfilled with grout immediately upon completion.

### 4.2 Laboratory Testing

All soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (AASHTO T89 and T90) and particle size (AASHTO T88) analyses were performed on selected soil samples representing the main soil layers encountered during the investigation. Unconfined compressive strength tests were performed on selected rock cores. Field visual descriptions of the soil samples were verified in the laboratory. Laboratory test results are shown in the *Boring Logs* (Appendix A), in the *Subsurface Soil Data Profile* (Exhibit 4), and in the *Laboratory Test Results* (Appendix B).

The soil samples will be retained in our laboratory for 60 days following this report submittal. The samples will be discarded unless a specific written request is received as to their disposition.

### 4.3 In-Situ Vane Shear Tests

To determine the in-situ undrained shear strength of the very soft to soft gray clay, Wang performed vane shear tests at the locations 12-VST-01, 12-VST-02, and VST-01 and in Borings 12-RWB-03, 12-RWB-03A, 12-RWB-05, 12-RWB-07 and 12-RWB-09 using an Acker Drill Company vane shear test kit. During testing, a cased borehole is extended to the desired depth, and a four-bladed vane is pushed into the undisturbed clay layer and slowly until the soil fails. After the peak strength value is recorded, the vane is rotated quickly several times to remold the soil, and the test is repeated at the same depth to measure a remolded or residual shear strength value. The ratio between the peak and remolded shear strength represents soil sensitivity. VST results are shown on boring logs included in Appendix A.

### 4.4 Pressuremeter Tests

Two pressuremeter tests were performed in the soft clay at a separate location identified as 12-PMT-01 to define the soil deformation response under lateral loading of the proposed soldier and tangent piles. The testing was conducted with a TEXAM Pressuremeter device on October 17, 2014, and a summary of the data obtained is provided in Appendix E.

## 5.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during our subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Subsurface Soil Data 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.

### 5.1 Soil Conditions

The pavement structure measured in the bridge borings is of no consequence for the design and construction of Retaining Wall 12. The borings drilled for the proposed retaining wall measured 2 to 9 inches of black and brown silty loam to silty clay loam topsoil. In descending order, the general lithologic succession encountered beneath the topsoil includes: 1) man-made ground (fill); 2) stiff to very stiff silty clay loam, 3) very soft to medium stiff clay to silty clay; 4) stiff to hard silty clay to silty clay loam; 5) dense to very dense silty loam; 6) very dense gravelly sandy loam to sandy gravel; and 7) dolostone bedrock.

*(1) Man-made ground (fill)*

Underneath the topsoil, the borings encountered up to 20.5 feet of mostly granular fill. The granular fill consists of very loose to very dense, sandy loam and silty loam to sandy gravel with sand-size and gravel-size construction debris. It has SPT N-values of 2 to 70 blows/foot and moisture content values of 1 to 47%. The cohesive fill consists of hard silty clay loam and has unconfined compressive strength ($Q_u$) values of more than 4.5 tsf and moisture content (MC) values of 11 to 16%. Boring 12-RWB-08 encountered a 2-inch thick layer of buried black loam topsoil beneath the fill layer.

*(2) Stiff to very stiff silty clay loam (Crust)*

Beneath the fill, Borings 12-RWB-02 through 12-RWB-06 and 12-RWB-08 sampled an up to 7.5-foot thick layer of stiff to hard gray silty clay to silty clay loam with $Q_u$ values of 1.2 to 4.3 tsf and MC values of 15 to 25%.

*(3) Very soft to medium stiff clay to silty clay (Chicago Blue Clay)*

Underneath the fill, the borings encountered up to 39 feet of very soft to medium stiff, gray clay to silty clay with $Q_u$ values of 0.1 to 0.9 tsf averaging 0.3 tsf and MC values of 17 to 30% with an average of 24%. The soil has liquid limit ($L_L$) values of 27 to 34% and plastic limit ($P_L$) values of 15 to 17%. According to the AASHTO soil classification, the subgrade soils belong to the A-6 group. This layer is commonly known as the “Chicago Blue Clay”.

*(4) Stiff to hard silty clay to silty clay loam*

At elevations of 542.0 to 548.2 feet (47 to 52 feet bgs), the borings advanced through up to 45 feet of stiff to hard silty clay to silty clay loam. This soil has $Q_u$ values of 1.1 to 9.1 tsf averaging 3.4 tsf and MC values of 11 to 37% averaging 19%. The soil has $L_L$ values of 22 to 51% and $P_L$ values of 17 to 20%. According to the AASHTO soil classification, the subgrade soils belong to the A-6 and A-7-6 groups.

Up to 8-foot thick interbeds of silty loam, silt, loam, sand, and gravelly sandy loam with N-values of

10 to more than 50 blows/foot and MC of 9 to 28% and soft to medium stiff clay to silty clay with average $Q_u$ and MC values of 0.4 tsf and 29%, respectively, were encountered within this layer.

*(4) Dense to very dense silty loam (Hardpan)*

At elevations of 502.0 to 507.6 feet (87 to 92 feet bgs), the borings advanced through up to 13.5 feet of dense to very dense silty loam hardpan. The hardpan has MC values of 7 to 14% averaging 11%, and SPT N-values greater than 50 blows/foot. According to the AASHTO soil classification, the soils belong to the A-4 group. This layer is commonly known as the "Chicago Hardpan".

*(5) Very dense gravelly sandy loam to sandy gravel*

At elevations of 502.0 feet (92 feet bgs), Borings 12-RWB-02, 12-RWB-08, and 12-RWB-09 advanced through up to 10 feet of gray, very dense gravelly sandy loam to sandy gravel with SPT N-values greater than 50 blows/foot, and MC values of 6 to 15%. This granular layer, found over the bedrock, is water bearing.

*(6) Dolostone bedrock*

Sound bedrock was encountered in Borings 12-RWB-02, 12-RWB-04, 12-RWB-06, and 12-RWB-08 at elevations of approximately 488.8 to 499.5 feet. The rock is strong, good to very good quality, light gray, moderately fractured, slightly to moderately vuggy dolostone. The RQD of the bedrock cores was measured at 64 to 95%.

### 5.2 Groundwater Conditions

The granular fill was found to be moist or wet within its bottom 1 to 5 feet. During drilling, saturated layer of sand, gravelly sand, and sandy gravel were observed in Borings 12-RWB-01, 12-RWB-05, 12-RWB-07, and 12-RWB-09 between elevations 511.7 and 578.9 feet (15.5 to 82.0 feet bgs). At boring completion, the groundwater could not be measured because of mud rotary drilling was used below depths of 10 to 20 feet bgs. Based on the previous experience at the site, the granular layer (layer 5) encountered just above the bedrock at elevations of 502.0 to 505.0 feet, is saturated and possibly artesian, under pressure.

### 5.3 Seismic Design Considerations

The Seismic Site Class was determined using IDOT Design Guide AGMU Memo 09.01 LRFD Seismic Soil Site Class Definition dated January 7, 2009 and IDOT spreadsheet "Seismic Site Class Determination" dated December 13, 2010. The result of our seismic site class determination is

presented in Appendix C. Based on the subsurface soil profile the site is in Seismic Site Class D.
The seismic spectral acceleration parameters were determined using the AASHTO computer program "Seismic Design Parameters, version 2.10" by specifying location by latitude and longitude. The procedure for determining seismic design data is included in the 2014 AASHTO LRFD Bridge Design Specifications. Considering seismic design spectrum values and Soil Site Class and based on Table 3.15.2-1 and Figure 2.3.10-2 in the IDOT 2012 Bridge Manual, the Seismic Performance Zone is 1. The recommended seismic design data are summarized below.

