STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHANGE RECONSTRUCTION
MONROE STREET (F.A.U. 1420) BRIDGE
OVER INTERSTATE 90/94
EXISTING SN 016-2054, PROPOSED SN 016-1700
SECTION 2014-016R&B
IDOT D-91-189-14, PTB 163/ITEM 001
COOK COUNTY, ILLINOIS

for

AECOM

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Technical Report Documentation Page

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11. Abstract

The existing, four-span bridge carrying Monroe Street Bridge 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 318.08 feet and an out-to-out width of 69.0 feet.

Below 12.0 feet of mostly granular fill, the borings encountered up to 42 feet of very soft to medium stiff clay and silty clay. Deeper foundation soils include stiff to very stiff silty clay loam and dense to very dense silt to gravelly sand resting on top of strong, very poor to fair rock quality dolostone. The bedrock was encountered at elevations of about 475.6 to 487.2 feet. The site classifies in the Seismic Class D and is in the Seismic Performance Zone 1.

Wang understands the proposed abutments will be located in front of the existing one where up to 10 feet of new fill will be placed. To limit the settlement to be less than 0.4 inches, we recommend Class I lightweight cellular concrete fill with unit weight of 30 pcf. We recommend the secant or tangent pile at the abutments be established to a minimum of 5 feet below the bottom of soft soil to meet the IDOT minimum requirements for global stability. We provide recommendations for drilled shafts socketed into the bedrock. The rock socketed shafts have factored resistances of about 2130 to 4205 kips for 3- to 4-foot diameter socket bases.

The TSL plan shows drilled soldier pile to support wingwall. Depending on the amount of axial load will be applied, Wang provides soldier pile unit side and end resistances to calculate capacity.

A number of temporary excavations will likely be required to remove the 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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FOR
AECOM

1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations, and recommendations for the design and reconstruction of the Monroe Street Bridge over Interstate 90/94 (I-90/94) within the Circle Interchange in Chicago, Cook County, Illinois. The proposed structure consists of abutments (west and east abutments) and three piers (Pier 1 through 3). A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands that AECOM envisions a new, four-span structure supporting the Monroe Street Bridge over both directions of I-90/94. The bridge will have a back-to-back length of approximately 318.08 feet; with span lengths ranging from 64.0 to 96.5 feet. The out-to-out deck width will measure 69.0 feet. Both abutments will be located in front of the existing ones.

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 016-2054 consists of a four-span bridge carrying the Monroe Street over I-90/94. The original structure was built in 1955 and has an overall length of approximately 341.2 feet with span lengths ranging from 67.5 to 100.5 feet. The out-to-out deck width is 71.6 feet. The existing

substructure consists of stub-abutments and multi-column piers founded on timber piles. 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 ground moraine till covered by thin and discontinuous lacustrine silt and clay. The ground elevation along the bridge ranges from 595 feet at west end to 594 feet at east end. Along I-90/94, the ground elevation is about 575.0 feet.

2.2 Surficial Cover

The project area was shaped during the Wisconsinan-age glaciation, and approximately 100-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 approximately 500 feet elevation or 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 lacustrine deposits, clay to silty clay diamictons, hardpan, and gravelly sands that overlie the bedrock. Dolostone bedrock was sampled or inferred at depths ranging from 98 to 118 feet bgs or 475.6 to 487.2 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 between August and December of 2015, consisted of five structure borings, designated as 2054-B-01 through 2054-B-05. Borings 2054-B-02, 2054-B-03, and 2054-B-05 were drilled in the shoulder and median areas of the existing I-90/94 interchange whereas Borings 2054-B-01 and 2054-B-04 were drilled along the existing bridge's west and east approach embankments, respectively. Due to time constrain, we blind drilled some of the borings to a certain depths before continue taking samples. The borings were drilled from elevations of 579.0 to 594.2 feet to depths of 97.5 to 128.0 feet bgs. Problems such as lost of drilling mud, borehole cave-in on granular layer above bedrock were encountered during drilling. It is possible that these problems would likely to appear during construction. Therefore, we recommend the Contractor shall take precautionary actions when drilling the drilled shafts as discussed in section 6.5.

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 Borings 2054-B-01ALT, and 2054-B-02 through 2054-B-05 in 2- to 10-foot runs. Please note that due to cave-in borehole and time constrain, we were unable to take another bedrock core in the borings with low RQD.

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 Vane Shear Tests

Wang performed vane shear tests in Boring 2054-B-01ALT to determine in-situ shear strength of very soft to soft silty clay. This borehole was performed without soil sampling below 15 feet. After drilling to the desired depth, casing was installed and vane shear test was performed using M-1000 Vane Borer Test Kit. Tests were performed in undisturbed and remolded conditions. We also performed another vane shear tests nearby the structure in Boring VST-03. We noticed large difference in cohesion (Su) values within the same layer between these two vane shear tests.

In general, the vane shear values for soft clays were significantly higher than the corresponding values from unconfined compressive strength tests using the RIMAC apparatus.

3.3 Laboratory Testing

Soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (T89/T90) and particle size analyses (T88) tests were performed on selected samples. Unconfined compressive strength test (T22) was performed on selected bedrock cores. 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).

The soil and rock samples will be retained in our laboratory for 60 days following this report submittal. Soil samples will be discarded unless a specific written request is received as to their disposition and the rock cores will be transported to IDOT District One laboratory for storage.

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 along I-90/94 and Monroe Street sections include 2.5 to 18.0 inches of asphalt pavement over 7.0 to 10.0 inches of concrete followed by crushed stone. In descending order, the general lithological succession encountered beneath the pavement includes: 1) man-made ground (fill); 2) very soft to medium stiff clay to silty clay; 3) stiff to hard silty clay to silty clay loam; 4) dense to very dense silt to gravelly sand; and 5) strong, very poor to good quality dolostone.

(1) Man-made ground (fill)

The existing fill is made up of about 12 feet of cohesive and granular fill. The granular fill consists of loose to medium dense, brown sand to sandy loam and gravel with N-values of 5 to 18 blows/foot with an average of 10 blows/foot and moisture content values of 3 to 14% with an average of 8%. The cohesive fill consists of stiff, gray silty clay loam with unconfined compressive strength (Q_u) values of 0.75 to 1.8 tsf and moisture content values of 20 to 26%.

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

At elevations of about 573.5 to 583.9 feet, the fill rests on top of 31- to 42-foot thick, very soft to medium stiff, gray clay to silty clay. The layer has Q_u values of 0.1 to 0.9 tsf with an average of 0.5 tsf and moisture contents ranging from 16 to 31% with an average of 24%. Laboratory index testing on samples from this layer show liquid limit (L_L) values of 37 to 42% and plastic limit (P_L) values of 19%. As discussed in Section 3.2, Qu values form vane shear tests are generally higher than Rimac tests. The vane shear tests results are shown in Borings 2054-B-01ALT and VST-03 and range from 0.37 to 2.03 tsf. According to the AASHTO Soil Classification System, the soil belongs to the A-6 and A-7-6 groups.

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

The very soft to medium stiff clay to silty clay is underlain by stiff to very stiff, gray silty clay to silty clay loam. The unit measures 17 to 30 feet in thickness, and its top lies at 37 to 52 feet bgs or 532.7 to 542.2 feet elevation. The Q_u values range between 1.3 to 4.8 tsf with an average of 2.7 tsf and moisture contents range between 14 and 28% averaging 19%. Laboratory index testing shows limit (L_L) values of 37 to 42% and plastic limit (P_L) values of 19%.

(4) Dense to very dense silt to gravelly sand

At depths of 64 to 77 feet bgs or 512.3 to 522.2 feet elevation, the borings encountered up to 41 feet of dense to very dense, gray silt to silty loam with trace gravel (hardpan) and sandy loam to gravelly sand. Hard drilling conditions were observed while drilling in this layer at depths of 65 to 92 feet bgs. SPT testing shows N-values of 32 to more than 94 blows/foot.

(5) Strong, fair rock quality dolostone

The borings encountered bedrock at elevations of 475.6 to 487.2 feet. The bedrock conditions were investigated by coring 2- to10-foot long bedrock cores. The bedrock cores obtained from borings drilled for West Abutment, Pier 3, and East Abutment, designated as Borings 2054-B-01, 2054-B-05, and 2054-B-04, revealed a strong dolostone with good rock quality having RQD values between 77 and 79%. Strong dolostone of poor rock quality having low RQD values were observed in Borings 2054-B-02 and 2054-B-03, drilled for Pier 1 and Pier 3. We estimated Geological Strength Index (GSI) values of 35 to 45 for this rock. Unconfined compressive strength values from testing on selected cores from borings 2054-B-01ALT, 2054-B-04, and 2054-B-05 measured between 9,910 and 13,510 psi with an average of 11,300 psi.

4.2 Groundwater Conditions

While drilling, the groundwater was measured in Borings 2054-B-03 and 2054-B-05 at elevations of 512.7 and 492.7 feet (66.8 and 87.0 feet bgs), respectively. Groundwater may also be perched within the granular fill layers. 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. One piezometer test conducted near the structure, designated as 30-PZ-01, shows an average water table elevation at 545.5 feet.

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. For analysis purposes, the base of the abutment caps was assumed to be at a depth of 10 feet bgs. The soils within the top 100 feet have a weighted average S_u of 1.0 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 = 4.1	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 embankments, approach slabs, and structure foundations are included in the following sections. It is understood the design will be based on 2014 AASHTO LRFD Bridge Design Specification and IDOT 2012 Bridge Manual.

5.1 Approach Embankments and Slabs

Wang understands the profile grade along Monroe Street will not be significantly changed; therefore, we anticipate negligible settlements for the approach embankments and approach slabs.

5.1.1 Settlement

The latest TSL Plan provided to Wang in October 2016 shows the proposed abutments will be located in front of the existing one where up to 10 feet of new fill will be required to place new approach slab, at both abutments. The existing grade will be raised due to the new fill. The existing slopes at East and West abutments are 1V:3H and 1V:2H, respectively. Assuming unit weight on new fill of 125 pcf, our analyses show settlements of 2.0 and 3.5 inches for east and west abutments/ wing walls, respectively. To limit the settlement to be less than 0.4 inches, we recommend Class I lightweight cellular concrete fill with unit weight of 30 pcf as per IDOT Guide Bridge Special Provisions (GBSP) No. 87.

5.1.2 Global Stability

The abutments and wingwalls will be constructed on deep foundations system consisted of drilled shaft and secondary CLSM shaft. Due to the proposed deep foundation system for abutments and wingwalls, we do not anticipate global instability of the proposed embankment.

The global stability of the abutments was analyzed based on the subsurface soil conditions encountered in the borings and the information provided in the TSL. The abutments heights are approximately 21.5 and 20.5 feet for the east and west embankments, respectively. The minimum required factor of safety (FOS) for both short-term and long-term conditions was taken from IDOT (1999) as 1.5. Analyses were performed with SLIDE v5 computer software. First, we run global stability analyses assuming the abutments were not supported on deep foundations. Our analyses show FOS less than the minimum required FOS. Second, we run global stability analysis for abutments constructed on deep foundations. Based on our analyses, the minimum drilled shafts embedment should be established to a minimum of 5 feet below soft soil (layer 2) to meet the IDOT minimum requirements for global stability, which is below elevations 536.6 to 537.0 feet. The

minimum FOS calculated for a short-term and long-term conditions are 1.7 and 4.7 respectively for the east abutment and 2.1 and 5.2 for the west abutment. Details of the Global Stability Analysis with the critical failure surfaces and results are presented in Appendix D.

5.2 Structure Foundations

Wang recommends supporting the abutments and piers on drilled shafts. The shafts could be supported within the hardpan or socketed into bedrock. Driven piles have been eliminated from this project due to noise and vibration concerns.

Preliminary service and factored loads for the substructures were provided by AECOM and are summarized in Table 2.

Table 2: Summary of Total Service and Factored Loads on Foundations

Substructure ID	Total Service Load (kips)	Total Factored Load (kips)
West Abutment	1682	2294
Pier 1	2859	3906
Pier 2	2997	4108
Pier 3	3406	4654
East Abutment	1790	2440

5.2.1 Drilled Shafts

The foundations for the abutment and piers could be supported on drilled shaft. Wang understands existing foundations are on timber piles; therefore we expect several new drilled shafts will be installed by coring through existing piles. Very dense silty clay loam or very dense silty loam (hardpan) was encountered only in two borings. Therefore, we do not recommend drilled shaft established on hardpan. We recommend the abutments and piers be supported on drilled shafts socketed into the bedrock. The bedrock was encountered at elevations ranging from 475.6 to 487.2 feet. The bedrock cores show very poor to good 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 2014 AASHTO LRFD *Bridge Design Specifications*, which indicate the sockets should be designed for a geotechnical unit base resistance factor (ϕ_{stat}) 0.50 (AASHTO 2014). GSI values were determined considering the rock mass structure and surface conditions of discontinuities of rock cores taken from soil borings GSI values ranged from 35 to 45. Based on this criterion, the R_F, R_N, and estimated base elevations for 3.0-, 3.5-, and 4.0- foot diameter sockets are summarized below in Table 3.

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-foot long, we estimate the end bearing will give more capacity than the side resistance. Therefore, we recommend considering only the end bearing resistance.

As discussed in Section 4.1, Boring 2054-B-02 and 2054-B-03, drilled for Piers 1 and 3, showed rock with RQD between 0 and 25% whereas Borings 2054-B-01, 2054-B-04, and 2054-B-05, drilled for West Abutment, Pier 2, and East Abutment, showed RQD between 77 and 79%.Given the difficulty of obtaining the bedrock cores and the general bedrock conditions within this project, we estimate RQD of 77 to 79% represent to actual conditions of bedrock for this bridge. Therefore, the shaft capacities for Pier 1 and Pier 3 shown in Table 3 are obtained based on the rock conditions of nearby Boring 2054-B-05. The quality of bedrock at Pier 1 and Pier 3 should be verified during construction.

Table 3: 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 (2054-B-01ALT) GSI - 40	584.0 (Assume)	487.2	3.0	670	4730	2365	3.0	100
			3.5	670	6440	3220	3.0	100
			4.0	670	8410	4205	3.0	100
Pier 1 (2054-B-05) GSI - 45	575.39	481.0	3.0	600*	4260	2130	3.0	98
			3.5	600*	5790	2895	3.0	98
			4.0	600*	7570	3785	3.0	98

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 2 (2054-B-05) GSI - 45	575.69	481.2	3.0	600	4260	2130	3.0	99
			3.5	600	5790	2895	3.0	99
			4.0	600	7570	3785	3.0	99
Pier 3 (2054-B-05) GSI - 45	575.29	479.4	3.0	600*	4260	2130	3.0	100
			3.5	600*	5790	2895	3.0	100
			4.0	600*	7570	3785	3.0	100
East Abutment (2054-B-04) GSI - 45	584.0 (Assume)	475.6	3.0	660	4690	2345	3.0	112
			3.5	660	6380	3190	3.0	112
			4.0	660	8340	4170	3.0	112

* Nominal unit socket base resistance is obtained based on rock condition from nearby boring (2054-B-05).

** Unit base resistance factor (ϕ_{stat}) 0.5 was used in accordance with Table 10.5.5.2.4-1, AASHTO 2014.

***The lengths shown in the table include a 1-foot shaft embedment into the abutments and piers and a 3-foot shaft embedment into the rock.

Given the uncertainty of bedrock condition at Piers 1 and 3, we recommend the bedrock condition be verified during construction. The following note should be included in drawings.

> *"The quality of bedrock at Pier 1 and Pier 3 shall be checked by the Contractor during construction to verify the design bedrock conditions. Boring 2054-B-05 information should be used as reference. An RQD of 75% or more should be verified."*

If an RQD of 75% could not be achieved, the rock socket should be extended to a depth where RQD of 75% is obtained.

5.2.2 Secant or Tangent Pile Abutment Wall

Wang understands the east and west abutments will be supported by secant or tangent type retaining wall. The I-90/94 top of pavement elevation in front of abutment is about 579 feet.