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

As per 2012 IDOT Bridge Manual, liquefaction analysis is not required for a site located in Seismic Performance Zone 1.

## 6.0 ANALYSIS AND RECOMMENDATIONS

The following sections present our engineering evaluations and recommendations for the selection of wall type and geotechnical parameters for the wall design.

### 6.1 Retaining Wall Type Evaluation

Based on the soil conditions encountered during our investigation and anticipated loads, a shallow foundation system consisting of spread footings is not suitable.

The proposed wall could be a cast-in-place concrete cantilever wall supported on driven piles or drilled shafts. An additional open cut excavation into the existing slope or a temporary soil retention system will be required to construct the footings. This would also require backfilling and more construction time. It is also understood that driven piles are not to be considered due to concern of noise and vibration.

A cantilever or tieback steel sheet pile wall will not be an appropriate wall system at this site due to concern of noise and vibration, utilities, and driving difficulty in hardpan.

A soldier pile and lagging type of retaining wall (S-P Wall) could be considered as a wall installed with a top-down constructed method. For the same reasons mentioned for the steel sheet pile wall, a driven soldier pile wall will not be suitable. Therefore, soldier piles installed in drilled shaft are recommended which will provide more passive resistance and a wider section can be used such as a wide flange beam (W) section. For the higher portion of the wall, larger soldier pile section and/or less spacing, of the piles, or ground anchors (tiebacks) may be necessary.

Another wall type option could be a tangent pile wall consisting of a single row of tangentially touching drilled, reinforced-concrete piles. The reinforcement of each pile may consist of a steel beam or reinforcing bar cage. Lateral deflections can be relatively less compared to an S-P Wall. The tangent pile wall can also be constructed with ground anchors.

It is understood that the designer has selected either a soldier pile or tangent pile wall. However, the particular wall type should be selected based on the wall type study including preliminary structural design, construction stages, and cost analysis. We recommend performing preliminary structural design based on the recommended geotechnical design parameters to determine feasibility of selected wall. Design considerations should include deflection control at the top of the wall.

The following presents our geotechnical design recommendations for the feasible wall types. For the non-gravity cantilevered wall, 2014 AASHTO LRFD Bridge Design Specifications should be followed.

### 6.2 Drilled Soldier Pile Wall

A soldier pile and lagging type of retaining wall (S-P Wall) can be considered as a wall installed with a top-down construction method.

The geotechnical design parameters shown in Tables 1 through 3 are recommended to be used for the design of the soldier pile wall. These parameters were determined based on the soil conditions encountered in the borings, and in-situ vane shear and pressuremeter tests in the soft silty clay layer. Based on the vane shear and pressuremeter test results, we concluded that higher values of shear strength of soft and very soft clays are justified compare to the shear strength obtained from Rimac tests on soil samples from the borings. The shear strength values for the soft and very soft clays are reflected in Tables 1 through 3. The design of the soldier-pile wall should ignore 3 feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to the excavation required for installation of concrete facing, drainage system and frost-heave condition.

In developing the design lateral pressure, the lateral pressure due to construction equipment surcharge load should be added to the lateral earth pressure. Drainage behind the wall and underdrain should be as per the 2012 IDOT Bridge Manual. The water pressure should be added to the earth pressure if drainage is not provided. The simplified earth pressure distributions shown in 2014 AASHTO LRFD Bridge Design Specifications should be used. Design considerations should include deflection control at the top of the wall. The recommendations pertaining to site preparation and earthwork are presented in subsequent sections of this report.

The plan should show a minimum timber lagging thickness of 3 inches. A Geocomposite Wall Drain should be placed over the timber lagging area in the front face of the wall and connected to the 4 inch diameter perforated drain pipe.

### 6.3 Tangent Pile Wall

A tangent pile wall consisting of a single row of tangentially touching drilled reinforced concrete shafts can be considered. Lateral movement of this type of wall is relatively small compared to more flexible wall systems. The geotechnical design parameters shown in Tables 1 through 3 are recommended to be used for the design of the tangent pile wall. The design of the wall should ignore 3 feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to excavation required for installation of concrete facing, drainage system and frost-heave condition.

In developing the design lateral pressure, the lateral pressure due to construction equipment surcharge load should be added to the lateral earth pressure. Drainage behind the wall can be provided by drilling a small hole between the drilled shafts and connecting with a geocomposite wall drain. The underdrain should be similar to the soldier pile wall as per 2012 IDOT Bridge Manual. The water pressure should be added to the earth pressure if drainage is not provided. The simplified earth pressure distributions shown in 2014 AASHTO LRFD Bridge Design Specifications should be used. Design considerations should include deflection control at the top of the wall. The recommendations pertaining to site preparation and earthwork are presented in subsequent sections of this report.

### 6.4 Lateral Design Pressures

The simplified earth pressure distributions shown in the 2014 AASHTO LRFD Bridge Design Specifications should be used. We recommend linearly increasing the unfactored lateral active earth pressure at 40 psf per foot of depth below the grade behind the wall for a horizontal grade. Additional lateral load from surcharge including live load should be as per 2014 AASHTO LRFD Bridge Design Specifications.

### 6.5 Resistance to Drilled Shafts Lateral Loads

Lateral loads on drilled shafts should be analyzed for maximum moments and lateral deflections. A geotechnical resistance factor of 1.0 should be used. The lateral load capacity analysis can be performed using a computer program such as COMP 624P, LPILE, LATPILE, or any other similar program. The estimated soil parameters that may be used to analyze the stresses and deflections of drilled shafts under lateral loads are presented in Tables 1 through 3. We considered the in-situ vane shear and pressuremeter test results for the soft clay.

Table 1: Geotechnical Parameters WALL 12, SN: 016-1801
For the Design of Soldier-Pile and Tangent Pile Wall
Borings 2081-B-06, 12-RWB-01, 12-RWB-02, 12-VST-01, and VST-01

| Layer Elevations/Soil Description | Moist Unit Weight (pcf) | Shear Strength Properties | | | Estimated Lateral Soil Modulus Parameter, k (pci) | Estimated Soil Strain Parameter, $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| | | Short Term | | Long Term | | |
| | | Cohesion Cu (psf) | Friction Angle, φ (Degree) | Friction Angle, φ' (Degree) | | |
| 594.7* to 591.7 Hard Silty Clay Loam Fill | 120 | 4500 | 0 | 30 | 2000 | 0.004 |
| 591.7 to 580.7 Loose to Medium Dense Sandy Gravel Fill or Crushed Stone | 115 | 0 | 31 | 31 | 25 | -- |
| 580.7 to 570.1 Soft to Medium Stiff Clay to Silty Clay | 115 | 750 | 0 | 30 | 100 | 0.010 |

| Layer Elevations/Soil Description | Moist Unit Weight (pcf) | Shear Strength Properties: Short Term: Cohesion Cu (psf) | Shear Strength Properties: Short Term: Friction Angle, φ (Degree) | Shear Strength Properties: Long Term: Friction Angle, φ' (Degree) | Estimated Lateral Soil Modulus Parameter, k (pci) | Estimated Soil Strain Parameter, $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| 570.1 to 557.6 Very Soft to Soft Clay to Silty Clay | 110 | 550 | 0 | 30 | 100 | 0.010 |
| 557.6 to 541.5 Medium Stiff to Stiff Clay to Silty Clay | 115 | 850 | 0 | 30 | 100 | 0.010 |
| 541.5 to 521.5 Very Stiff Silty Clay | 120 | 2900 | 0 | 31 | 1000 | 0.005 |
| 521.5 to 517.0 Stiff Clay | 120 | 1400 | 0 | 30 | 500 | 0.005 |
| 517.0 to 511.5 Soft to Medium Stiff Clay | 110 | 440 | 0 | 30 | 30 | 0.020 |
| 511.5 to 507.0 Medium Dense Silt | 115 | 0 | 33 | 33 | 60 | -- |
| 507.0 to 488.8** Very Dense Silty Loam to Sandy Gravel | 125 | 0 | 36 | 36 | 125 | -- |

* Approximate finished grade at back face of wall
** Approximate top of bedrock elevation.