We recommend minimal secant or tangent piles diameters of 2.0 feet. The shafts should be designed for vertical loading as discussed in Section 5.2 and shown in Table 2, as well as for lateral earth pressure and lateral deformation. The shaft nominal unit socket resistances are presented in Table 3. The design embedment depth for the wall sections should include a minimum FOS of 1.5 against earth pressure failure for walls in the long-term (drained) condition using the soil parameters shown below in Table 4. To evaluate the lateral deformation of the wall, we recommend the parameters shown in Tables 7 through 9, Section 5.2.3 below, for use via the p-y curve (COM624P) method. We recommend limiting the lateral movement to approximately 0.5-inch total at the top of the abutment.

Table 4: Geotechnical Parameters for Design of Secant or Tangent Pile Walls

Soil Type (Layer)	Unit Weight (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients[1)]	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
New FILL behind Abutments/ wingwalls EL. 596.5 to 586	125	0	30	0.33	3.00
Loose to M Dense SANDY LOAM FILL (1) EL. 586 to 584	115	0	30	0.33	3.00
V. Soft to Soft CLAY(2) EL 584 to 542 feet	115	0	28	0.36	2.77
Stiff to Hard SILTY CLAY to SILTY CLAY LOAM (3) EL 542 to 516 feet	120	0	30	0.33	3.00
Dense to V. Dense SILT to GRAVELLY SAND (4) EL 516 to 476 feet	125	0	36	0.26	3.85

1) Straight Backfill

5.2.3 Wingwall Foundation

Wingwalls will be constructed at each side of the abutments. The TSL plan shows drilled soldier pile will be utilized for this application. We do not anticipate the foundation of the wingwalls will be set on rock. Therefore, depending on the amount of axial load will be applied from the wingwall, Tables 5 and 6 can be used to calculate drilled shaft/ soldier pile capacity.

Table 5: Estimated Drilled Soldier Pile Resistances for Wingwalls at East Abutment
Borings 2054-B-04 and 29-RWB-02

Soil Type (Layer) Elevation Range (feet)	Nominal Unit Side Resistance (ksf)	Factored Unit Side Resistance (ksf)	Nominal Unit Tip Resistance (ksf)	Factored Unit Tip Resistance (ksf)
Loose to Dense SANDY LOAM FILL (1) EL. 597 to 583 feet	1.6	0.9	27.6	13.8
V. Soft to M. Stiff CLAY to SILTY CLAY(2) EL 583 to 542 feet	0.2	0.1	1.8	0.7
Stiff to V. Stiff SILTY CLAY to SILTY CLAY LOAM (3) EL 542 to 517 feet	1.1	0.5	18.0	7.2
V. Dense SILT to SILTY LOAM (4) EL 517 to 476 feet	7.4	4.1	60.0	30.0

Table 6: Estimated Drilled Soldier Pile Resistances for Wingwalls at West Abutment
Borings 2054-B-01 and 2054-B-01ALT

Soil Type (Layer) Elevation Range (feet)	Nominal Unit Side Resistance (ksf)	Factored Unit Side Resistance (ksf)	Nominal Unit Tip Resistance (ksf)	Factored Unit Tip Resistance (ksf)
Loose to M. Dense SAND FILL (1) EL. 599 to 584 feet	1.2	0.7	12.0	6.0
M. Stiff CLAY to SILTY CLAY(2) EL 584 to 571 feet	0.4	0.2	6.3	2.5
Soft to M. Stiff CLAY to SILTY CLAY (3) EL 571 to 542 feet	0.3	0.1	4.5	1.8
Stiff to V. Stiff SILTY CLAY (4) EL 542 to 522 feet	1.1	0.5	18.0	7.2
Dense to V. Dense SANDY LOAM to GRAVELLY SAND (5) EL 522 to 489 feet	6.6	3.6	54.0	27.0

As per our discussion with AECOM in October 2016, we understand there will not be drilled soldier pile for the wingwall located on top of the existing Siphon. Therefore, we do not anticipate any conflict to the existing siphon.

5.2.4 Lateral Loading

Lateral loads on 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 Tables 7 and 8 and rock parameters are included in Table 9. The parameters for the soft silty clay (**Layer 2**) were obtained from vane shear testing conducted near the west abutment in Boring 2054-B-01ALT and near east abutment in Boring VST-03. Information on the vane shear testing is provided in the boring log.

Table 7: Recommended Soil Parameters for Lateral Load Analysis at East Abutment
Borings 2054-B-03, 2054-B-04, and VST-03

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} (%)
New FILL behind Abutments/ wingwalls EL. 596.5 to 586	125	0	30	20	--
Loose to M Dense SANDY LOAM FILL (1) EL. 586 to 576	115	0	30	20	--
V. Soft to Soft CLAY(2) EL 576 to 565 feet	115	380	0	30	2.0
V. Soft to Soft CLAY (2) EL 565 to 533 feet	115	850	0	100	1.0
Stiff to Hard SILTY CLAY to SILTY CLAY LOAM (3) EL 533 to 516 feet	120	2200	0	1000	0.5
Dense to V. Dense SILT to SILTY LOAM and SAND to SANDY LOAM (4) EL 516 to 476 feet	125	0	36	125	--

Table 8: Recommended Soil Parameters for Lateral Load Analysis at West Abutment
Borings 2054-B-01 and 2054-B-01ALT

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} (%)
New FILL behind Abutments/ wingwalls EL. 596.5 to 586	125	0	30	20	--
Loose to M Dense SANDY LOAM FILL (1) EL. 593 to 584	115	0	30	20	--
V. Soft to Soft CLAY(2) EL 584 to 542 feet	115	800	0	100	1.0
Stiff to V Stiff SILTY CLAY to SILTY CLAY LOAM (3) EL 542 to 522 feet	120	2300	0	1000	0.5
Dense to V. Dense SANDY LOAM to GRAVELLY SAND and SILT (4) EL 522 to 487 feet	125	0	36	125	--

Table 9: Recommended Rock Parameters for Lateral Load Analysis
Borings 2054-B-01ALT and 2054-B-04

Rock Type	Total Unit Weight, γ (pcf)	Young's Modulus (ksi)	Uniaxial Comp. Strength (ksi)	RQD (%)	Lateral Rock Modulus Parameter
Good Quality DOLOSTONE	135	2,500	10.0	77 to 79	0.0005

5.3 Stage Construction Design Recommendations

The existing bridge will be closed to traffic during construction. Wang assumes the removal of the existing abutments will require temporary shoring of the surrounding embankment soils, including the

support of soft silty clay. At the abutments, auger refusals were recorded throughout the embankment; several attempts at numerous locations were performed before we were finally able to drill outside the refusal. The origin of these refusals is unknown and installing a full line of temporary support with steel sheet piling might prove difficult, as the sheeting would also meet with refusal prior to reaching the design tip elevation. At both abutments, they should be supported by a *Temporary Soil Retention System* designed by the Contractor and approved by IDOT prior to construction. A Temporary Soil Retention Systems are also required to accommodate the constructions of the proposed piers.

5.4 Ground Movement Evaluations

Wang submitted a Geotechnical Design Memorandum (GDM) for ground surface settlement of existing structures behind abutments in June 2016. The memo discussed the anticipated ground movement of buildings due to wall movement. Wang performed analyses to check the ground movements near nearby buildings based on the maximum deflection of 0.5% and 1 inch as per IDOT document included in the email dated November 14 2016 from IDOT BBS Geotechnical Unit. Wang estimated maximum ground movement to be less than 0.3 inches. The GDM is presented in Appendix E.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

All vegetation, 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. The construction of temporary support at the abutments may impact the nearby building, utility, and roadway. Precautions should be taken by the Contractor to prevent excessive movement and to maintain stability of nearby building, utility, and roadway.

6.3 Filling and Backfilling

Fill material required to attain the final design elevations should be structural fill material and should be pre-approved prior to placement. Compacted cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (IDOT 2016). The fill material should be free of organic matter and debris. Structural fill should be placed in lifts and compacted according to IDOT Section 205, *Embankment* (IDOT 2016).

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

6.4 Earthwork Operations

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

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

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

6.5 Drilled Shafts

The installation of drilled shafts through the water-bearing sand and gravelly sand frequently occurring above the hard silty clay and/or immediately atop of bedrock may present challenges. We expect the shaft excavations will encounter groundwater in granular layer shown in borings and the Contractor should be prepared to install casing and provide drilling fluid at each shaft location. For shafts socketed into the underlying bedrock, casing extending to the top of bedrock elevation will be required to seal the excavation for coring. Failure to anticipate the challenges posed by the groundwater at this depth will result in caving or heaving sand and complicate bedrock coring

operations. Prior to coring the bedrock, casing should be firmly seated into the top of the rock, and any drilling fluid removed to prevent caking of mud on the sides of the bedrock sockets. The shafts should be designed 6 inches larger in diameter than the proposed sockets.

The soft soil layer with Qu less than 0.5 tsf (500 ksf cohesion) is prone to squeeze if left open for long period of time. Therefore, to minimize the squeeze potential, casing should be provided.

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.

Bedrock conditions should be verified at Piers 1 and 3 as discussed in Section 5.2.1

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
062-067551
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS
Exp 11/30/2017

Andri A. Kurnia, P.E.
Geotechnical Engineer

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

Corina T. Farez, P.E., P.G.
Proncipal

REFERENCES

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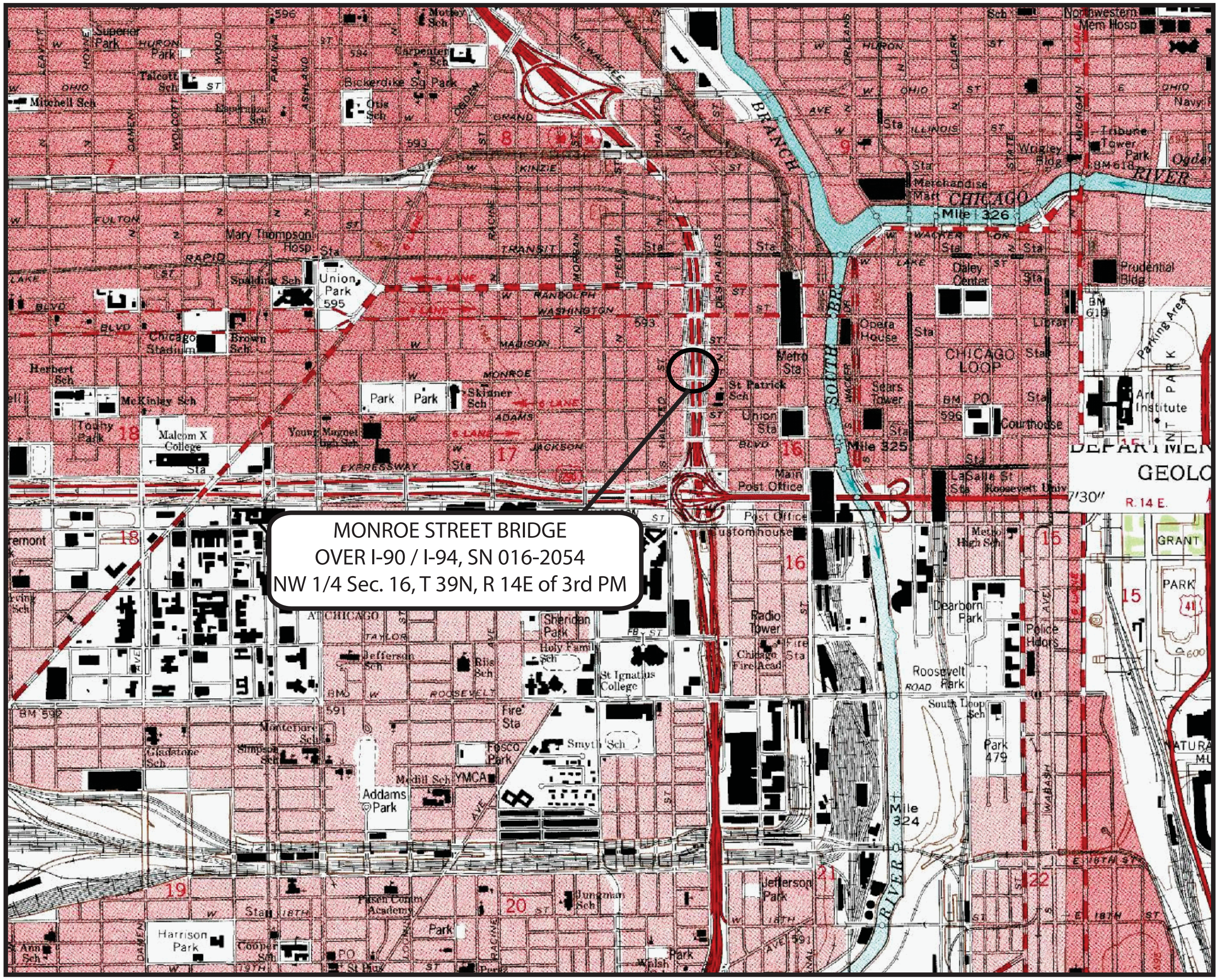
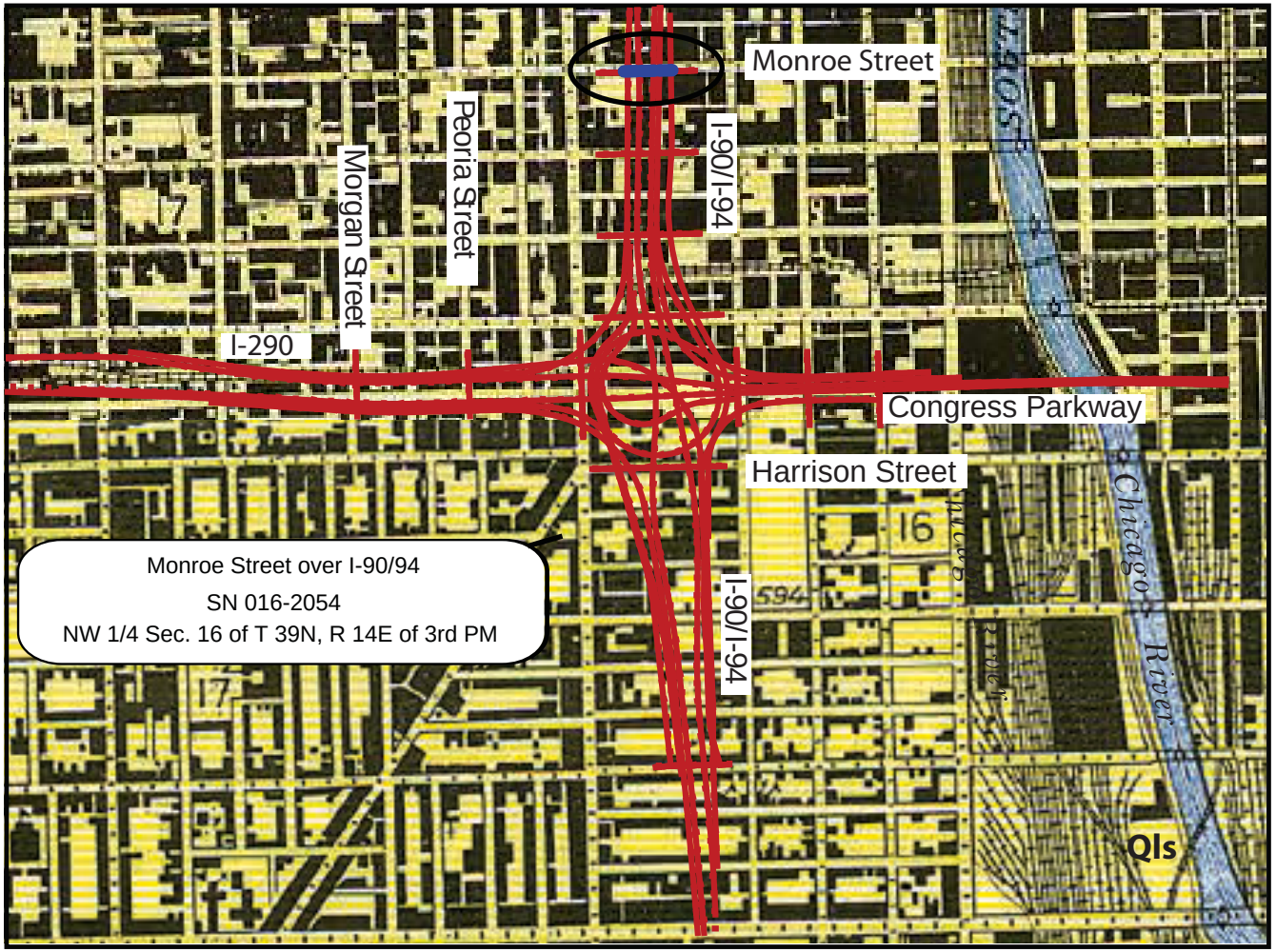
EXHIBITS



Cook County

0 0.25 0.5 Mile

SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY		
SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: R. KC CHECKED BY: A. Kurnia
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01



Modified after Bretz (1926)

REGIONAL GEOLOGY

Wedron Group

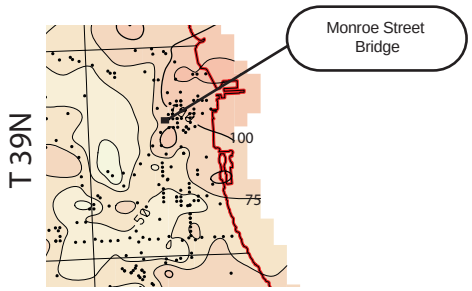
- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

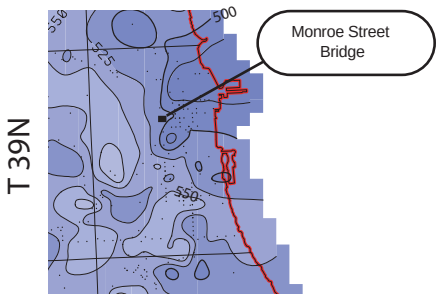
Legend

Qls	Glacial lake bottom (Covered by lacustrine deposits)

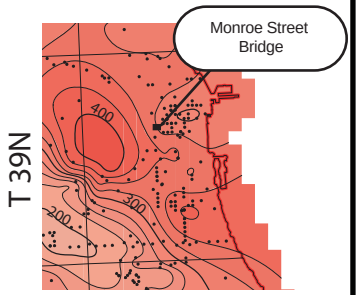
DRIFT THICKNESS



BEDROCK TOPOGRAPHY



BEDROCK THICKNESS



Modified after Leetaru et. al. (2004)

0 2 4 8 miles

SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, CHICAGO, IL

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

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

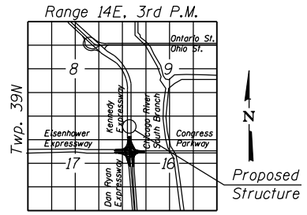
FOR AECOM | 1100-04-01

Bench Mark: Chisel "X" on east side of I-90 ±80' S of Monroe Street on SE corner of Handhole on concrete. Elevation 578.58'.

Existing Structure:
S.N. 016-2054 was originally built as F.A. Route 173, Section S-0101.2-4B in 1955. The existing structure is a four-span bridge with a reinf. concrete deck supported on W36 beams. The existing structure has an overall length of 341'-2" with span lengths 67'-6", 2 @ 100'-6" and 67'-6" and an out to out deck width 71'-7", carrying four traffic lanes. The existing substructure consists of stub-abutments and multi-column piers founded on timber piles.

Traffic Control: The existing bridge will be closed to traffic and detoured during construction.

No Salvage



LOCATION SKETCH

HIGHWAY CLASSIFICATION

F.A.I. Rte. Adams NB Ent
Functional Class: Interstate
ADT: 4400 (2012); 5000 (2040)
ADT: 88 (2012); 100 (2040)
DHV: 640 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. Adams SB Exit
Functional Class: Interstate
ADT: 1900 (2012); 5000 (2040)
ADTT: 52.06 (2012); 137 (2040)
DHV: 360 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. SW Exit Ramp
Functional Class: Interstate
ADT: 2900 (2012); 40000 (2040)
ADTT: 0 (2012); 1215.4 (2040)
DHV: 3,160 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. NB Bypass @ Monroe
Functional Class: Interstate
ADT: NA; 22000 (2040)
ADTT: NA; 461.8 (2040)
DHV: 1,650 (2040)
Design Speed: 40 m.p.h.
Posted Speed: 40 m.p.h.
Traffic: one-way
Directional Distribution: NA

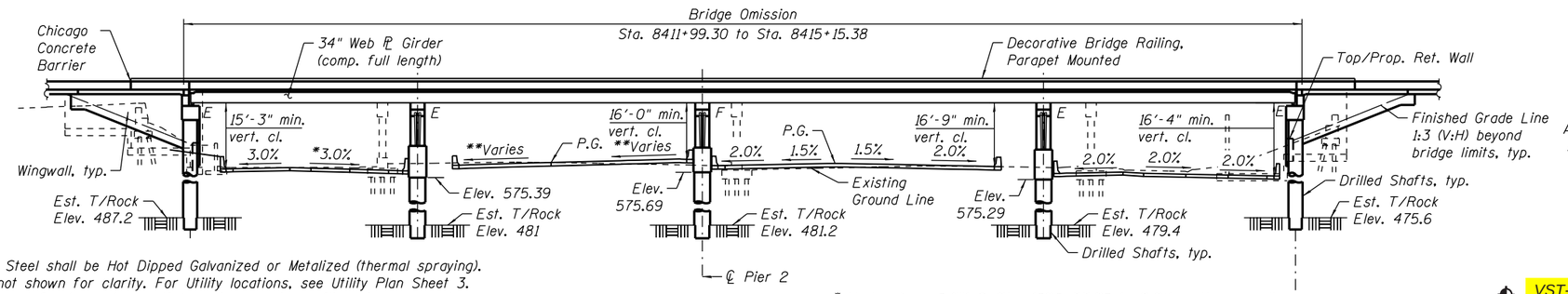
F.A.I. Rte. NB 90/94 @ Monroe
Functional Class: Interstate
ADT: 130800 (2012); 116000 (2040)
ADTT: 12408 (2012); 10660 (2040)
DHV: 7,130 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 45 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. SB 90/94 @ Monroe
Functional Class: Interstate
ADT: 119900 (2012); 87000 (2040)
ADTT: 12217 (2012); 9177 (2040)
DHV: 5,760 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 45 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. Madison NB Exit
Functional Class: Interstate
ADT: 5200 (2012); 6000 (2040)
ADTT: 93.6 (2012); 108 (2040)
DHV: 540 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.U. Rte. 1420 Monroe St
Functional Class: Minor Arterial
ADT: 11300 (2012); 12000 (2040)
ADTT: 283 (2012); 300 (2040)
DHV: 1200 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: two-way
Directional Distribution: NA

NB Bypass
Functional Class: Interstate
ADT: NA (2012); 17000 (2040)
ADTT: NA (2012); 440 (2040)
DHV: 1680 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA



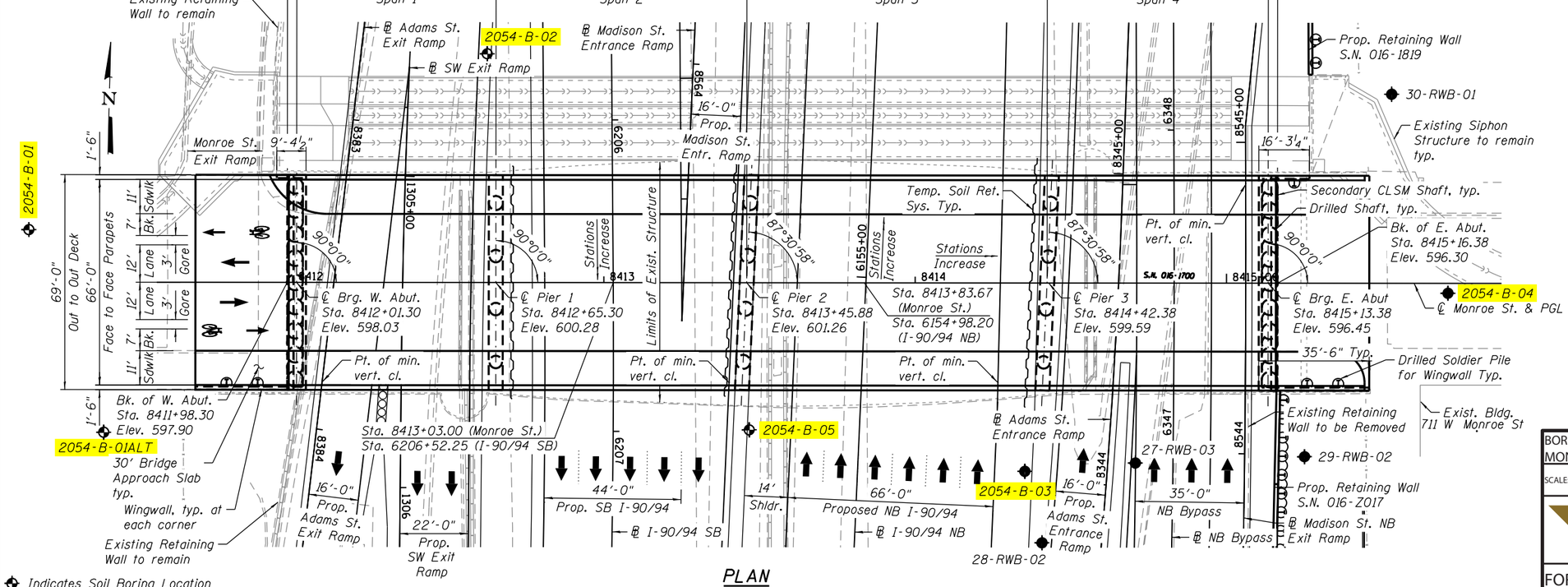
ELEVATION

* Varies from 3.0% @ Sta. 1305+28.07 to 2.0% in the opposite direction @ Sta. 1306+28.07
** Varies from 2.0% @ Sta. 6206+14.92 to 4.0% @ Sta. 6207+21.92

NOTES:

1. All Structural Steel shall be Hot Dipped Galvanized or Metalized (thermal spraying).
2. Utilities are not shown for clarity. For Utility locations, see Utility Plan Sheet 3.
3. Existing abutment front row batter timber piles are in conflict with proposed abutment shaft construction.

VST-03
187 feet North of 2054-B-04



PLAN

GENERAL PLAN
MONROE ST. OVER I-90/94
(KENNEDY EXPRESSWAY)
F.A.U. 1420
SECTION 2014-016R&B
COOK COUNTY
STATION 8413+45.88
STRUCTURE NO. 016-1700

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

BORING LOCATION PLAN: CIRCLE INTERCHANGE RECONSTRUCTION
MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY

SCALE: GRAPHICAL | EXHIBIT 3 | DRAWN BY: R. KC | CHECKED BY: A. KURNIA

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

FOR AECOM | 1100-04-01

AECOM

USER NAME = BhattA	DESIGNED - JXH	REVISED	
	CHECKED - ATB	REVISED	
PLOT SCALE = N.T.S.	DRAWN - GF	REVISED	
PLOT DATE = 10/2/2016	CHECKED - DD	REVISED	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-016R&B	COOK		
		CONTRACT NO. 60X95		
ILLINOIS FED. AID PROJECT				

016-1700-CIRCLE100-SHT-ACM-ST-TSL-001

◄ W

E ►

West Abutment | Pier 1 | Pier 2 | Pier 3 | East Abutment

Proposed Profile

2054-B-01 8411+15.30 593.9

2054-B-01ALT 8411+39.40 594.2

590 (estimate)

Existing Grade Elev.

Top of Shaft Elev.

2054-B-02 8412+62.47 579.0 575.4

2054-B-05 8413+46.74 579.7 575.7

2054-B-03 8414+35.27 579.4 575.3

2054-B-04 8415+71.14 593.6

590.0 (estimate)

ELEVATION (feet)

600 590 580 570 560 550 540 530 520 510 500 490 480 470 460

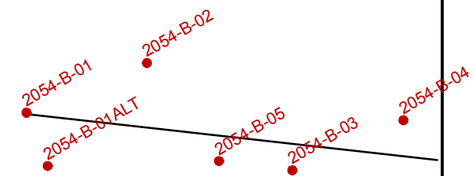
0 50 100 150 200 250 300 350 400 450 500

DISTANCE ALONG PROFILE (feet)

Lithology Graphics

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

N



Site Map Scale 1 inch equals 185 feet

Explanation:

2054-B-01 8411+15.30 — Borehole Number Station

Borehole Lithology

N--N-value, (blw/12 in)
Qu--UC Strength, (tsf)
MC--Moisture Content, (%)

Water Level Reading at time of drilling.

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

0 50

Horizontal Scale (feet)

Vertical Exaggeration: 2x

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

Soil Profile
Monroe Street Bridge Over I-90/94

WEI SINCE 1982

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

JOB NUMBER	PLATE NUMBER
1100-04-01	EXHIBIT 4

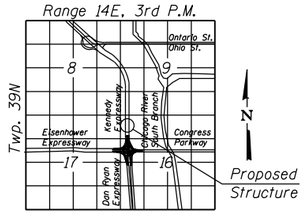
WEI 11X17 1100401.GPJ WANGENG.GDT 6/22/16

Bench Mark: Chisel "X" on east side of I-90 ±80' S of Monroe Street on SE corner of Handhole on concrete. Elevation 578.58'.

Existing Structure:
S.N. 016-2054 was originally built as F.A. Route 173, Section S-0101.2-4B in 1955. The existing structure is a four-span bridge with a reinf. concrete deck supported on W36 beams. The existing structure has an overall length of 341'-2" with span lengths 67'-6", 2 @ 100'-6" and 67'-6" and an out to out deck width 71'-7", carrying four traffic lanes. The existing substructure consists of stub-abutments and multi-column piers founded on timber piles.

Traffic Control: The existing bridge will be closed to traffic and detoured during construction.