Table 2: Geotechnical Parameters WALL 12, SN: 016-1801
For the Design of Soldier-Pile and Tangent Pile Wall
Borings 12-RWB-03 through 12-RWB-06, 12-VST-02, and 12-PMT-01

| Layer Elevations/Soil Description | Moist Unit Weight (pcf) | Shear Strength Properties | | | Estimated Lateral Soil Modulus Parameter, k (pci) | Estimated Soil Strain Parameter, $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| | | Short Term | | Long Term | | |
| | | Cohesion Cu (psf) | Friction Angle, φ (Degree) | Friction Angle, φ’ (Degree) | | |
| 595.7* to 590.1 Medium Dense to Dense Silty Loam to Gravelly Silty Loam Fill | 115 | 0 | 34 | 34 | 90 | -- |
| 590.1 to 579.3 Loose to Medium Dense Sandy Gravel Fill | 115 | 0 | 31 | 31 | 25 | -- |
| 579.3 to 568.9 Medium Stiff to Stiff Clay to Silty Clay | 115 | 750 | 0 | 30 | 100 | 0.010 |
| 568.9 to 557.3 Soft to Medium Stiff Clay to Silty Clay | 115 | 500 | 0 | 30 | 100 | 0.010 |
| 557.3 to 547.1 Medium Stiff to Stiff Clay to Silty Clay | 115 | 750 | 0 | 30 | 100 | 0.010 |
| 547.1 to 537.1 Stiff Silty Clay to Silty Clay Loam | 120 | 1500 | 0 | 30 | 500 | 0.005 |
| 537.1 to 522.6 Very Stiff to Hard Silty Clay to Silty Clay Loam | 120 | 3300 | 0 | 30 | 1000 | 0.005 |
| 522.6 to 517.1 Stiff Clay | 120 | 1200 | 0 | 30 | 500 | 0.005 |
| 517.1 to 512.0 Medium Dense Silt to Silty Loam | 115 | 0 | 32 | 32 | 60 | -- |
| 512.0 to 502.1 Very Stiff to Hard Silty Clay Loam to Silty Loam | 120 | 5500 | 0 | 30 | 2000 | 0.004 |

| Layer Elevations/Soil Description | Moist Unit Weight (pcf) | Shear Strength Properties: Short Term Cohesion Cu (psf) | Shear Strength Properties: Short Term Friction Angle, φ (Degree) | Shear Strength Properties: Long Term Friction Angle, φ' (Degree) | Estimated Lateral Soil Modulus Parameter, k (pci) | Estimated Soil Strain Parameter, $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| 502.1 to 494.8** Very Dense Silty Loam | 125 | 0 | 36 | 36 | 125 | -- |

* Approximate finished grade at back face of wall
**Approximate top of bedrock elevation

Table 3: Geotechnical Parameters WALL 12, SN: 016-1801
For Design of Soldier-Pile and Tangent Pile Wall
Boring 12-RWB-07 through 12-RWB-09 and 2082-B-03

| Layer Elevations/Soil Description | Moist Unit Weight (pcf) | Shear Strength Properties: Short Term Cohesion Cu (psf) | Shear Strength Properties: Short Term Friction Angle, φ (Degree) | Shear Strength Properties: Long Term Friction Angle, φ' (Degree) | Estimated Lateral Soil Modulus Parameter, k (pci) | Estimated Soil Strain Parameter, $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| 595.8* to 585.6 Loose to Medium Dense Sand to Sandy Gravel Fill | 115 | 0 | 34 | 34 | 90 | -- |
| 585.6 to 581.5 Medium Dense to Dense Sand to Sandy Gravel Fill | 120 | 0 | 35 | 35 | 90 | -- |
| 581.5 to 567.6 Soft to Medium Stiff Clay to Silty Clay | 115 | 700 | 0 | 30 | 100 | 0.010 |
| 567.6 to 552.8 Very Soft to Soft Clay to Silty Clay | 115 | 500 | 0 | 30 | 100 | 0.010 |
| 552.8 to 548.2 Stiff Clay to Silty Clay | 120 | 900 | 0 | 30 | 500 | 0.005 |
| 548.2 to 537.3 Stiff to Very Stiff Silty Clay to Silty Clay Loam | 120 | 1400 | 0 | 30 | 500 | 0.005 |
| 537.3 to 523.2 Very Stiff to Hard Silty Clay Loam to Silty Loam | 120 | 3,600 | 0 | 30 | 1000 | 0.005 |

| Layer Elevations/Soil Description | Moist Unit Weight (pcf) | Shear Strength Properties | | | Estimated Lateral Soil Modulus Parameter, k (pci) | Estimated Soil Strain Parameter, $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| | | Short Term | | Long Term | | |
| | | Cohesion Cu (psf) | Friction Angle, φ (Degree) | Friction Angle, φ' (Degree) | | |
| 508.2 to 499.5** Very Dense Silty Loam to Gravelly Sand | 120 | 0 | 36 | 36 | 125 | -- |

* Finished grade at back face of wall
**Approximate top of bedrock elevation

### 6.6 Global Stability

Conventional global slope stability analysis was performed at Station 7305+30 considering a retained height of 23.0 feet as per the TSL provided by TSC on July 18, 2016. Analysis was performed with SLIDE v6 computer software. The minimum factor of safety (FOS) calculated was less than the minimum required of 1.5 without considering soldier/tangent pile embedment. We performed global stability analysis considering pile embedment to obtain an FOS of at least 1.5. The embedded portion of the soldier piles will provide resistance against the slope instability above the tip of the soldier piles. Our analysis indicates that pile embedment to a minimum elevation of 549.0 feet, within the stiff clay to silty clay, will result in a FOS of 1.5. Therefore, to provide global stability with FOS of at least 1.5, we recommend that the wall tip embedment should be at least to a minimum elevation of 549 feet. Details of the global stability analysis with critical failure surfaces and results are presented in Appendix D.

### 6.7 Wall Deflection and Ground Movement

There is no existing structure or building behind the proposed retaining wall and no major underground utility is identified. The maximum deflection allowed for a permanent retaining wall is one percent of the retained height but not greater than one inch as per Chicago Department of Transportation (CDOT).

## 7.0 CONSTRUCTION CONSIDERATIONS

### 7.1 Excavation

Any required excavations should be performed in accordance with local, state, and federal regulations including current OSHA regulations. The potential effect of ground movements upon nearby structures and utilities should also be taken into consideration.

### 7.2 Dewatering

Groundwater level measurements were made in the borings at the time of drilling. The granular fill soils may exhibit perched groundwater conditions. These layers may be intercepted during cut slope shallow excavations. Seepage water that does accumulate in open excavations above groundwater level can be removed using the sump pump method.

### 7.3 Filling and Backfilling

All fill and backfill materials should be pre-approved by the site engineer. The backfill material should be free of organic materials and debris. Backfill material should be compacted in lifts no greater than 8 inches in loose thickness. Each layer should be compacted to a minimum 95 percent of the maximum dry density as determined by AASHTO T 99, Standard Proctor Method.

### 7.4 Wall Construction

The wall should be constructed as per IDOT Standard Specifications and current special provisions developed by IDOT.

### 7.5 Drilled Shafts

The drilled shafts should be constructed in accordance with the IDOT Special Provision *Drilled Shafts* (GBSP No. 86). We recommend that the drilled shaft installation procedure be reviewed and approved by IDOT.

The groundwater is expected to be located within the granular fill soils layer. As a minimum, temporary casing will be required in the upper surficial granular fill soils extending into clay to prevent groundwater from entering the shafts and prevent loss of ground around the shafts. Temporary casing should be socketed a few feet into the clay soil to effectively seal the groundwater infiltration into the drilled shafts. Special care should be taken to prevent loss of ground during shaft installation adjacent to the existing buried utilities. It is preferable to advance the temporary casing ahead of the excavation operation.

The field vane shear tests indicated that the strength of the soft clay at some locations may not be sufficient to resist squeeze into the drilled shafts. IDOT requires providing temporary casing through soft clay in order to properly construct the drilled shafts. We recommend providing temporary casing to Elevation 540.0 feet. The following note should be shown on the plan.

*"Based on the high squeeze potential of the clay soils, the use of temporary casing will be required to Elevation 540.0 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."*

Groundwater is also expected from granular soils within very stiff to hard clay deposit and above the bedrock. Drilled shafts extending through and into these granular soils will require temporary casing or a slurry method of excavation.

To verify structural integrity of concrete, non-destructing integrity testing on completed drilled shafts should be performed using the Crosshole Sonic Logging (CSL) method. The IDOT special provision "Crosshole Sonic Logging" dated March 9, 2010 or latest edition should be included for this inspection and testing requirements. Wang recommends providing CSL in one drilled shaft for every five drilled shafts.

Drilled shafts should be spaced to miss existing piles as much as possible. However, it may not be possible to miss all the existing piles. The existing retaining wall is supported on vertical and batter piles. If the existing piles are encountered, the contractor should drill out or extract piles during construction of the drilled shafts. The contractor should be alerted with a note on the contract plan about the existing wall to be removed and encountering of footings and piles during drilled shafts construction.

## 7.6 Construction Monitoring

There is no need for special construction monitoring for the retaining wall except normally required by the IDOT Standard Specifications for Roadway and Bridge Construction and special provisions.

## 8.0 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 wall 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.**

Mohammed A. Kothawala, P.E., D.GE
Senior Geotechnical Engineer 1-20-2017

Corina T. Farez, P.E., P.G.
QA/QC Reviewer

MOHAMMED A KOTHAWALA
062-040483
LICENSED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

License Expires
11-30-2017

## *REFERENCES*

AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (2014) *LRFD Bridge Design Specifications*. United States Department of Transportation, Washington, D.C.

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.

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

ILLINOIS DEPARTMENT OF TRANSPORTATION (2015) *Geotechnical Manual.* IDOT Bureau of Materials and Physical Research, Springfield, IL.

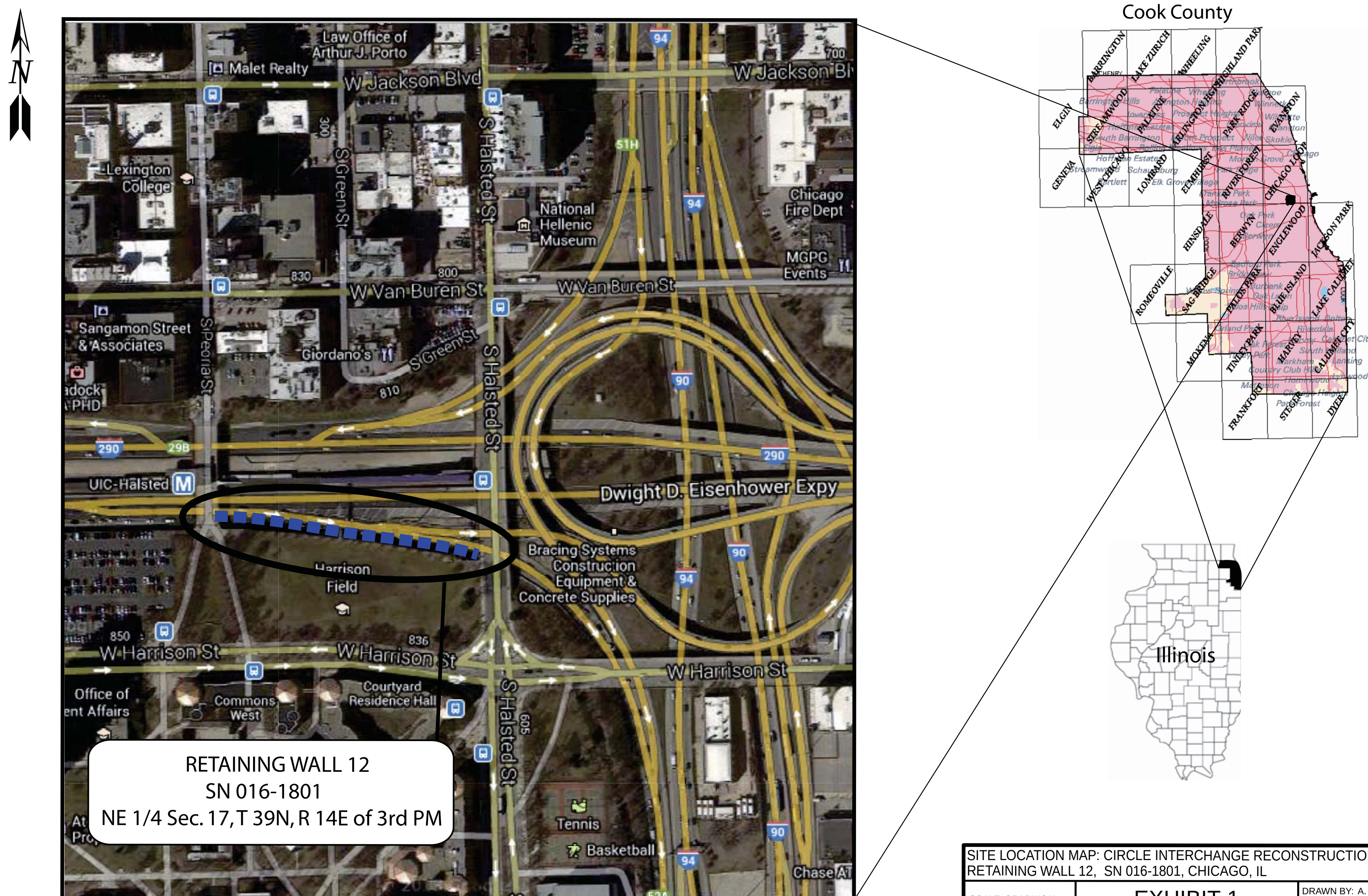
ILLINOIS DEPARTMENT OF TRANSPORTATION (2016) *Standard Specifications for Road and Bridge Construction.* IDOT Division of Highways, Springfield, IL.

ILLINOIS DEPARTMENT OF TRANSPORTATION (2012) *Bridge Manual.* IDOT Bureau of Bridges and Structures, Springfield, IL.

LEIGHTON, M.M., EKBLAW, G.E., and HORBERG, L. (1948) *Physiographic Divisions of Illinois.* The Journal of Geology, v. 56, p. 16-33.