No Salvage



LOCATION SKETCH

HIGHWAY CLASSIFICATION

F.A.I. Rte. Adams NB Ent
Functional Class: Interstate
ADT: 4400 (2012); 5000 (2040)
ADT: 88 (2012); 100 (2040)
DHV: 640 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. Adams SB Exit
Functional Class: Interstate
ADT: 1900 (2012); 5000 (2040)
ADTT: 52.06 (2012); 137 (2040)
DHV: 360 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. SW Exit Ramp
Functional Class: Interstate
ADT: 2900 (2012); 40000 (2040)
ADTT: 0 (2012); 1215.4 (2040)
DHV: 3,160 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. NB Bypass @ Monroe
Functional Class: Interstate
ADT: NA; 22000 (2040)
ADTT: NA; 461.8 (2040)
DHV: 1,650 (2040)
Design Speed: 40 m.p.h.
Posted Speed: 40 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. NB 90/94 @ Monroe
Functional Class: Interstate
ADT: 130800 (2012); 116000 (2040)
ADTT: 12408 (2012); 10660 (2040)
DHV: 7,130 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 45 m.p.h.
Traffic: one-way
Directional Distribution: NA

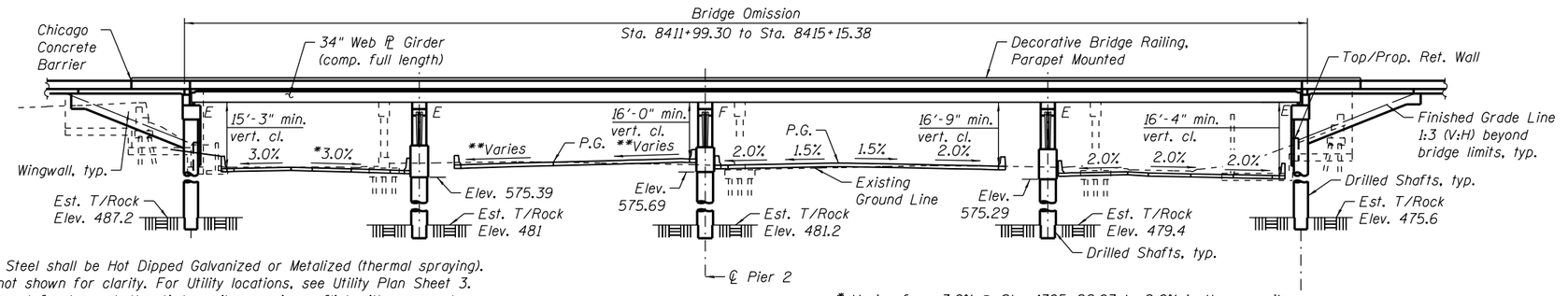
F.A.I. Rte. SB 90/94 @ Monroe
Functional Class: Interstate
ADT: 119900 (2012); 87000 (2040)
ADTT: 12217 (2012); 9177 (2040)
DHV: 5,760 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 45 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.I. Rte. Madison NB Exit
Functional Class: Interstate
ADT: 5200 (2012); 6000 (2040)
ADTT: 93.6 (2012); 108 (2040)
DHV: 540 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

F.A.U. Rte. 1420 Monroe St
Functional Class: Minor Arterial
ADT: 11300 (2012); 12000 (2040)
ADTT: 283 (2012); 300 (2040)
DHV: 1200 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: two-way
Directional Distribution: NA

NB Bypass
Functional Class: Interstate
ADT: NA (2012); 17000 (2040)
ADTT: NA (2012); 440 (2040)
DHV: 1680 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Traffic: one-way
Directional Distribution: NA

EXHIBIT 5



ELEVATION

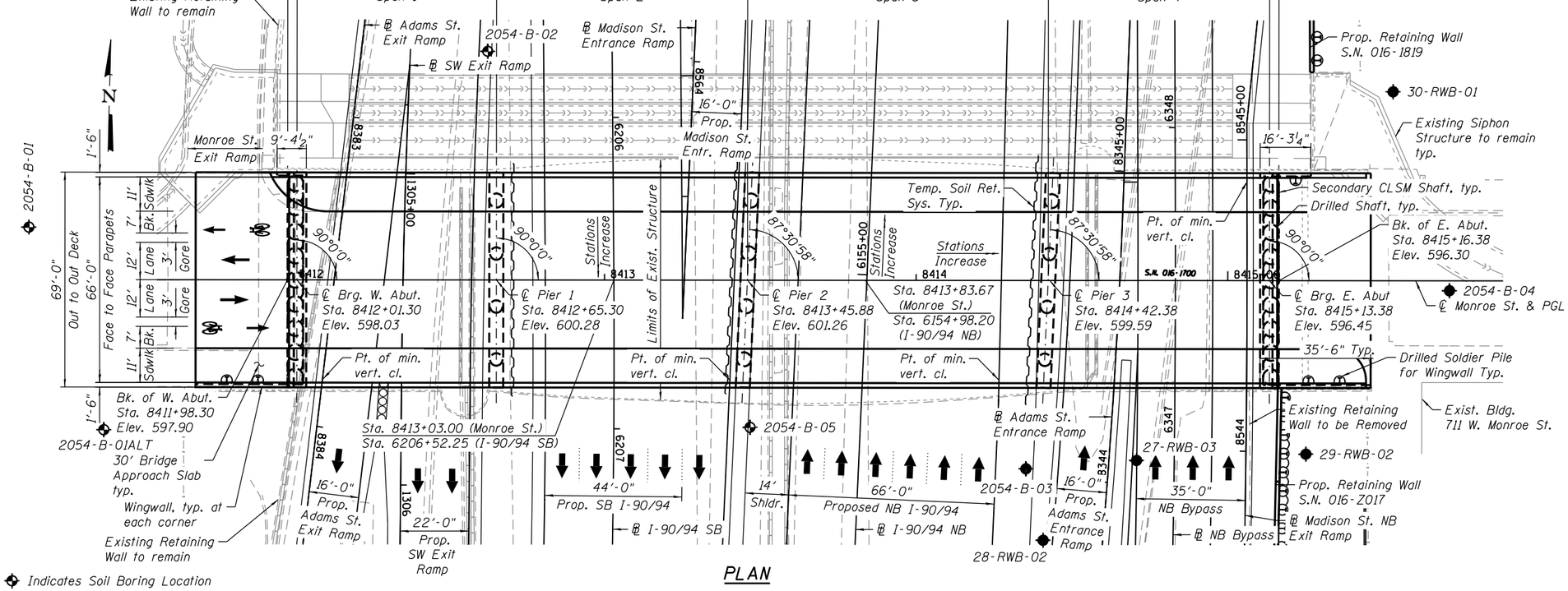
* Varies from 3.0% @ Sta. 1305+28.07 to 2.0% in the opposite direction @ Sta. 1306+28.07
** Varies from 2.0% @ Sta. 6206+14.92 to 4.0% @ Sta. 6207+21.92

NOTES:

1. All Structural Steel shall be Hot Dipped Galvanized or Metalized (thermal spraying).
2. Utilities are not shown for clarity. For Utility locations, see Utility Plan Sheet 3.
3. Existing abutment front row batter timber piles are in conflict with proposed abutment shaft construction.

ABUTMENT DEFLECTION CRITERIA

Max. total lateral deflection at the top of the abutment wall shall not exceed 0.5% of exposed height of the abutment wall.



PLAN

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition with 2016 Interims

LOADING HL-93

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

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
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

GENERAL PLAN
MONROE ST. OVER I-90/94
(KENNEDY EXPRESSWAY)
F.A.U. 1420
SECTION 2014-016R&B
COOK COUNTY
STATION 8413+45.88
STRUCTURE NO. 016-1700

AECOM

USER NAME = BhattA	DESIGNED - JXH	REVISED
	CHECKED - ATB	REVISED
PLOT SCALE = N.T.S.	DRAWN - GF	REVISED
PLOT DATE = 10/2/2016	CHECKED - DD	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-016R&B	COOK		
		CONTRACT NO. 60X95		
		ILLINOIS FED. AID PROJECT		

016-1700-CIRCLE100-SHT-ACM-ST-TSL-001

APPENDIX A

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BORING LOG 2054-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: 593.94 ft
North: 1899809.22 ft
East: 1171258.81 ft
Station: 8411+15.30
Offset: 16.865 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	593.7	3.5-inch thick ASPHALT						
	592.9	8.5-inch thick CONCRETE --PAVEMENT--						
		Loose, gray CRUSHED STONE --BASE COURSE--			1	3 2 3	NP	6
	590.9	Loose to medium dense, brown, coarse SAND, trace gravel; moist --FILL--	5		2	4 4 3	NP	9
					3	2 6 12	NP	10
					4	50/5	NP	3
	583.9		10					
		Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			5	2 3 3	0.89 B	23
		--L_L(%)=42, P_L(%)=19-- --%Gravel=1.2-- --%Sand=8.5-- --%Silt=43.0-- --%Clay=47.3-- --A-7-6 (21)--	15		6	2 3 3	0.66 B	24
					7	4 3 4	0.57 B	25
			20		8	2 3 3	0.66 B	22
					9	0 1 1	0.66 B	21
			25		10	1 2 2	0.49 B	24
			30		11	0 0 1	0.41 B	25
					12	1 1 1	0.35 B	27
			35		13	0 1 2	0.33 B	26
			40		14	1 2 2	0.49 B	23
			45		15	2 2 3	0.90 B	25
			50		16	1 3 4	0.66 B	28

GENERAL NOTES

Begin Drilling: **09-21-2015** Complete Drilling: **09-22-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **K&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 20', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **Mud at 10 ft**
Time After Drilling: **24 hours**
Depth to Water: **24.00 ft**

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

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BORING LOG 2054-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: 593.94 ft
North: 1899809.22 ft
East: 1171258.81 ft
Station: 8411+15.30
Offset: 16.865 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	542.2	Stiff to very stiff, gray SILTY CLAY, trace gravel						
			55		17	4 5 7	1.97 B	21
			60		18	4 5 7	1.80 B	18
			65		19	4 9 11	3.20 B	20
			70		20	7 7 10	2.13 B	25
	522.2	Dense, gray SANDY LOAM, trace gravel; wet						
			75		21	10 15 24	NR	
			80		22	15 15 17	NP	12
	512.2	Very dense, gray GRAVELLY SAND; wet to saturated						
		--HARD DRILLING-- *possible cobbles*	85		23	26 28 50/4	NP	13
		losing mud	90		24	50/5	NP	13
		--HARD DRILLING-- *possible cobbles*	95		25	70 50/4	NP	13
		lost 600 gl of mud between 87.0 and 97.5 ft			26	60 50/4	NP	17
	496.4	Boring terminated at 97.50 ft	100					

GENERAL NOTES

Begin Drilling **09-21-2015** Complete Drilling **09-22-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **3.25" HSA to 20', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 10 ft**
Time After Drilling **24 hours**
Depth to Water ▼ **24.00 ft**

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

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BORING LOG 2054-B-01ALT

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 594.23 ft
North: 1899744.77 ft
East: 1171284.45 ft
Station: 8411+39.40
Offset: 48.180 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	593.9	4-inch thick ASPHALT --PAVEMENT--						
		Very dense, dark brown SANDY LOAM, some gravel and wood fragments --FILL--			1	5 50/5"	NP	14
	587.2		5					
			10		2	5 5 5	NR	
	582.2							
		Medium stiff, gray CLAY to SILTY CLAY	15		3	2 2 2	0.67 N/6	25
		--In-Situ Vane Shear, 22.0 feet-- --$S_{u\ undis}$ = 873.7 psf-- --$S_{u\ remold}$ = 524.2 psf-- --Sensitivity = 1.7--	20		2	VS		
			25 ▽					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--In-Situ Vane Shear, 27.0 feet-- --$S_{u\ undis}$ = 830.0 psf-- --$S_{u\ remold}$ = 677.1 psf-- --Sensitivity = 1.2--			4	VS		
		--In-Situ Vane Shear, 29.5 feet-- --$S_{u\ undis}$ = 1004.7 psf-- --$S_{u\ remold}$ = 502.4 psf-- --Sensitivity = 2.0--	30		5	VS		
		--In-Situ Vane Shear, 32.0 feet-- --$S_{u\ undis}$ = 808.1 psf-- --$S_{u\ remold}$ = 567.9 psf-- --Sensitivity = 1.4--			6	VS		
		--In-Situ Vane Shear, 34.5 feet-- --$S_{u\ undis}$ = 677.1 psf-- --$S_{u\ remold}$ = 371.3 psf-- --Sensitivity = 1.8--	35		7	VS		
		--In-Situ Vane Shear, 37.0 feet-- --$S_{u\ undis}$ = 611.6 psf-- --$S_{u\ remold}$ = 415.0 psf-- --Sensitivity = 1.5--			8	VS		
		--In-Situ Vane Shear, 39.5 feet-- --$S_{u\ undis}$ = 1048.4 psf-- --$S_{u\ remold}$ = 436.8 psf-- --Sensitivity = 2.4--	40		9	VS		
		--In-Situ Vane Shear, 42.0 feet-- --$S_{u\ undis}$ = 895.5 psf-- --$S_{u\ remold}$ = 480.5 psf-- --Sensitivity = 1.9--			10	VS		
		--In-Situ Vane Shear, 44.5 feet-- --$S_{u\ undis}$ = 939.2 psf-- --$S_{u\ remold}$ = 698.9 psf-- --Sensitivity = 1.3--	45		11	VS		
		--In-Situ Vane Shear, 47.0 feet-- --$S_{u\ undis}$ = 1004.7 psf-- --$S_{u\ remold}$ = 633.4 psf-- --Sensitivity = 1.6--	49.5			VS		
		--In-Situ Vane Shear, 49.5 feet-- --$S_{u\ undis}$ = 1026.6 psf-- --$S_{u\ remold}$ = 567.9 psf-- --Sensitivity = 1.8--	50		13			
	544.2							

GENERAL NOTES

Begin Drilling: **12-16-2015** Complete Drilling: **12-16-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 7 ft**
Time After Drilling **24 hours**
Depth to Water ▽ **25.00 ft**

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

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BORING LOG 2054-B-01ALT

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 594.23 ft
North: 1899744.77 ft
East: 1171284.45 ft
Station: 8411+39.40
Offset: 48.180 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--Drilled Without Sampling from 50 to 97 feet--	55			VS		
			60					
			65					
			70					
			75					
	497.2	Very dense, gray SILT; moist	80					
			85					
			90					
			95					
			100		4	36 50/3		19

GENERAL NOTES

Begin Drilling **12-16-2015** Complete Drilling **12-16-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 7 ft**
Time After Drilling **24 hours**
Depth to Water ▼ **25.00 ft**

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BORING LOG 2054-B-01ALT

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 594.23 ft
North: 1899744.77 ft
East: 1171284.45 ft
Station: 8411+39.40
Offset: 48.180 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	492.5							
		Very dense, gray, fine SAND; wet			5	26 43 50/2		17
	489.7							
	489.2	Hard (4.5P), gray SILTY CLAY LOAM	105					
		--difficult drilling from 105 feet-- --WEATHERED BEDROCK--						
	487.2							
		Strong, light gray, good rock quality, bedded, slightly vuggy DOLOSTONE, up to 24 inch beds, 7-inch joint spacing, joints with less than 0.2 inch or no infilling, hard joint walls	110			CORE		
		--Run 1 -RECOVERY= 98%-- --RQD= 77%-- --Qu = 13,510 psi--			1			
			115					
	477.2							
		Boring terminated at 117.00 ft						
			120					
			125					

GENERAL NOTES

Begin Drilling **12-16-2015** Complete Drilling **12-16-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 7 ft**
Time After Drilling **24 hours**
Depth to Water ▼ **25.00 ft**

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

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BORING LOG 2054-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: 579.01 ft
North: 1899869.30 ft
East: 1171404.59 ft
Station: 8412+62.47
Offset: 73.447 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	578.6	5-inch thick ASPHALT						
	577.8	10-inch thick CONCRETE --PAVEMENT--						
		Very dense, gray CRUSHED STONE			1	21 29 25	NP	4
	575.8	--BASE COURSE--						
		Stiff, gray SILTY CLAY LOAM, trace gravel --FILL--	5		2	6 4 6	1.80 B	20
	573.5	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			3	0 0 1	0.33 B	23
			10		4	0 2 3	0.57 B	18
					5	1 2 2	0.82 B	20
			15		6	0 2 3	0.82 B	24
					7	1 2 2	0.82 B	24
			20		8	0 1 2	0.57 B	24
					9	0 0 0	0.41 B	25
			25		10	0 0 1	0.41 B	26
			30		11	0 1 1	0.33 N/6	
					12	4 5 5	0.90 B	25
			35		13	1 2 2	0.74 B	31
	542.3	Stiff to hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel						
			40		14	3 3 5	1.80 B	22
		--L_L(%)=27, P_L(%)=16-- --%Gravel=4.4-- --%Sand=21.2-- --%Silt=54.9-- --%Clay=19.5-- --A-6 (6)--	45		15	6 6 6	1.89 B	18
			50		16	5 8 13	3.61 B	21

GENERAL NOTES

Begin Drilling: **09-15-2015** Complete Drilling: **09-20-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **K&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **Mud at 5 ft**
Time After Drilling: **120 hours**
Depth to Water: **2.00 ft**

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

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BORING LOG 2054-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: 579.01 ft
North: 1899869.30 ft
East: 1171404.59 ft
Station: 8412+62.47
Offset: 73.447 LT

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	11 12 11	4.84 B	14
	522.3	Medium stiff, gray CLAY to SILTY CLAY, trace gravel						
			60		18	0 0 1	0.74 B	27
	517.3	Very stiff, gray SILTY CLAY LOAM, trace gravel						
			65		19	5 14 15	2.50 P	12
	512.3	Very dense, gray GRAVELLY SAND to SANDY LOAM; wet to saturated			20	50/5	NP	15
		--hard drilling, 69.5 to 73.5 feet-- *possible cobbles*	70					
			75		21	34 37 50/5	NP	13
		--hard drilling, 73.5 to 78.5 feet-- *possible cobbles*						
			80		22	50/4	NP	15
	497.8	Very dense, gray, fine SAND; saturated						
			85		23	32 47 47	NP	19
	492.3	Very dense, gray SILT; saturated						
			90		24	18 30 42	NP	24
	487.3	Very dense, gray GRAVELLY SAND; saturated						
			95		25	38 42 50/4	NP	11
	483.0	--very hard, steady drilling-- --WEATHERED BEDROCK--						
	481.0	Strong, light gray, very poor rock quality, bedded, slightly vuggy DOLOSTONE, highly			1	CORE		
	479.0	fragmented, 2-inch joint spacing,	100					

GENERAL NOTES

Begin Drilling: **09-15-2015** Complete Drilling: **09-20-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **K&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **Mud at 5 ft**
Time After Drilling: **120 hours**
Depth to Water: **2.00 ft**

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

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BORING LOG 2054-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: 579.01 ft
North: 1899869.30 ft
East: 1171404.59 ft
Station: 8412+62.47
Offset: 73.447 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		joints with less than 0.2 inch or no infilling, hard joint walls --Run 1 -RECOVERY= 83%-- --RQD= 25%-- Boring terminated at 100.00 ft	105 110 115 120 125					

GENERAL NOTES

Begin Drilling **09-15-2015** Complete Drilling **09-20-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 5 ft**
Time After Drilling **120 hours**
Depth to Water ▼ **2.00 ft**

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

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BORING LOG 2054-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: 579.44 ft
North: 1899739.53 ft
East: 1171580.53 ft
Station: 8414+35.27
Offset: 60.482 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		18-inch thick, ASPHALT --PAVEMENT--						
	577.9							
		Very dense, white and brown SANDY GRAVEL --BASE COURSE--			1	16 33 18	NP	3
	575.7							
		Very stiff, gray SILTY CLAY LOAM, trace gravel	5		2	10 4 4	3.49 B	15
	573.9							
		Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			3	2 2 2	0.41 B	19
			10		4	3 3 2	0.90 B	16
					5	0 0 2	0.25 B	22
			15		6	0 0 0	0.33 B	25
					7	0 0 0	0.16 B	26
			20		8	0 0 0	0.33 B	26
					9	0 0 2	0.16 B	26
			25		10	0 0 1	0.33 B	25
					11	0 1 2	0.41 B	26
			30		12	2 6 11	0.25 P	21
		--L_L(%)=37, P_L(%)=19-- --%Gravel=1.8-- --%Sand=13.8-- --%Silt=48.4-- --%Clay=35.9-- --A-6 (15)--	35		13	0 1 3	0.66 B	26
			40		14	2 3 4	0.90 B	20
			45		15	4 4 9	0.75 P	21
	532.7							
		Stiff to very stiff, gray SILTY CLAY, trace gravel	50		16	4 7 10	3.36 B	16

GENERAL NOTES

Begin Drilling: **09-13-2015** Complete Drilling: **09-14-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&N** Logger: **A. Tomaras** Checked by: **C. Marin**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **66.75 ft**
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 2054-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: 579.44 ft
North: 1899739.53 ft
East: 1171580.53 ft
Station: 8414+35.27
Offset: 60.482 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	5 8 11	3.85 B	20
			60		18	5 7 8	2.50 N/6	
	515.6	Dense, gray SANDY LOAM; wet *interbedded SILT* --hard drilling--	65		19	6 14 25	NP	13
	512.7	Very dense, gray SILT; wet to saturated	70		20	38 50/5	NP	16
			75		21	30 50/5	NP	18
	492.7	Very dense, gray SANDY LOAM; wet	80		22	26 36 44	NP	25
			85		23	31 37 36	NP	17
	487.7	Very dense, gray SILT; wet	90		24	22 37 40	NP	17
			95		25	16 29 31	NP	16
	479.4		100		26	50/5	NP	17

GENERAL NOTES

Begin Drilling: **09-13-2015** Complete Drilling: **09-14-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&N** Logger: **A. Tomaras** Checked by: **C. Marin**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **66.75 ft**
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 2054-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: 579.44 ft
North: 1899739.53 ft
East: 1171580.53 ft
Station: 8414+35.27
Offset: 60.482 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Strong, light gray, very poor rock quality, bedded, highly fragmented DOLOSTONE, 1-inch joint spacing, joints with more than 0.2 inch or no infilling, vuggy, and with stylolitic surfaces.						
		--Run 1 -RECOVERY= 55%--						
		--RQD= 0%--	105		1			
	469.4		110					
		Boring terminated at 110.00 ft						
			115					
			120					
			125					

GENERAL NOTES

Begin Drilling **09-13-2015** Complete Drilling **09-14-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&N** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **66.75 ft**
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 2054-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: 593.64 ft
North: 1899800.05 ft
East: 1171715.00 ft
Station: 8544+51.68
Offset: 64.9267 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	593.0	7-inch thick CONCRETE --PAVEMENT--						
		Construction debris						
		--hard drilling, 1 to 12 feet-- *--possible cobbles--*						
			5					
		Drilled without sampling						
			10					
	581.6							
		Drilled without sampling						
			15					
			20					
			25					
			30					
		Drilled without sampling						
			35					
			40					
			45					
			50					

GENERAL NOTES

Begin Drilling **08-24-2015** Complete Drilling **08-25-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" IDA HSA to 18', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 12 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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BORING LOG 2054-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: 593.64 ft
North: 1899800.05 ft
East: 1171715.00 ft
Station: 8544+51.68
Offset: 64.9267 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Drilled without sampling	55					
			60					
	530.1	Stiff to very stiff, gray SILTY CLAY LOAM, trace gravel	65		1	6 7 11	1.89 B	17
	524.6							
	524.1	Gray GRAVELLY SAND; saturated	70		2	12 11 12	3.28 B	16
		Stiff, gray SILTY CLAY	75		3	4 4 6	1.31 B	28
	516.9	Very dense, gray, fine SAND, interbedded silt; wet	80		4	16 25 45	NP	14
	511.9	Very dense, gray SILT; wet	85		5	28 50/5	NP	20
			90		6	45 50/5	NP	18
			95		7	41 50/5	NP	19
			100		8	41 40 50/5	NP	20

GENERAL NOTES

Begin Drilling: **08-24-2015** Complete Drilling: **08-25-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **2.25" IDA HSA to 18', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **Mud at 12 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 2054-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: 593.64 ft
North: 1899800.05 ft
East: 1171715.00 ft
Station: 8544+51.68
Offset: 64.9267 RT

Depth (ft)	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
105				9	28 39 47	NP	22
110	483.1	--hard drilling from 110.5 feet-- *--possible cobbles--* Very dense, gray SILTY LOAM, some gravel, and rock fragments		10	27 50/3	NP	25
115				11	50/4	NP	17
		--hard drilling-- *--possible cobbles--*					
120	475.6	Strong, light gray, good rock quality, bedded DOLOSTONE, beds up to 24 inch, 9 inch joint spacing, joints with more than 0.2 inch or no infilling, vuggy, and with stylolitic surfaces. --Run 1 -RECOVERY= 98%-- --RQD= 79%-- --Qu = 10,470 psi--	CORE	1			
125							
130	465.6	Boring terminated at 128.00 ft					
135							
140							
145							
150							

GENERAL NOTES

Begin Drilling **08-24-2015** Complete Drilling **08-25-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" IDA HSA to 18', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **Mud at 12 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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BORING LOG 2054-B-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: 579.67 ft
North: 1899750.65 ft
East: 1171491.71 ft
Station: 8413+46.74
Offset: 47.243 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Drilled without sampling	5					
			10					
			15					
			20					
			25					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Drilled without sampling	30					
			35					
			40					
			45					
			50					

GENERAL NOTES

Begin Drilling **09-23-2015** Complete Drilling **09-23-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **87.00 ft**
At Completion of Drilling ▼ **washed**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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BORING LOG 2054-B-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: 579.67 ft
North: 1899750.65 ft
East: 1171491.71 ft
Station: 8413+46.74
Offset: 47.243 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Drilled without sampling	55					
			60					
			65					
			70					
			75					
		Drilled without sampling	80					
		--hard drilling, 75.0 to 80.0 feet-- *possible cobbles*	85					
			90					
			95					
	481.2	--AUGER REFUSAL--	100					
		Strong, light gray, good rock quality, bedded DOLOSTONE,				COR		

GENERAL NOTES

Begin Drilling **09-23-2015** Complete Drilling **09-23-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **87.00 ft**
At Completion of Drilling ▼ **washed**
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 2054-B-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: 579.67 ft
North: 1899750.65 ft
East: 1171491.71 ft
Station: 8413+46.74
Offset: 47.243 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		beds up to 18 inch, vuggy and occasionally cherty rock, with horizontal and vertical joints, 9 inch joint spacing, joints with more than 0.2 inch or no infilling, and hard joint wall.				E		
		--Run 1 -RECOVERY= 98%--			1			
		--RQD= 77%--						
		--Qu = 9,910 psi--	105					
	471.2	Boring terminated at 108.50 ft						
			110					
			115					
			120					
			125					

GENERAL NOTES

Begin Drilling **09-23-2015** Complete Drilling **09-23-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **87.00 ft**
At Completion of Drilling ▼ **washed**
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 27-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: 579.64 ft
North: 1899634.17 ft
East: 1171605.63 ft
Station: 6345+83.90
Offset: 10.7197 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Medium dense, gray GRAVELLY SAND --FILL--			1	14 11 6	NP	5
	576.6	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel	5		2	2 2 2	0.41 B	23
					3	1 1 1	0.41 B	26
			10		4	1 1 2	0.41 B	25
					5	1 1 2	0.25 B	25
			15		6	1 1 2	0.41 B	25
					7	1 1 1	0.41 B	17
			20		8	0 1 2	0.33 B	26
					9	1 1 2	0.33 B	26
			25		10	3 3 4	0.41 B	25
			30		11	1 2 2	0.41 B	26
					12	1 2 3	0.41 B	26
			35		13	2 2 2	0.16 B	26
	537.9	Stiff to very stiff, gray SILTY CLAY, trace gravel	40		14	3 4 4	0.90 B	22
			45		15	3 4 6	2.87 B	17
			50		16	5 5 7	1.56 B	22

GENERAL NOTES

Begin Drilling: **06-24-2014** Complete Drilling: **06-24-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B-57 TMR**
Driller: **N&K** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **unable to measure**
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 27-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: 579.64 ft
North: 1899634.17 ft
East: 1171605.63 ft
Station: 6345+83.90
Offset: 10.7197 LT

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	6 8 11	3.53 B	21
	522.9							
		Stiff, gray CLAY to SILTY CLAY, trace gravel --L_L(%)=41, P_L(%)=19X-- --%Gravel=0.3-- --%Sand=1.6-- --%Silt=51.6-- --%Clay=46.5-- --A-7-6 (23)--	60		18	3 4 4	1.23 B	41
	517.9							
		Dense, gray SANDY LOAM, trace gravel						
	514.6		65		19	8 21 21	NP	13
		Boring terminated at 65.00 ft						
			70					
			75					

GENERAL NOTES

Begin Drilling **06-24-2014** Complete Drilling **06-24-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR**
Driller **N&K** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
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 28-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: 579.73 ft
North: 1899716.72 ft
East: 1171586.62 ft
Station: 6154+17.38
Offset: 60.7088 RT

Depth (ft)	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
0	579.4	4-inch thick, ASPHALT --PAVEMENT--					
	578.0	17-inch thick, CONCRETE with rebar --PAVEMENT--					
		Medium to very dense, white CRUSHED STONE		1	19 33 28	NP	4
	575.4	--BASE COURSE--		2	10 5 5	NP	5
5		Hard, brown and gray SILTY					
	574.2	CLAY LOAM, trace gravel					
		Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel		3	1 2 2	0.41 B	21
10				4	0 0 2	0.16 B	29
				5	0 0 0	0.25 B	32
15				6	0 0 2	0.33 B	26
				7	0 0 1	0.33 B	23
20				8	0 0 1	0.41 B	23
				9	0 0 2	0.16 B	26
25				10	0 0 2	0.33 B	26
30				11	0 0 2	0.33 B	25
				12	0 0 2	0.33 B	25
35				13	0 2 3	0.57 B	26
	543.0	Stiff to hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel					
40				14	2 3 4	1.07 B	22
45				15	3 5 7	1.80 B	21
50				16	4 5 8	2.13 B	22

GENERAL NOTES

Begin Drilling: **07-24-2014** Complete Drilling: **07-24-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **A&K** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **unable to measure**
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 28-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: 579.73 ft
North: 1899716.72 ft
East: 1171586.62 ft
Station: 6154+17.38
Offset: 60.7088 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	6 9 15	4.26 B	22
			60		18	6 8 12	2.95 B	17
	518.0	Dense, gray SANDY LOAM, trace gravel --MOIST--						
	514.7		65		19	8 20 19	NP	15
		Boring terminated at 65.00 ft	70					
			75					

GENERAL NOTES

Begin Drilling **07-24-2014** Complete Drilling **07-24-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **A&K** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
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 29-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: 591.82 ft
North: 1899679.29 ft
East: 1171674.90 ft
Station: 8542+32+38
Offset: 23.4686 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Black SANDY LOAM, trace slag --FILL--			1	8 16 17	NP	12
	589.8	Dense to very dense, brown SANDY GRAVEL --FILL--	5		2	4 13 24	NP	8
					3	5 50/3"	NP	10
	583.1	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel	10		4	1 2 3	0.66 B	16
					5	0 0 0	0.25 B	27
			15		6	0 0 0	0.25 B	27
					7	0 0 0	0.25 B	27
			20		8	0 0 0	0.25 B	27
					9	0 0 0	0.25 B	24
			25		10	0 0 0	0.66 B	25
			30		11	0 0 0	0.41 B	26
					12	0 1 2	0.25 P	26
		--L_L(%)=34, P_L(%)=17-- --%Gravel=10.0-- --%Sand=13.8-- --%Silt=47.8-- --%Clay=28.5-- --A-6 (11)--	35		13	0 0 0	0.33 B	27
			40		14	0 0 0	0.41 B	27
			45		15	0 2 2	0.57 B	23
			50		16	2 3 3	0.66 B	27

GENERAL NOTES

Begin Drilling **06-17-2014** Complete Drilling **06-17-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10',mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
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 11/18/16

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BORING LOG 29-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: 591.82 ft
North: 1899679.29 ft
East: 1171674.90 ft
Station: 8542+32+38
Offset: 23.4686 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	540.1							
		Stiff, gray SILTY CLAY LOAM, trace gravel	55		17	3 4 6	1.48 B	21
	535.1							
		Stiff, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel --L_L(%)=24, P_L(%)=14-- --%Gravel=5.8-- --%Sand=19.4-- --%Silt=57.2--	60		18	4 9 8	1.75 P	16
	530.1							
		Very stiff, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel	65		19	4 7 13	2.30 B	18
	526.8	Boring terminated at 65.00 ft	70					
			75					

GENERAL NOTES

Begin Drilling **06-17-2014** Complete Drilling **06-17-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10',mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
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 30-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: 593.54 ft
North: 1899863.46 ft
East: 1171695.35 ft
Station: 8545+20.14
Offset: 45.6914 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	593.24	4-inch thick, ASPHALT						
	592.5	--PAVEMENT--						
	592.0	8-inch thick, CONCRETE						
		--PAVEMENT--						
		6-inch thick, loose black SANDY LOAM, little gravel						
		--FILL--						
		Loose, brownish red SANDY GRAVEL, trace brick fragments	5		1	4 3 5	NP	12
	588.0	--FILL--						
		Loose, black SANDY LOAM, little gravel			2	3 3 2	NP	14
		--FILL--			3	4 3 3	NP	17
	585.5							
		Loose to medium dense, brown GRAVELLY SAND, trace brick fragments						
		--FILL--	10		4	3 4 3	NP	15
					5	15 9 7	NP	22
	580.5							
		Very soft to soft, gray CLAY to SILTY CLAY, trace gravel			6	0 1 0	0.33 B	25
			15		7	0 0 0	0.16 B	25
					8	0 0 0	0.16 B	27
			20		9	0 0 0	0.16 B	26
					10	0 0 0	0.16 B	25
			25					
			30		11	0 0 0	0.16 B	25
					12	0 0 2	0.33 B	24
			35		13	0 1 2	< 0.25 P	31
			40		14	0 0 2	0.08 B	27
			45		15	0 0 0	0.25 B	26
			50		16	0 0 1	0.33 B	25