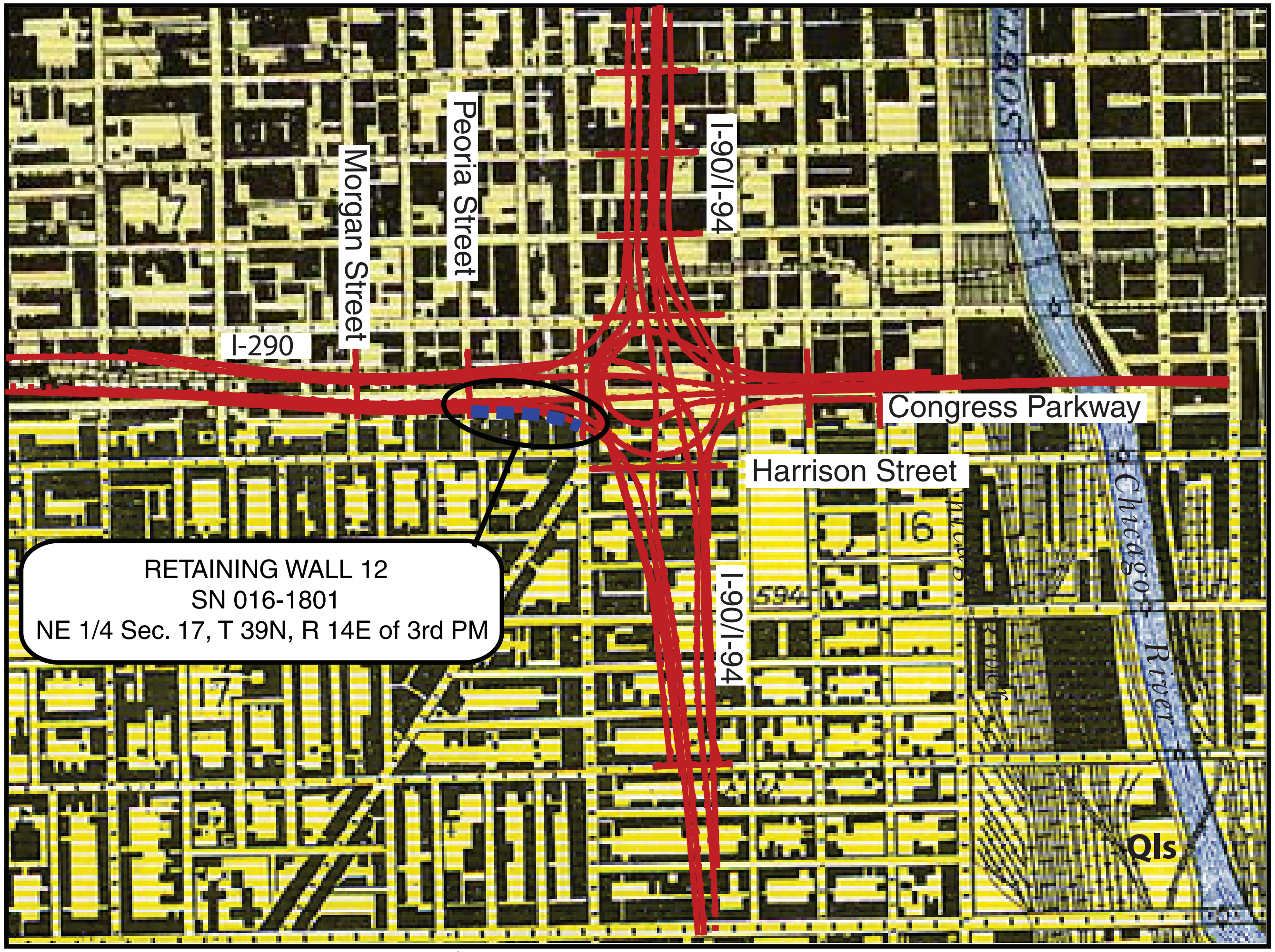
University of Illinois, Bulletin No.423, Engineering Propoerties of Chicago Subsoils

# EXHIBITS




0 0.25 0.5 Mile

| SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 12, SN 016-1801, CHICAGO, IL | | |
|---|---|---|
| SCALE: GRAPHICAL | EXHIBIT 1 | DRAWN BY: A. Hamad<br>CHECKED BY: C. Marin |
| Wang Engineering | | 1145 N. Main Street<br>Lombard, IL 60148<br>www.wangeng.com |
| FOR AECOM | | 1100-04-01 |




Modified after Bretz (1926)

## REGIONAL GEOLOGY


**Wedron Group**

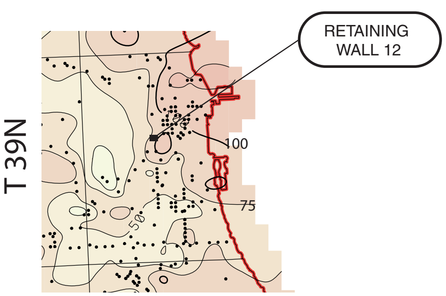
- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

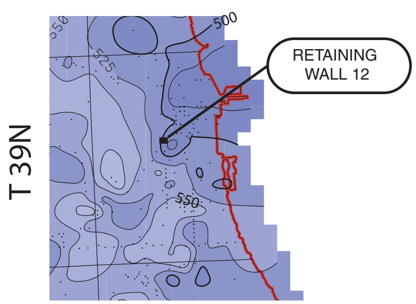
# Legend

Qls — Glacial lake bottom (Covered by lacustrine deposits)

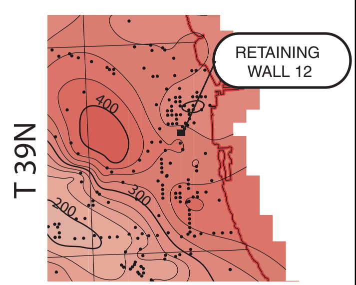
DRIFT THICKNESS




BEDROCK TOPOGRAPHY




BEDROCK THICKNESS




Modified after Leetaru et. al. (2004)

0 2 4 8 miles

SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 12, SN 016-1801, CHICAGO, IL

| | | |
|---|---|---|
| SCALE: GRAPHICAL | EXHIBIT 2 | DRAWN BY: A. Hamad<br>CHECKED BY : C. Marin |


Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com


FOR AECOM

1100-04-01

Bench Mark: Cut □ on northwest corner of sign foundation at north side of Harrison Street, approximately 80' west of west line of Morgan Street. Elev. = 593.07

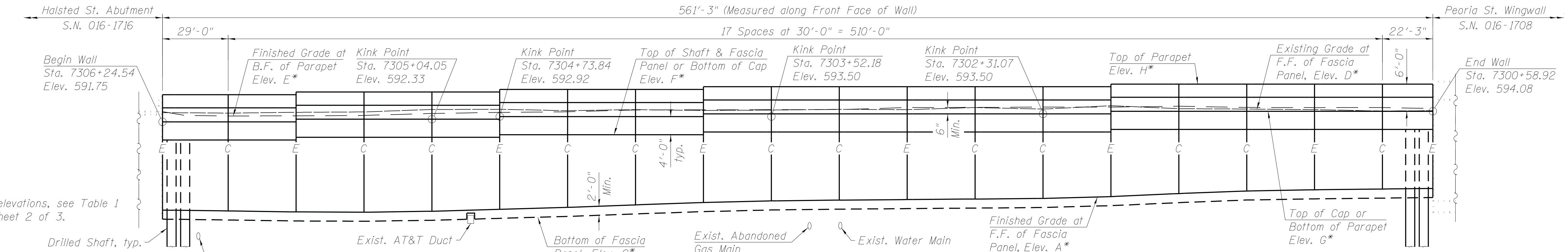
Existing Structure: Existing Retaining Wall 10. Constructed in 1955 under U.I. 261 (101) F.A. Route 131; Section 2525-103. Reinforced concrete wall on pile. Total length of 532'-9" from Halsted Street to Peoria Street. Height varies 17'-6" to 17'-7". Founded on timber piles. The existing wall is to be removed and replaced.

I-290 EB traffic control to be utilized during construction.

No Salvage.

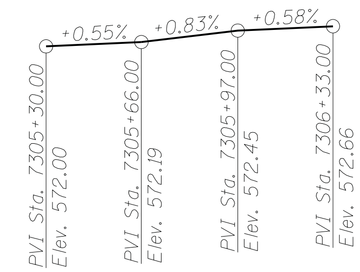
Notes:

1.) Wall offsets are measured from the ℄ of Taylor ES Ramp to the front face of cast-in-place fascia panels.
2.) C denotes Construction Joint
3.) E denotes Expansion Joint
4.) F.F. denotes Front Face.
5.) B.F. denotes Back Face.
6.) Wall to be built along straight chords between construction joints.
7.) Shaft diameter, spacing and tip elevation to be determined during final design.



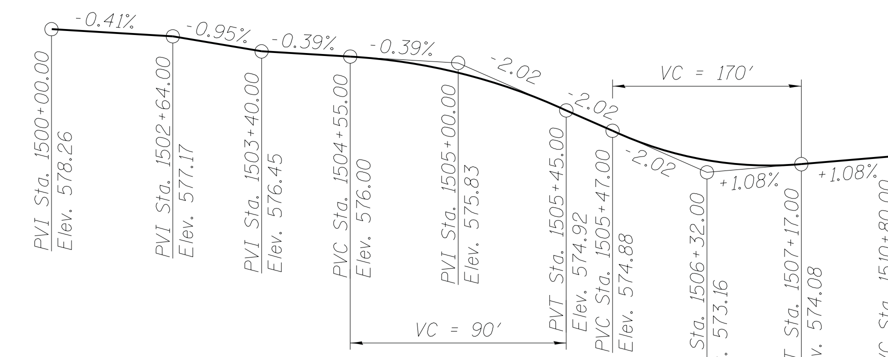

## ELEVATION

(Looking South at F.F. of Wall, Proposed Concrete Barrier not shown for clarity.)



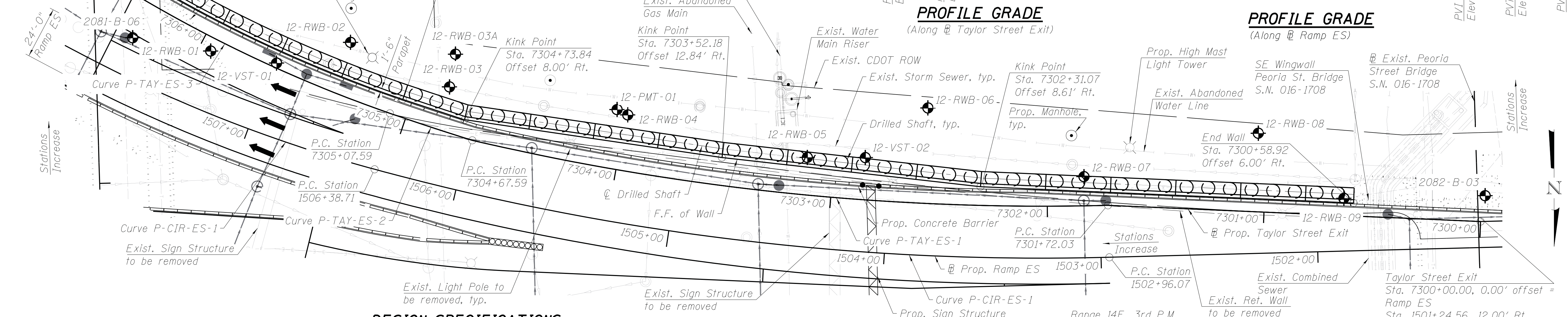

## PROFILE GRADE

(Along ℄ Taylor Street Exit)




## PROFILE GRADE

(Along ℄ Ramp ES)




## PLAN

## HIGHWAY CLASSIFICATION

| Ramp ES | Taylor Street Exit |
|---|---|
| Functional Class: Interstate | Functional Class: Interstate |
| ADT: 43,900 (2012); 44,000 (2040) | ADT: 2,600 (2012); 2,000 (2040) |
| ADTT: 4,226 (2012); 4,235 (2040) | ADTT: 100 (2012); 80 (2040) |
| DHV: 2,140 (2040) | DHV: 154 (2040) |
| Design Speed: 40 m.p.h. | Design Speed: 35 m.p.h. |
| Posted Speed: 35 m.p.h. | Posted Speed: 30 m.p.h. |
| One-Way Traffic | One-Way Traffic |
| Directional Distribution: 100% | Directional Distribution: 100% |

## DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 and 2016 Interim Specifications

## DESIGN STRESSES

**FIELD UNITS**

f'c = 7,000 psi (Drilled Shafts)**
f'c = 3,500 psi (All other concrete)
fy = 60,000 psi (Reinforcement)

** Final concrete strength will be determined during final design

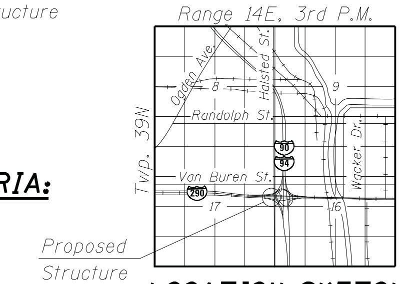
## LEGEND:

Ex. Chain Link Fence
Combined Sewer
Electric
Water
Fiber Optic
Ex. Storm Sewer
Prop. Storm Sewer
Soil Boring

## WALL DEFLECTION CRITERIA:

Maximum lateral deflection at top of the wall: 1% of Retained Soil Height

Anticipated ground movement behind the wall: N/A




## LOCATION SKETCH

BORING LOCATION PLAN: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 12, SN 016-1801, CHICAGO, IL

| SCALE: GRAPHICAL | EXHIBIT 3 | DRAWN BY: A. Hamad CHECKED BY: M.Kothawala |
|---|---|---|

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR AECOM | 1100-04-01

TranSystems

| USER NAME = tlrevzin | DESIGNED - WJC | REVISED - |
|---|---|---|
| | CHECKED - DL | REVISED - |
| PLOT SCALE = 48.00 ' / in. | DRAWN - WJC | REVISED - |
| PLOT DATE = 8/11/2016 | CHECKED - DL | REVISED - |