GENERAL NOTES

Begin Drilling: **07-24-2014** Complete Drilling: **07-27-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **unable to measure**
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 30-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: 593.54 ft
North: 1899863.46 ft
East: 1171695.35 ft
Station: 8545+20.14
Offset: 45.6914 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	536.8	Very stiff, gray SILTY CLAY to SILTY CLAY LOAM, trace to some gravel	55		17	2 5 6	0.25 B	23
			60		18	4 7 10	1.72 B	19
			65		19	5 9 12	3.50 N/6	25
			70		20	7 12 15	2.87 B	19
			75		21	4 5 7	1.39 B	25
	511.8	Very dense, gray SILT, trace gravel	80		22	11 11 10	0.16 B	27
			85		23	30 45 25/3	NP	19
	506.8	Gray fine SAND; moist						
	504.5	Very dense, gray SILTY LOAM, trace gravel	90		24	20 28 36	NP	17
			95		25	52/6	NP	12
			100		26	36 50/5	NP	10

GENERAL NOTES

Begin Drilling **07-24-2014** Complete Drilling **07-27-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
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 30-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: 593.54 ft
North: 1899863.46 ft
East: 1171695.35 ft
Station: 8545+20.14
Offset: 45.6914 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			105		27	50/6	NP	9
			110		28	18 24 35	NP	10
	482.0							
		Strong, light gray, poor rock mass quality, bedded slightly weathered DOLOSTONE, with			1			
	480.0	shale partings, up to 18-inch beds, <2-inch spaced joints, horizontal joints with none or less than <0.2-inch infilling, hard joint wall, with stylolitic surfaces, and moderately vuggy porosity.	115					
		Run 1 - RECOVERY = 100% RQD = 21%						
		Boring terminated at 113.50 ft	120					
			125					

GENERAL NOTES

Begin Drilling **07-24-2014** Complete Drilling **07-27-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

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BORING LOG VST-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: 593.21 ft
North: 1899985.05 ft
East: 1171693.33 ft
Station: 8415+53.90
Offset: 182.276 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	592.9	ASPHALT --PAVEMENT-- Medium dense, brown gravelly coarse SAND --FILL--						
			5		1	5 7 7	NP	6
	586.5	Medium stiff, brown and gray SILTY CLAY LOAM						
			10		2	3 2 2	0.75 P	26
	580.2	Soft, gray SILTY CLAY						
			15		3	3 2 2	NR	
					4	1 1 1	0.25 P	23
	575.0							
		--In-Situ Vane Shear, 19.5 feet-- --$S_{u\ undis}$ = 425.9 psf-- --$S_{u\ remold}$ = 371.3 psf-- --Sensitivity = 1.1--	20		1	VS		
		--In-Situ Vane Shear, 22.0 feet-- --$S_{u\ undis}$ = 371.3 psf-- --$S_{u\ remold}$ = 305.8 psf-- --Sensitivity = 1.2--			2	VS		
		--In-Situ Vane Shear, 24.5 feet--	25		3			
		--$S_{u\ undis}$ = 382.2 psf-- --$S_{u\ remold}$ = 316.7 psf-- --Sensitivity = 1.2--				VS		
		--In-Situ Vane Shear, 27.0 feet-- --$S_{u\ undis}$ = 393.1 psf-- --$S_{u\ remold}$ = 338.5 psf-- --Sensitivity = 1.2--			4	VS		
		--In-Situ Vane Shear, 29.5 feet--	30		5	VS		
		--$S_{u\ undis}$ = 622.5 psf-- --$S_{u\ remold}$ = 371.3 psf-- --Sensitivity = 1.7--						
		--In-Situ Vane Shear, 32.0 feet-- --$S_{u\ undis}$ = 535.1 psf-- --$S_{u\ remold}$ = 327.6 psf-- --Sensitivity = 1.6--			6	VS		
		--In-Situ Vane Shear, 34.5 feet--	35		7	VS		
		--$S_{u\ undis}$ = 535.1 psf-- --$S_{u\ remold}$ = 393.1 psf-- --Sensitivity = 1.4--						
		--In-Situ Vane Shear, 37.0 feet-- --$S_{u\ undis}$ = 655.2 psf-- --$S_{u\ remold}$ = 404.1 psf-- --Sensitivity = 1.6--			8	VS		
		--In-Situ Vane Shear, 39.5 feet--	40		9	VS		
		--$S_{u\ undis}$ = 622.5 psf-- --$S_{u\ remold}$ = 382.2 psf-- --Sensitivity = 1.6--						
		--In-Situ Vane Shear, 42.0 feet-- --$S_{u\ undis}$ = 851.8 psf-- --$S_{u\ remold}$ = 458.7 psf-- --Sensitivity = 1.9--			10	VS		
		--In-Situ Vane Shear, 44.5 feet--	45		11	VS		
		--$S_{u\ undis}$ = 928.3 psf-- --$S_{u\ remold}$ = 600.6 psf-- --Sensitivity = 1.5--						
		--In-Situ Vane Shear, 47.0 feet-- --$S_{u\ undis}$ = 1266.8 psf-- --$S_{u\ remold}$ = 633.4 psf-- --Sensitivity = 2.0--			12	VS		
			50					

GENERAL NOTES

Begin Drilling: **12-02-2015** Complete Drilling: **12-02-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&N** Logger: **F. Bozga** Checked by: **A. Kurnia**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **unable to measure**
Time After Drilling: **NA**
Depth to Water: **NA**

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

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BORING LOG VST-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: 593.21 ft
North: 1899985.05 ft
East: 1171693.33 ft
Station: 8415+53.90
Offset: 182.276 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	541.7	--In-Situ Vane Shear, 51.0 feet-- --$S_{u\ undis}$ = 1681.8 psf-- --$S_{u\ remold}$ = 1266.8 psf-- --Sensitivity = 1.3-- Boring terminated at 51.50 ft			13	VS		
			55					
			60					
			65					
			70					
			75					

GENERAL NOTES

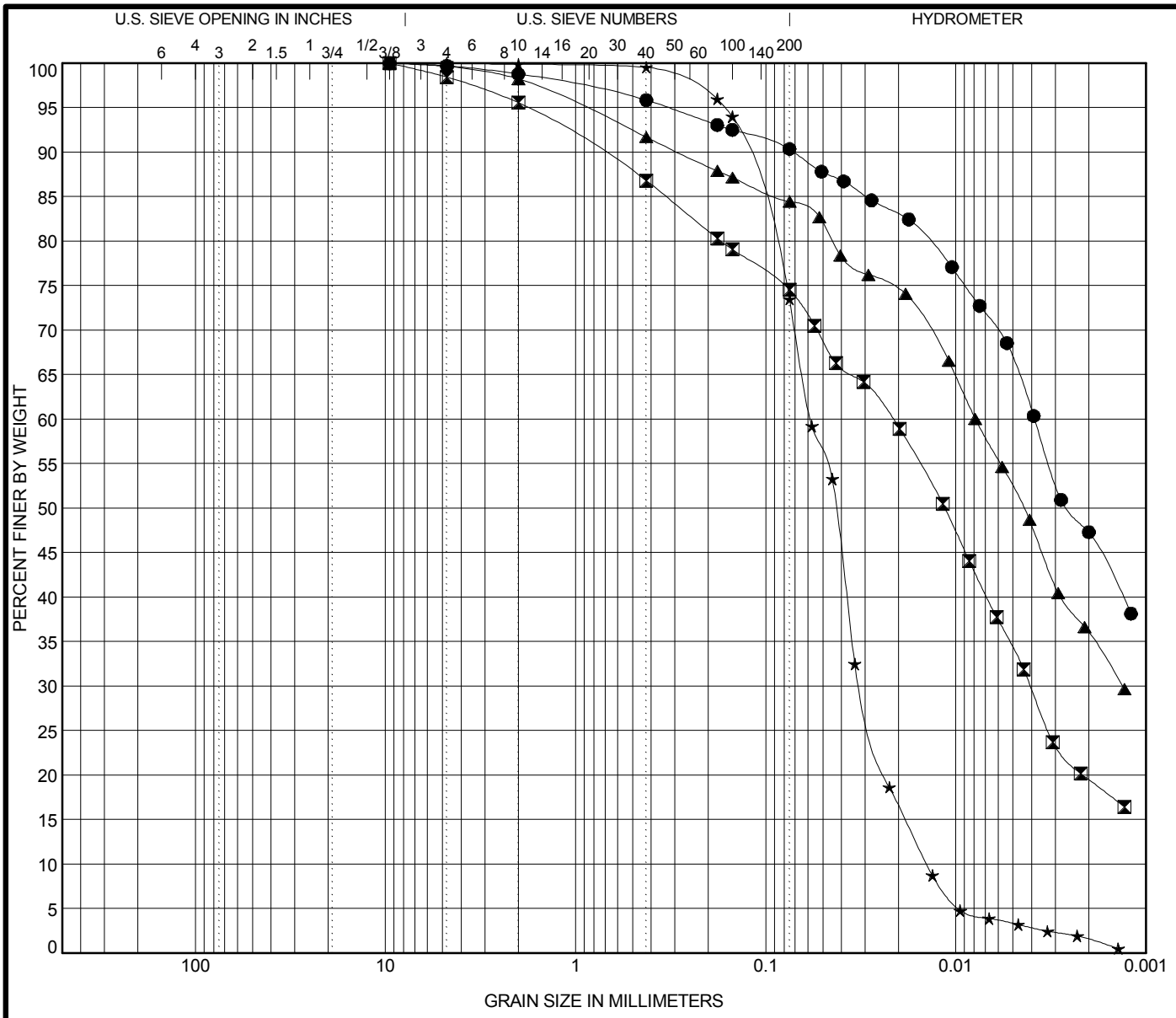
Begin Drilling **12-02-2015** Complete Drilling **12-02-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **unable to measure**
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
●	2054-B-01#6	13.5 ft	**Clay**	**42**	**19**	**23**		
⊠	2054-B-02#15	43.5 ft	**Silty Clay Loam**	**27**	**16**	**11**		
▲	2054-B-03#13	33.5 ft	**Clay**	**37**	**19**	**18**		
★	2054-B-03#23	83.5 ft	**Silty Loam**	**NP**	**NP**	**NP**	**1.21**	**4.08**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2054-B-01#6	13.5 ft	**9.5**	**0.004**			**1.2**	**8.5**	**43.0**	**47.3**
⊠	2054-B-02#15	43.5 ft	**9.5**	**0.022**	**0.004**		**4.4**	**21.2**	**54.9**	**19.5**
▲	2054-B-03#13	33.5 ft	**9.5**	**0.008**	**0.001**		**1.8**	**13.8**	**48.4**	**35.9**
★	2054-B-03#23	83.5 ft	**4.75**	**0.058**	**0.032**	**0.014**	**0.1**	**27.1**	**71.3**	**1.5**

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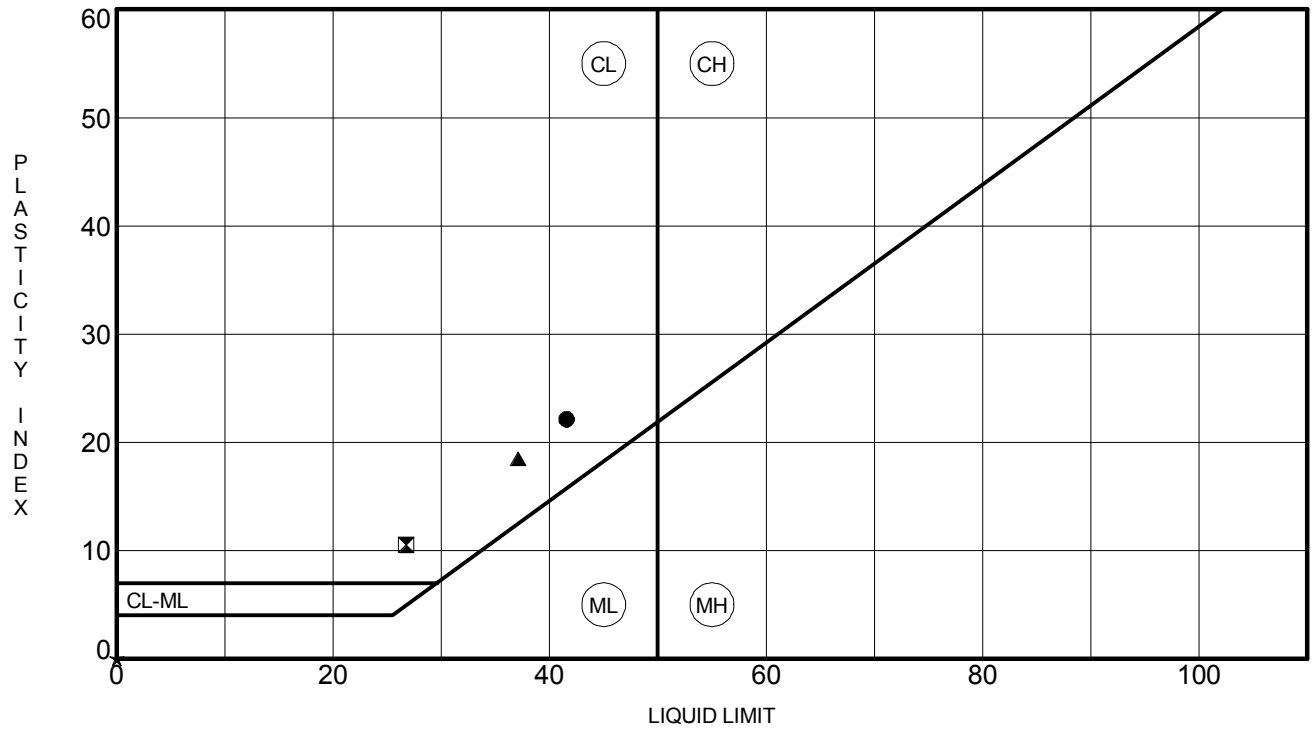
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

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

Number: 1100-04-01



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	2054-B-01#6	13.5 ft	42	19	23	90	Clay
⊠	2054-B-02#15	43.5 ft	27	16	11	75	Silty Clay Loam
▲	2054-B-03#13	33.5 ft	37	19	18	84	Clay
★	2054-B-03#23	83.5 ft	NP	NP	NP	73	Silty Loam

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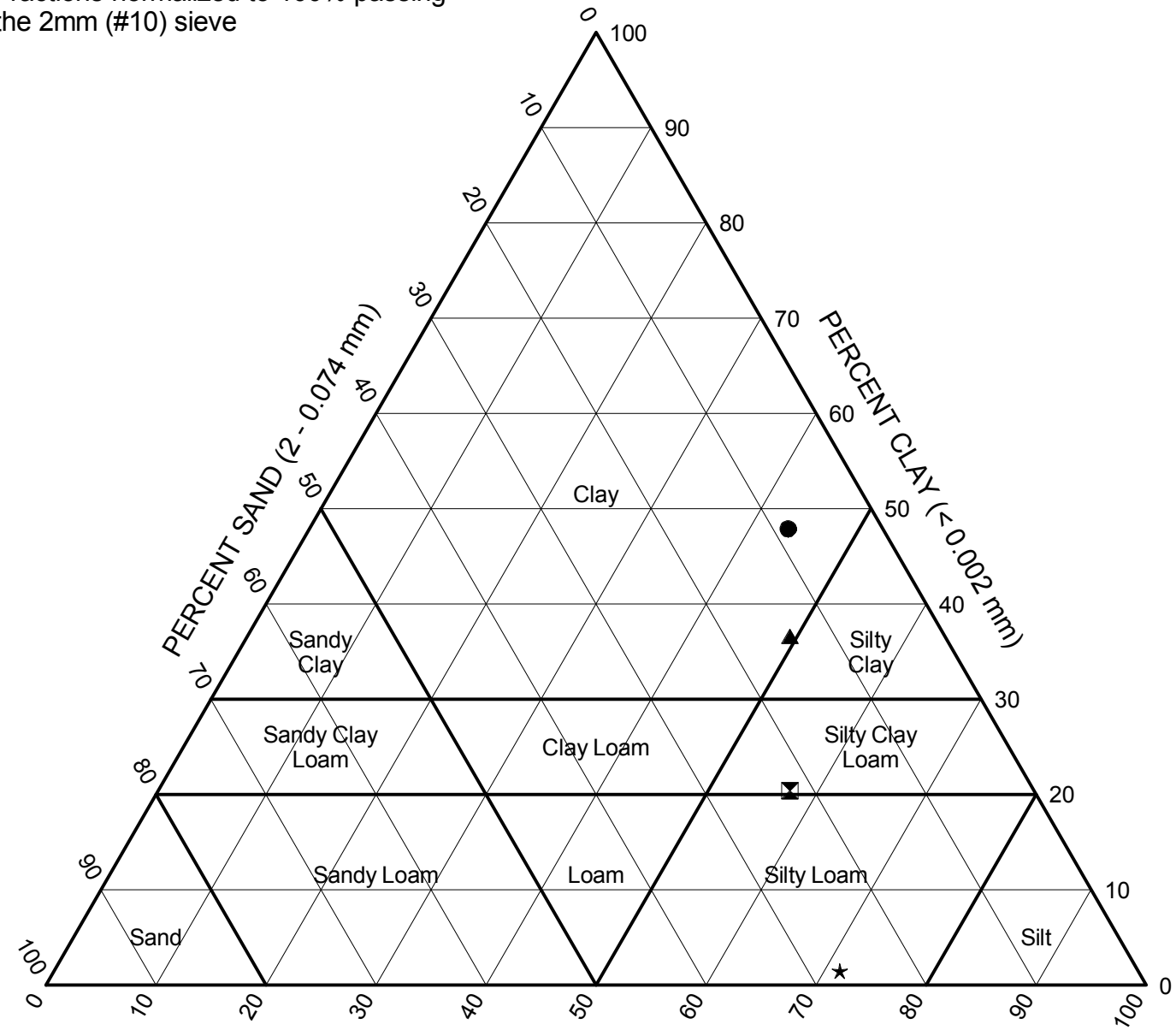
ATTERBERG LIMITS' RESULTS

Project: Circle Interchange Reconstruction

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

Number: 1100-04-01

Fractions normalized to 100% passing the 2mm (#10) sieve



	Sample	Depth (ft)	Sand (%)	Silt (%)	Clay (%)	Classification		
						IL DOT	AASHTO	ASTM
●	**2054-B-01#6**	**13.5**	**8.6**	**43.5**	**47.9**	**Clay**	**A-7-6 (21)**	**CL**
⧗	**2054-B-02#15**	**43.5**	**22.2**	**57.4**	**20.4**	**Silty Clay Loam**	**A-6 (6)**	**CL**
▲	**2054-B-03#13**	**33.5**	**14.1**	**49.3**	**36.6**	**Clay**	**A-6 (15)**	**CL**
★	**2054-B-03#23**	**83.5**	**27.1**	**71.4**	**1.5**	**Silty Loam**	**A-4 (0)**	**ML**

WEI SINCE 1982

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IDH Textural Classification Chart

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 (ft)	Location	Sample Description	Length (in)		Diameter (in)	Total Load (lbs)	Total Pressure (psi)	Fracture Type*	Break Date	Tested By	Area (in^2)
					Before Capping	After Capping							
2054-B01-ALT	7617	110.0		Dolomite	3.88	3.97	2.04	44180	13510	3	1/27/16	AM	3.27

*** 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: _____ 1/28/16

Checked by: _____ 1/29/16

WANG ENGINEERING, INC.
1145 N. Main Street, Lombard. IL 60148

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 (ft)	Location	Sample Description	Length (in)		Diameter (in)	Total Load (lbs)	Total Pressure (psi)	Fracture Type*	Break Date	Tested By	Area (in^2)
					Before Capping	After Capping							
2054-B-05	6569	101.0		Dolomite	3.88	4.03	2.06	33010	9910	3	9/29/15	AM	3.33
2054-B-04 (D)	6570	120.5		Dolomite	3.92	4.13	2.06	34880	10470	3	9/29/15	AM	3.33

*** Fracture Types:**

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

Prepared by:_____

Checked by: _____

WANG ENGINEERING, INC.
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APPENDIX C

Boring 2054-B-01ALT:
Run #1, 107.0' to 117.0', RECOVERY = 98% , RQD = 77%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION MONROE STREET
BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY

SCALE : GRAPHIC	APPENDIX C	DRAWN BY: C. Marin CHECKED BY: A. Kurnia

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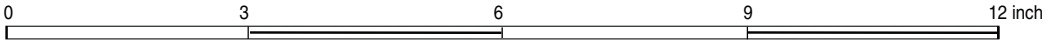
FOR AECOM	1100-04-01



Boring 2054-B-02:
Run #1, 98.0' to 100.0', RECOVERY = 83% , RQD = 25%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY

SCALE : GRAPHIC	APPENDIX C	DRAWN BY: C. Marin CHECKED BY: A. Kurnia

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FOR AECOM	1100-04-01

Boring 2054-B-03:
Run #1, 100.0' to 110.0', RECOVERY = 55% , RQD = 0%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY

SCALE : GRAPHIC	APPENDIX C	DRAWN BY: C. Marin CHECKED BY: A. Kurnia

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FOR AECOM	1100-04-01

0 3 6 9 12 inch

Boring 2054-B-04:
Run #1, 118' to 128', RECOVERY = 98% , RQD = 79%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY

SCALE : GRAPHIC	APPENDIX C	DRAWN BY: C. Marin CHECKED BY: A. Kurnia

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FOR AECOM	1100-04-01

Boring 2054-B-05:
Run #1, 98.5' to 108.5', RECOVERY = 98% , RQD = 77%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION MONROE STREET BRIDGE OVER I-90/94, SN 016-2054, COOK COUNTY

SCALE : GRAPHIC	APPENDIX C	DRAWN BY: C. Marin CHECKED BY: A. Kurnia

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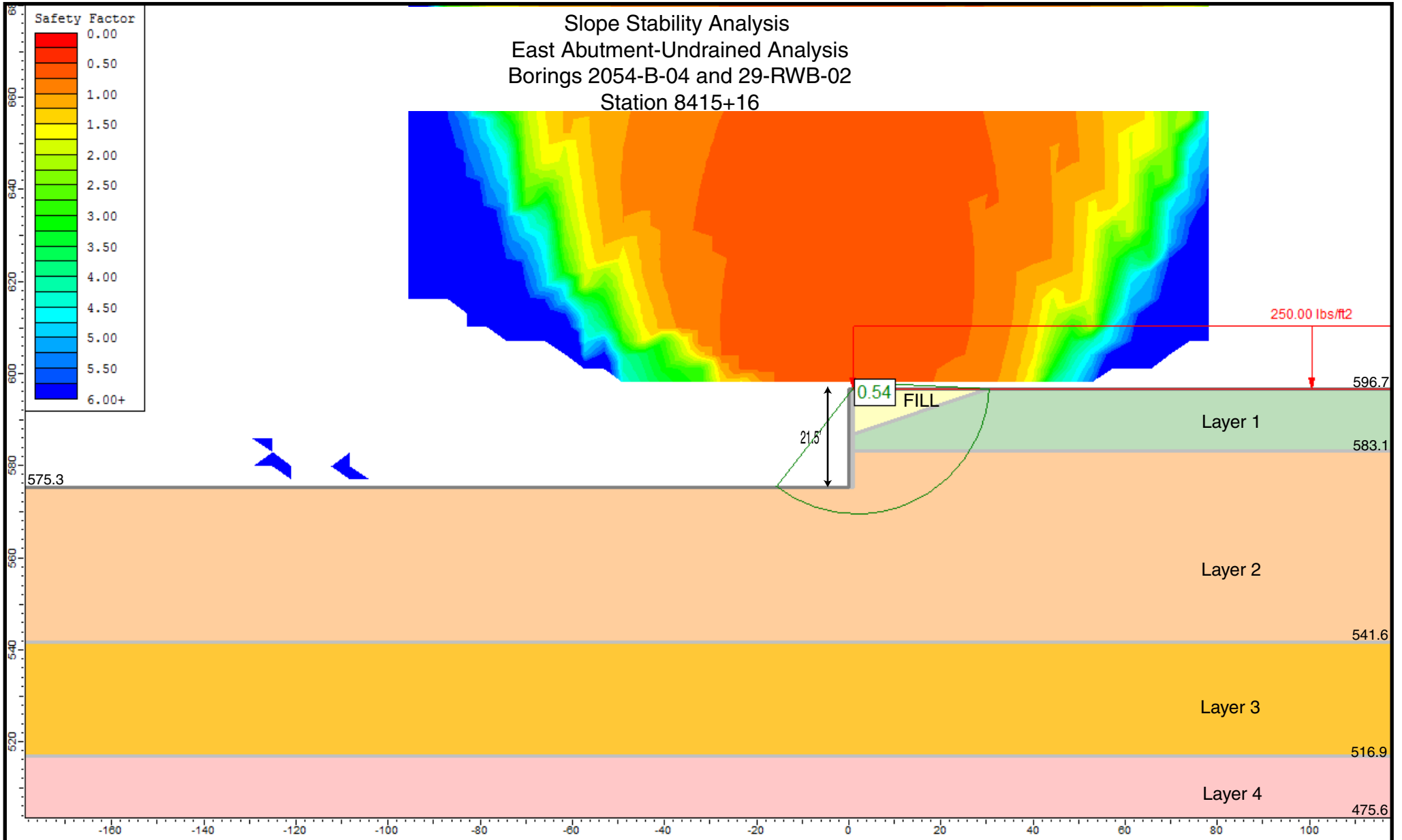
FOR AECOM	1100-04-01

APPENDIX D



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Undrained Parameter C_u (psf)	Undrained Parameter ϕ (deg.)
FILL	New IDOT FILL	125	1000	0
1	Loose to Dense SANDY LOAM FILL	115	0	31
2	V. Soft to M. Stiff CLAY to SILTY CLAY	110	300	0
3	Stiff to V. Stiff SILTY CLAY to SILTY CLAY LOAM	120	2000	0
4	V. Dense SILT to SILTY LOAM	120	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRiDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-1** | DRAWN BY: A. Hamad | CHECKED BY: A. Kurnia

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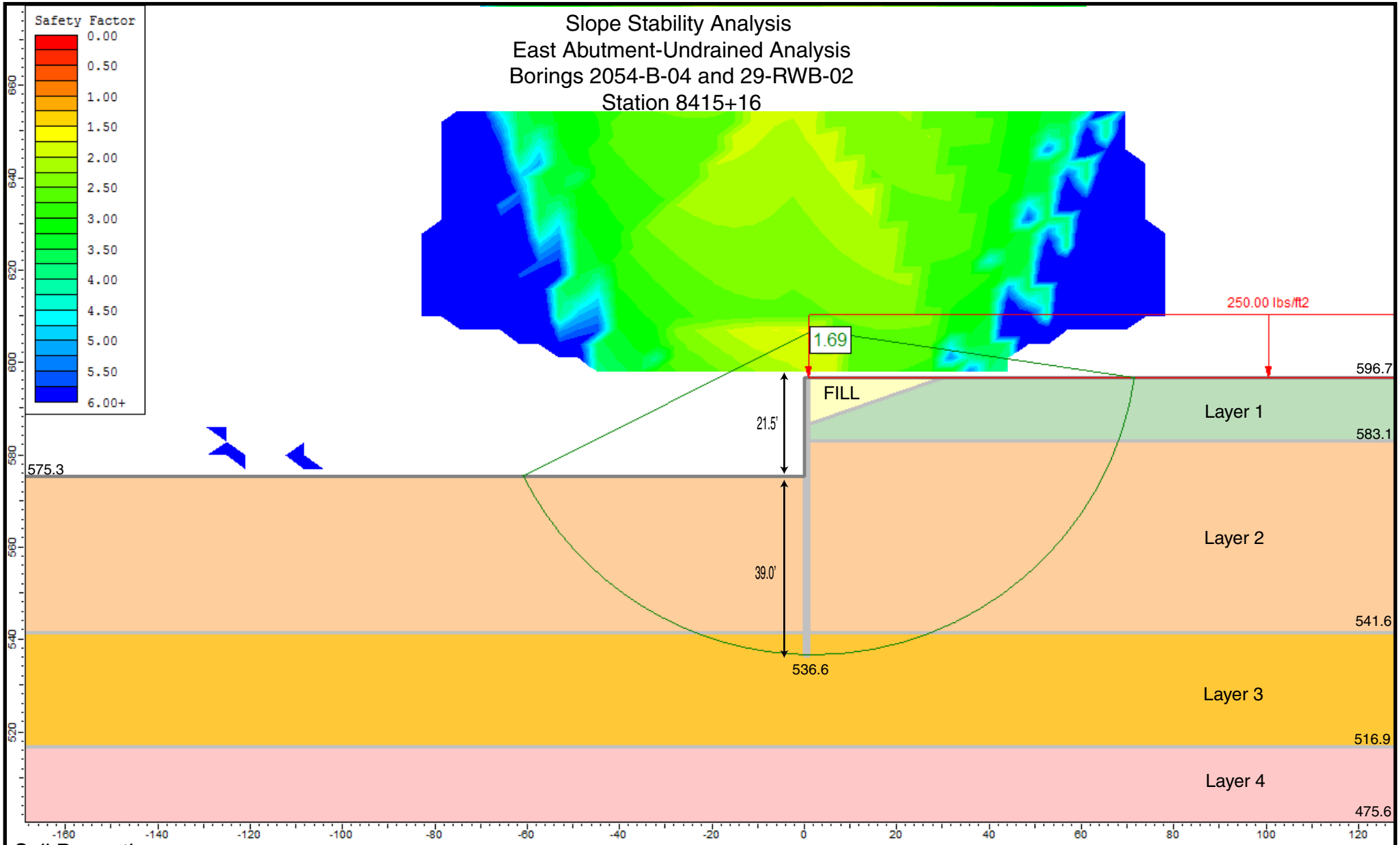
FOR AECOM | **1100-04-01**

Slope Stability Analysis
East Abutment-Undrained Analysis
Borings 2054-B-04 and 29-RWB-02
Station 8415+16



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Undrained Parameter C_u (psf)	Undrained Parameter ϕ (deg.)
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2	V. Soft to M. Stiff CLAY to SILTY CLAY	110	300	0
3	Stiff to V. Stiff SILTY CLAY to SILTY CLAY LOAM	120	2000	0
4	V. Dense SILT to SILTY LOAM	120	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRIDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-2** | DRAWN BY: A. Hamad | CHECKED BY: A. Kurnia