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

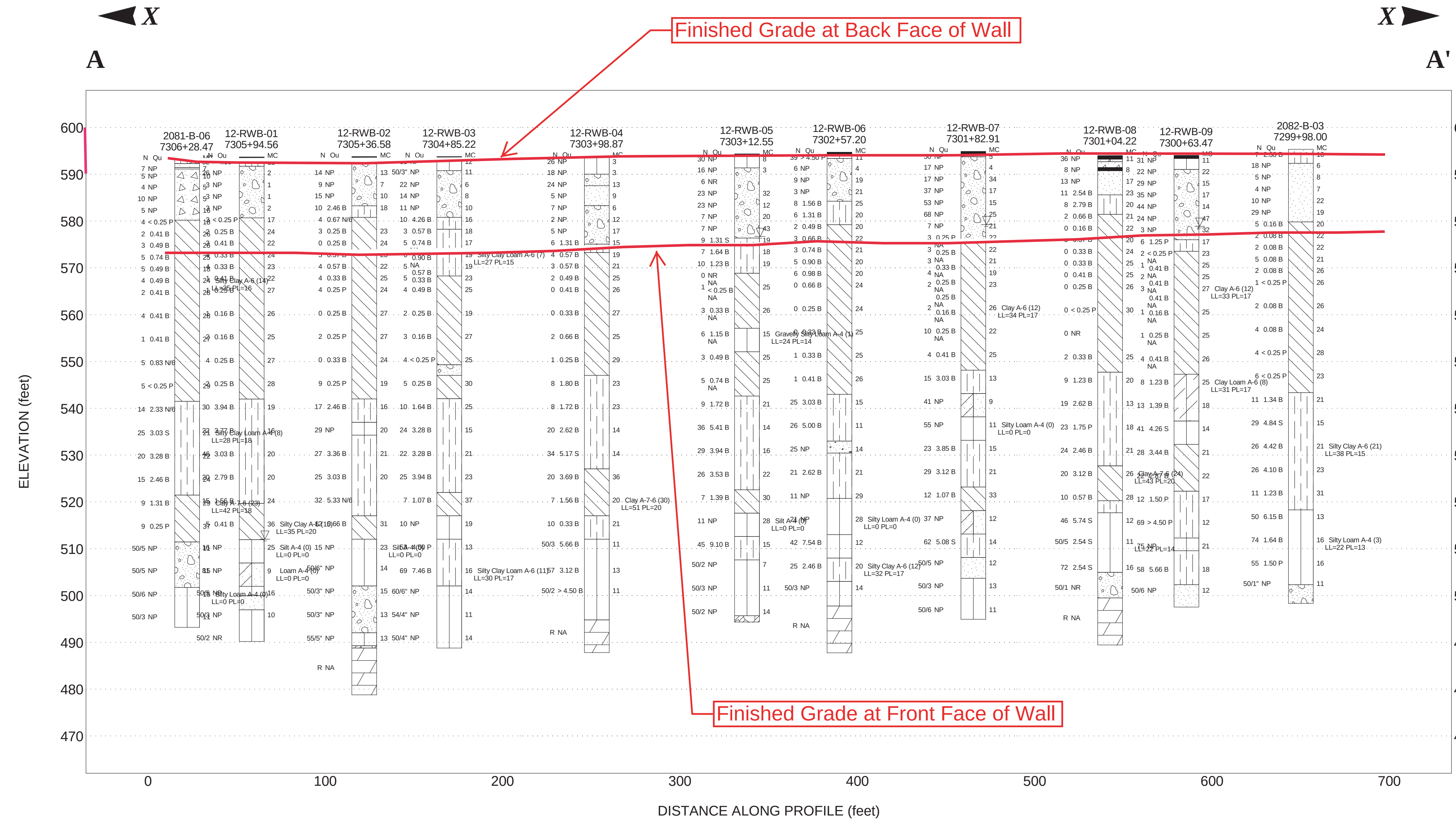
SHEET NO. 1 OF 3 SHEETS

| F.A.I. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 290 | 2014-002R&B | COOK | 3 | 1 |

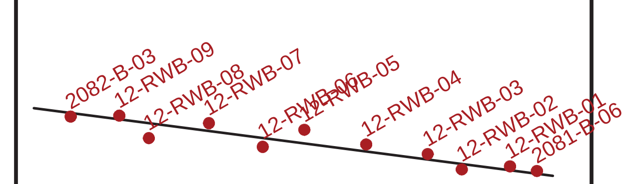
CONTRACT NO. 60X76

ILLINOIS FED. AID PROJECT

3:23:24 PM - pw:\\617479-PWINT.aecomonline.local:AECOM_DS02_NA\Documents\01 Americas\Transportation\60269938 Circle\Phase_II\000_CADD\008_Structural\Structure_016-1801\TSL\Sheets\016801-60X76-SHT-TSL-001

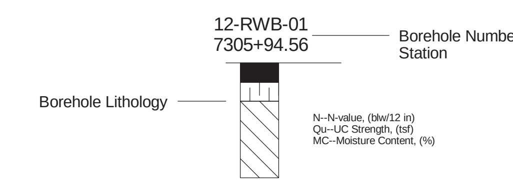



N




Site Map Scale 1 inch equals 255 feet

# Explanation:




▽ Water Level Reading at time of drilling.

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

0 70

Horizontal Scale (feet)

Vertical Exaggeration: 2.5x

## Lithology Graphics

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

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

**Section Name A-A'**
**Figure Title**

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 7/28/16

# APPENDIX A

Wang Engineering

wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

# BORING LOG 12-RWB-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: 593.72 ft
North: 1897780.69 ft
East: 1171075.09 ft
Station: 7305+94.56
Offset: 5.9839 LT

## SOIL AND ROCK DESCRIPTION

| Elevation (ft) | Description |
|---|---|
| 593.4 | 4-inch thick, brown SILTY LOAM --TOPSOIL-- |
| 591.7 | Hard, brown SILTY CLAY LOAM, trace gravel --FILL-- |
| | Very loose to medium dense, brown SANDY GRAVEL --FILL-- |
| 580.7 | Very soft to soft, gray CLAY to SILTY CLAY, trace gravel |

| Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|
| 1 | 6 13 19 | > 4.50 | 11 |
| 2 | 8 13 13 | NP | 2 |
| 3 | 3 1 2 | NP | 1 |
| 4 | 2 2 1 | NP | 1 |
| 5 | 1 1 2 | NP | 2 |
| 6 | 1 1 2 | < 0.25 P | 17 |
| 7 | 1 1 1 | 0.25 B | 24 |
| 8 | 0 0 3 | 0.41 B | 22 |
| 9 | 3 2 2 | 0.33 B | 24 |
| 10 | 2 2 2 | 0.33 B | 23 |
| 11 | 0 0 1 | 0.41 B | 22 |
| 12 | 0 0 1 | 0.25 B | 27 |
| 13 | 0 0 1 | 0.16 B | 26 |
| 14 | 0 0 2 | 0.16 B | 25 |
| 15 | 1 2 2 | 0.25 B | 27 |
| 16 | 0 0 2 | 0.25 B | 28 |

Depth (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

## GENERAL NOTES

Begin Drilling **07-19-2013** Complete Drilling **07-19-2013**
Drilling Contractor **Wang Testing Service** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **3.25" HSA to 8', mud rotary thereafter, boring backfilled upon completion**

## WATER LEVEL DATA

While Drilling **82.00 ft**
At Completion of Drilling **Not Observed**
Time After Drilling **NA**
Depth to Water **NA**

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

Wang Engineering

wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

# BORING LOG 12-RWB-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: 593.72 ft
North: 1897780.69 ft
East: 1171075.09 ft
Station: 7305+94.56
Offset: 5.9839 LT

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|
| 542.0 | Very stiff, gray SILTY CLAY, trace gravel and sand lenses | | | | | |
| | | 55 | 17 | 4 9 21 | 3.94 B | 19 |
| | | 60 | 18 | 6 9 13 | 3.77 B | 16 |
| | | 65 | 19 | 13 20 26 | 3.03 B | 20 |
| | | 70 | 20 | 8 7 13 | 2.79 B | 20 |
| 519.7 | Soft to stiff, gray CLAY to SILTY CLAY, trace gravel | 75 | 21 | 5 7 8 | 1.56 B | 24 |
| | --$L_L$(%)=35, $P_L$(%)=20-- --%Gravel=0.7-- --%Sand=3.4-- --%Silt=60.1-- --%Clay=35.8-- --A-6 (15)-- | 80 | 22 | 2 2 3 | 0.41 B | 36 |
| 512.0 | Medium dense, gray SILT, trace sand lenses --Wet-- --%Gravel=0.5-- --%Sand=3.9-- --%Silt=91.4-- --%Clay=4.1-- --A-4 (0)-- | 85 | 23 | 2 3 13 | NP | 25 |
| 507.0 | Very dense, gray LOAM to SANDY LOAM, little gravel --%Gravel=11.5-- --%Sand=43.6-- --%Silt=40.2-- --%Clay=4.6-- --A-4 (0)-- | 90 | 24 | 46 41 40 | NP | 9 |
| 502.0 | Gray SILT | | | | | |
| 500.0 | Very dense, gray, fine SAND | 95 | 25 | 46 50/5 | NP | 16 |
| 497.0 | Very dense, gray SILTY LOAM, some gravel | | 26 | 50/3 | NP | 10 |
| | | 100 | | | | |

## GENERAL NOTES

Begin Drilling **07-19-2013** Complete Drilling **07-19-2013**
Drilling Contractor **Wang Testing Service** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **3.25" HSA to 8', mud rotary thereafter, boring backfilled upon completion**

## WATER LEVEL DATA

While Drilling: **82.00 ft**
At Completion of Drilling: **Not Observed**
Time After Drilling: **NA**
Depth to Water: **NA**

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

Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

# BORING LOG 12-RWB-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: 593.72 ft
North: 1897780.69 ft
East: 1171075.09 ft
Station: 7305+94.56
Offset: 5.9839 LT

| Profile | Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type *recovery* | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|---|
| | 490.2 | --ROLLER-BIT REFUSAL-- | | | 27 | 50/2 | NR | |
| | | Boring terminated at 103.50 ft | 105 | | | | | |
| | | | 110 | | | | | |
| | | | 115 | | | | | |
| | | | 120 | | | | | |
| | | | 125 | | | | | |

## GENERAL NOTES

Begin Drilling **07-19-2013** Complete Drilling **07-19-2013**
Drilling Contractor **Wang Testing Service** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **3.25" HSA to 8', mud rotary thereafter, boring backfilled upon completion**

## WATER LEVEL DATA

While Drilling ▽ **82.00 ft**
At Completion of Drilling ▼ **Not Observed**
Time After Drilling **NA**
Depth to Water ▽ **NA**

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

Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

# BORING LOG 12-RWB-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: 593.80 ft
North: 1897776.68 ft
East: 1171010.55 ft
Station: 7305+36.58
Offset: 24.3228 RT

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|
| 593.0 | 9-inch thick, brown SILTY LOAM --TOPSOIL-- | | | | | |
| 592.5 | Very dense, brown SILTY CLAY LOAM --FILL-- | | 1 | 21 38 32 | NP | 3 |
| | Loose to medium dense, brown SANDY GRAVEL, trace brick fragments --FILL-- | 5 | 2 | 17 9 5 | NP | 13 |
| | | | 3 | 2 2 7 | NP | 7 |
| | | 10 | 4 | 9 6 9 | NP | 10 |
| 583.3 | Very stiff, gray SILTY CLAY LOAM, trace gravel | | 5 | 4 4 6 | 2.46 B | 18 |
| 580.8 | Soft to medium stiff, gray CLAY, trace to little gravel | 15 | 6 | 2 2 2 | 0.67 N/6 | |
| | | | 7 | 1 1 2 | 0.25 B | 23 |
| | | 20 | 8 | 0 0 0 | 0.25 B | 24 |
| | | | 9 | 0 2 3 | 0.57 B | 23 |
| | | 25 | 10 | 1 2 2 | 0.57 B | 22 |
| | | | 11 | 1 1 3 | 0.33 B | 25 |
| | | 30 | 12 | 1 2 2 | 0.25 P | 24 |
| | | 35 | 13 | 0 0 0 | 0.25 B | 27 |
| | | 40 | 14 | 0 0 2 | 0.25 P | 27 |
| | | 45 | 15 | 0 0 0 | 0.33 B | 24 |
| | | 50 | 16 | 3 4 5 | 0.25 P | 19 |

## GENERAL NOTES

Begin Drilling **07-05-2013** Complete Drilling **07-09-2013**
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: **Not Observed**
At Completion of Drilling: **Not Observed**
Time After Drilling: **NA**
Depth to Water: **NA**

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

Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

# BORING LOG 12-RWB-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: 593.80 ft
North: 1897776.68 ft
East: 1171010.55 ft
Station: 7305+36.58
Offset: 24.3228 RT

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type (recovery) | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| 542.0 | Very stiff, gray SILTY CLAY, trace gravel | | | | | | |
| | | 55 | | 17 | 4 7 10 | 2.46 B | 16 |
| 537.0 | Gray SILTY LOAM | | | | | | |
| 534.3 | Very stiff to hard, gray SILTY CLAY, trace to little gravel | | | 18 | 14 15 14 | NP | 20 |
| | | 60 | | | | | |
| | | 65 | | 19 | 6 10 17 | 3.36 B | 21 |
| | *--Sand lenses--* | 70 | | 20 | 8 12 13 | 3.03 B | 20 |
| | | 75 | | 21 | 13 15 17 | 5.33 N/6 | |

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type (recovery) | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| 517.0 | Medium stiff, gray CLAY | | | | | | |
| | | 80 | | 22 | 3 6 6 | 0.66 B | 31 |
| 512.0 | Medium dense to very dense, gray SILT<br>--%Gravel=0.0--<br>--%Sand=5.1--<br>--%Silt=90.6--<br>--%Clay=4.2--<br>--A-4 (0)-- | 85 | | 23 | 6 6 9 | NP | 23 |
| | | 90 | | 24 | 50/6" | NP | 14 |
| 502.0 | Very dense, gray SANDY GRAVEL, trace clay pockets<br>--Moist-- | | | 25 | 50/3" | NP | 15 |
| | | 95 | | | | | |
| | *--Possible Cobbles--* | 100 | | 26 | 50/3" | NP | 13 |

## GENERAL NOTES

Begin Drilling **07-05-2013** Complete Drilling **07-09-2013**
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 ▽ **Not Observed**
At Completion of Drilling ▼ **Not Observed**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

Wang Engineering

wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

# BORING LOG 12-RWB-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: 593.80 ft
North: 1897776.68 ft
East: 1171010.55 ft
Station: 7305+36.58
Offset: 24.3228 RT

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type recovery | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| 492.0 | Very dense, gray SILTY LOAM, trace gravel | | | 27 | 55/5" | NP | 13 |
| 489.3 | --DIFFICULT DRILLING-- | | | | | | |
| 488.8 | --WEATHERED BEDROCK-- | 105 | | | | | |
| | Strong, light gray, very good rock mass quality, bedded fresh DOLOSTONE, up to 14-inch beds, 8-inch joint spacing, horizontal joints with none to less than 0.2-inch greenish gray infilling, hard joint wall, with stylolitic surfaces, and moderately vuggy porosity. --Run 1 - RECOVERY=100%-- --RQD=95%-- | 110 | | 1 | CORE | | |
| 478.8 | Boring terminated at 115.00 ft | 115 | | | | | |
| | | 120 | | | | | |
| | | 125 | | | | | |

## GENERAL NOTES

Begin Drilling **07-05-2013** Complete Drilling **07-09-2013**
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: **Not Observed**
At Completion of Drilling: **Not Observed**
Time After Drilling: **NA**
Depth to Water: **NA**

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