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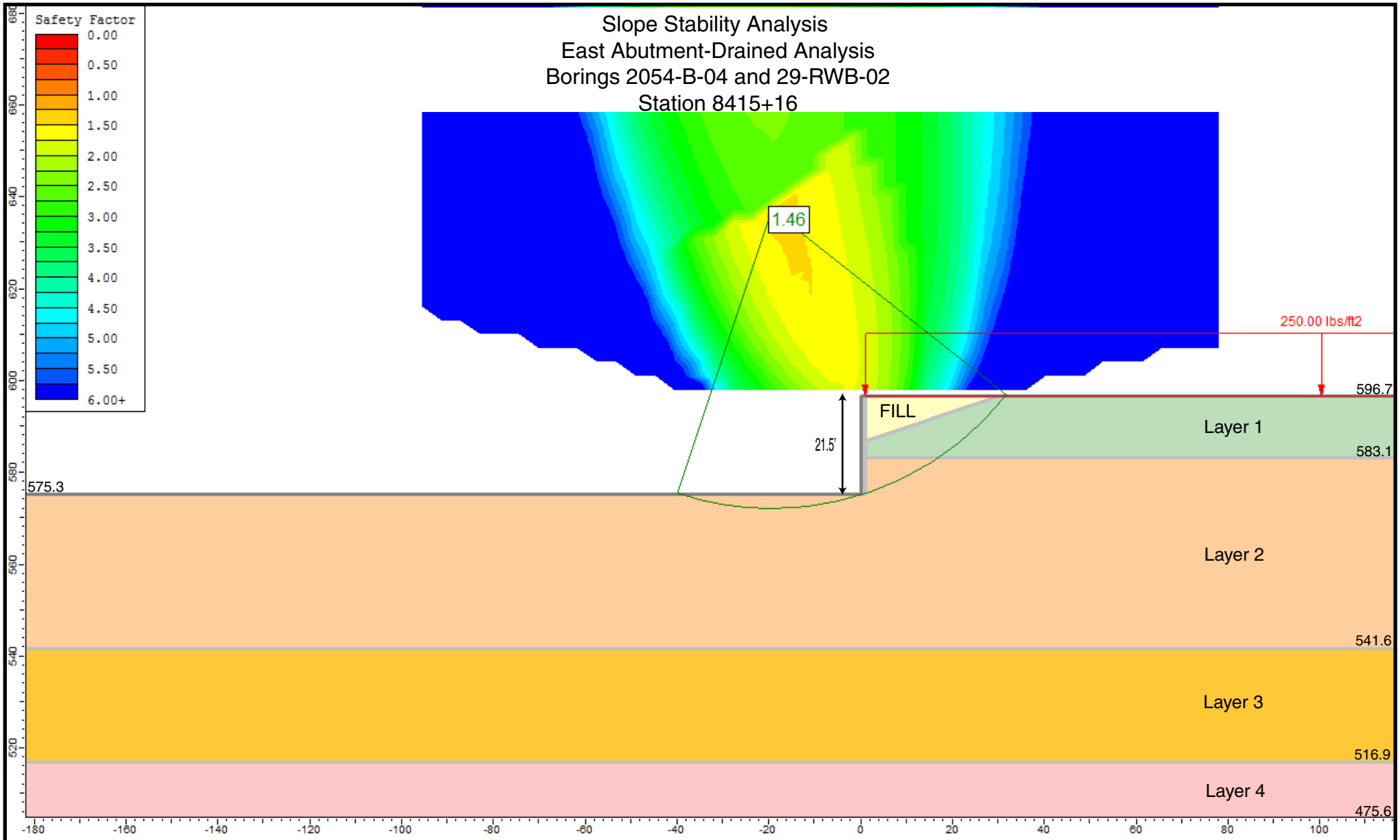

Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ (deg.)
FILL	New IDOT FILL	125	100	30
1	Loose to Dense SANDY LOAM FILL	115	0	31
2	V. Soft to M. Stiff CLAY to SILTY CLAY	110	50	30
3	Stiff to V. Stiff SILTY CLAY to SILTY CLAY LOAM	120	100	32
4	V. Dense SILT to SILTY LOAM	120	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRIDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-3** | DRAWN BY: A. Hamad | CHECKED BY: A. Kurnia

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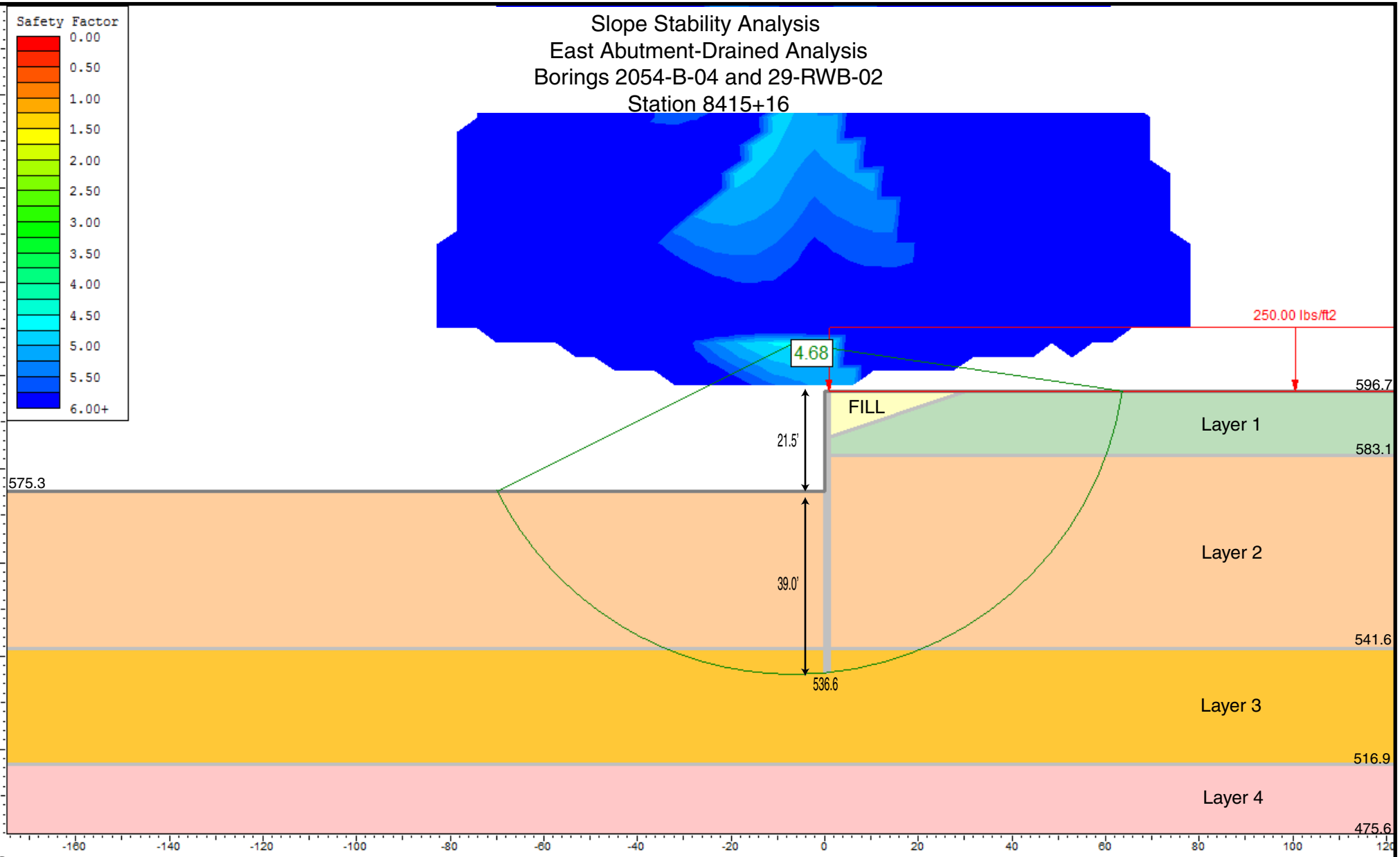
FOR AECOM | **1100-04-01**

Slope Stability Analysis
East Abutment-Drained Analysis
Borings 2054-B-04 and 29-RWB-02
Station 8415+16



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ (deg.)
FILL	New IDOT FILL	125	100	30
1	Loose to Dense SANDY LOAM FILL	115	0	31
2	V. Soft to M. Stiff CLAY to SILTY CLAY	110	50	30
3	Stiff to V. Stiff SILTY CLAY to SILTY CLAY LOAM	120	100	32
4	V. Dense SILT to SILTY LOAM	120	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRiDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-4** | DRAWN BY: A. Hamad, CHECKED BY: A. Kurnia

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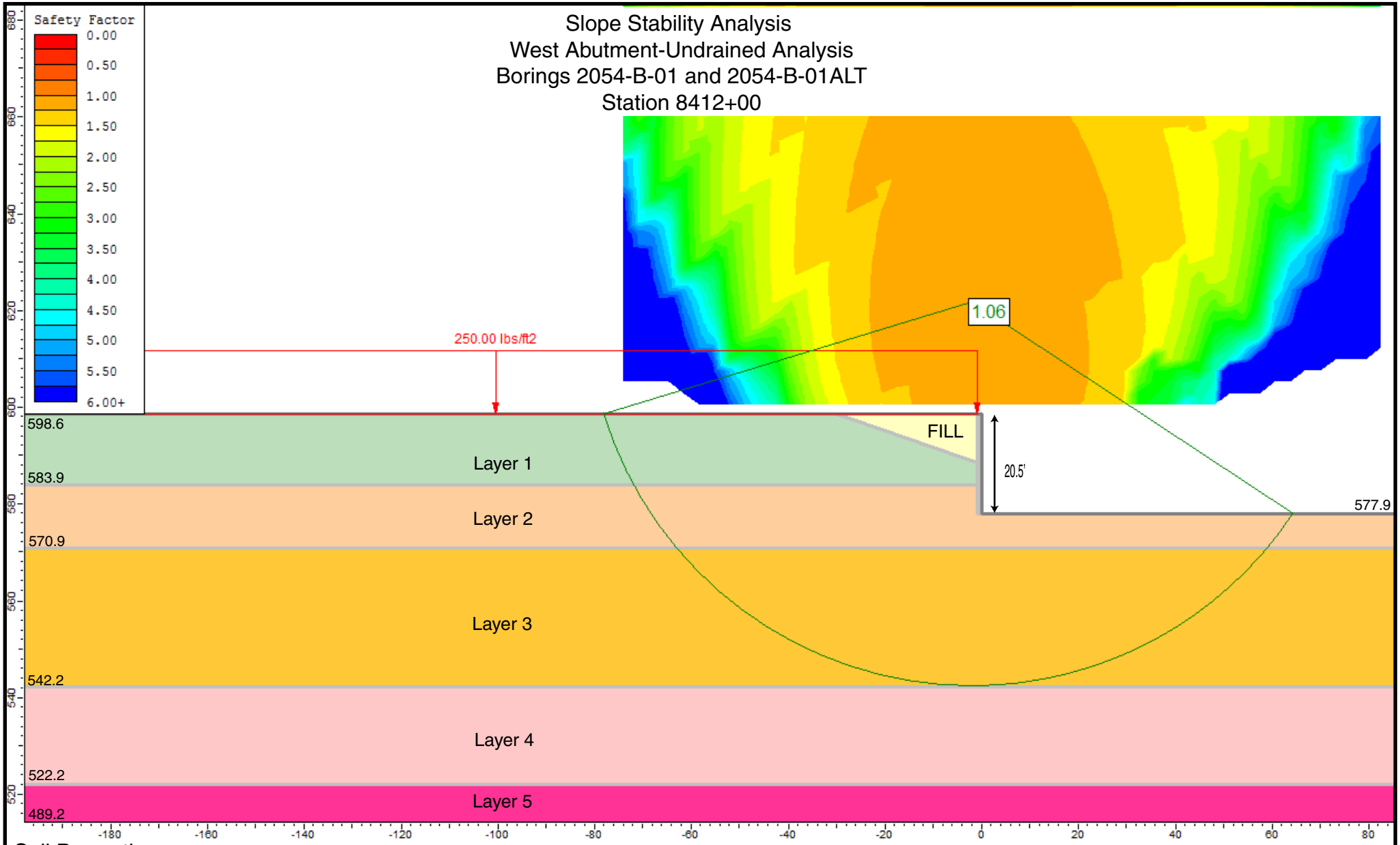
Slope Stability Analysis
West Abutment-Undrained Analysis
Borings 2054-B-01 and 2054-B-01ALT
Station 8412+00



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Undrained Parameter C_u (psf)	Undrained Parameter ϕ (deg.)
FILL	New IDOT FILL	125	1000	0
1	Loose to M.Dense SAND FILL	115	0	30
2	M. Stiff CLAY to SILTY CLAY	115	700	0
3	Soft to M.Stiff CLAY to SILTY CLAY	115	500	0
4	Stiff to V. Stiff SILTY CLAY	120	2000	0
5	Dense to V.Dense SANDY LOAM to GRAVELLY SAND	125	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRIDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-5** | DRAWN BY: A. Hamad | CHECKED BY: A. Kurnia

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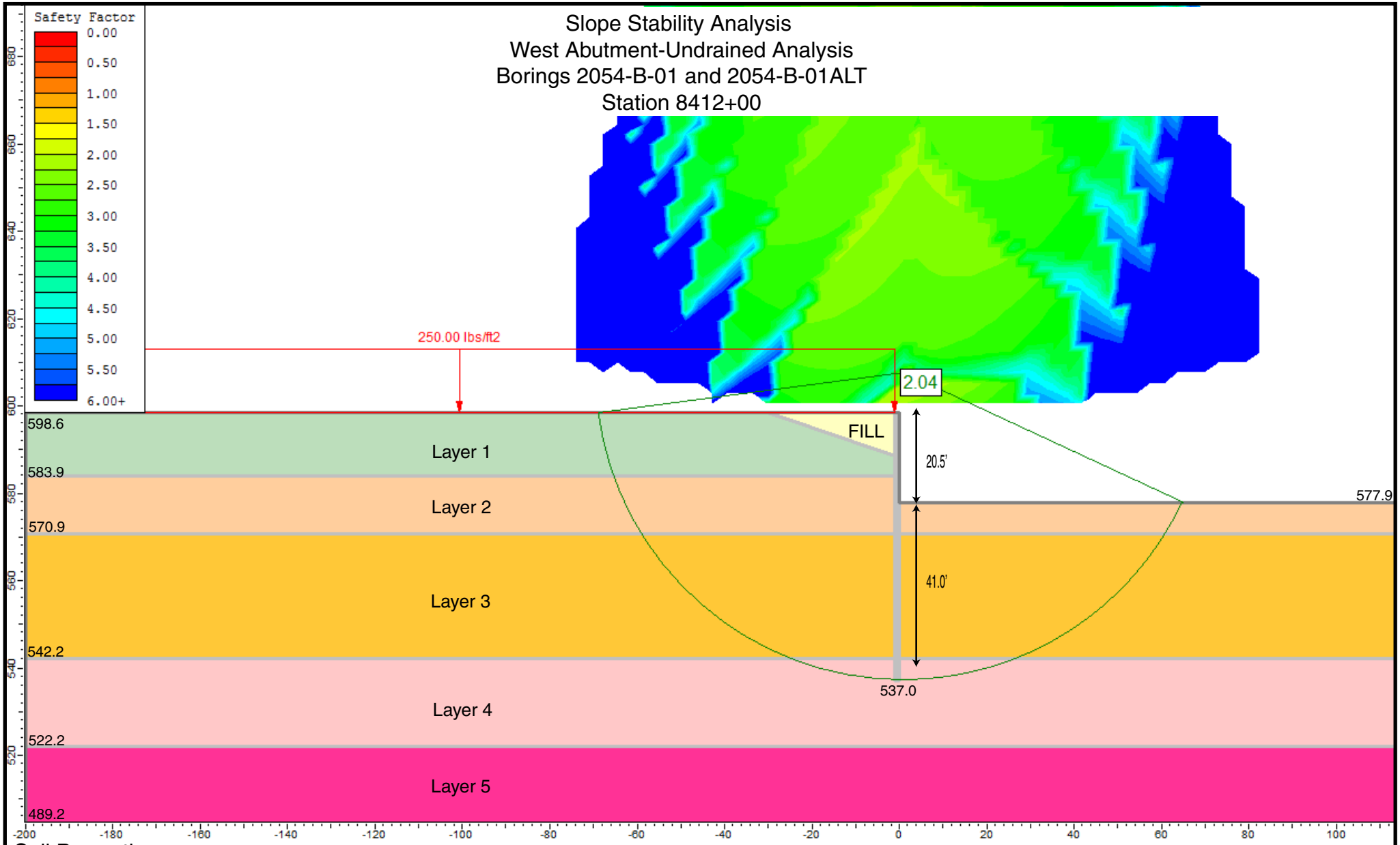
FOR AECOM | **1100-04-01**

Slope Stability Analysis
West Abutment-Undrained Analysis
Borings 2054-B-01 and 2054-B-01ALT
Station 8412+00



Soil Properties:

Layer ID	Soil Type	Unit Weight	Undrained Parameter	
		(pcf)	C_u (psf)	ϕ (deg.)
FILL	New IDOT FILL	125	1000	0
1	Loose to M.Dense SAND FILL	115	0	30
2	M. Stiff CLAY to SILTY CLAY	115	700	0
3	Soft to M.Stiff CLAY to SILTY CLAY	115	500	0
4	Stiff to V. Stiff SILTY CLAY	120	2000	0
5	Dense to V.Dense SANDY LOAM to GRAVELLY SAND	125	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRiDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-6** | DRAWN BY: A. Hamad, CHECKED BY: A. Kurnia

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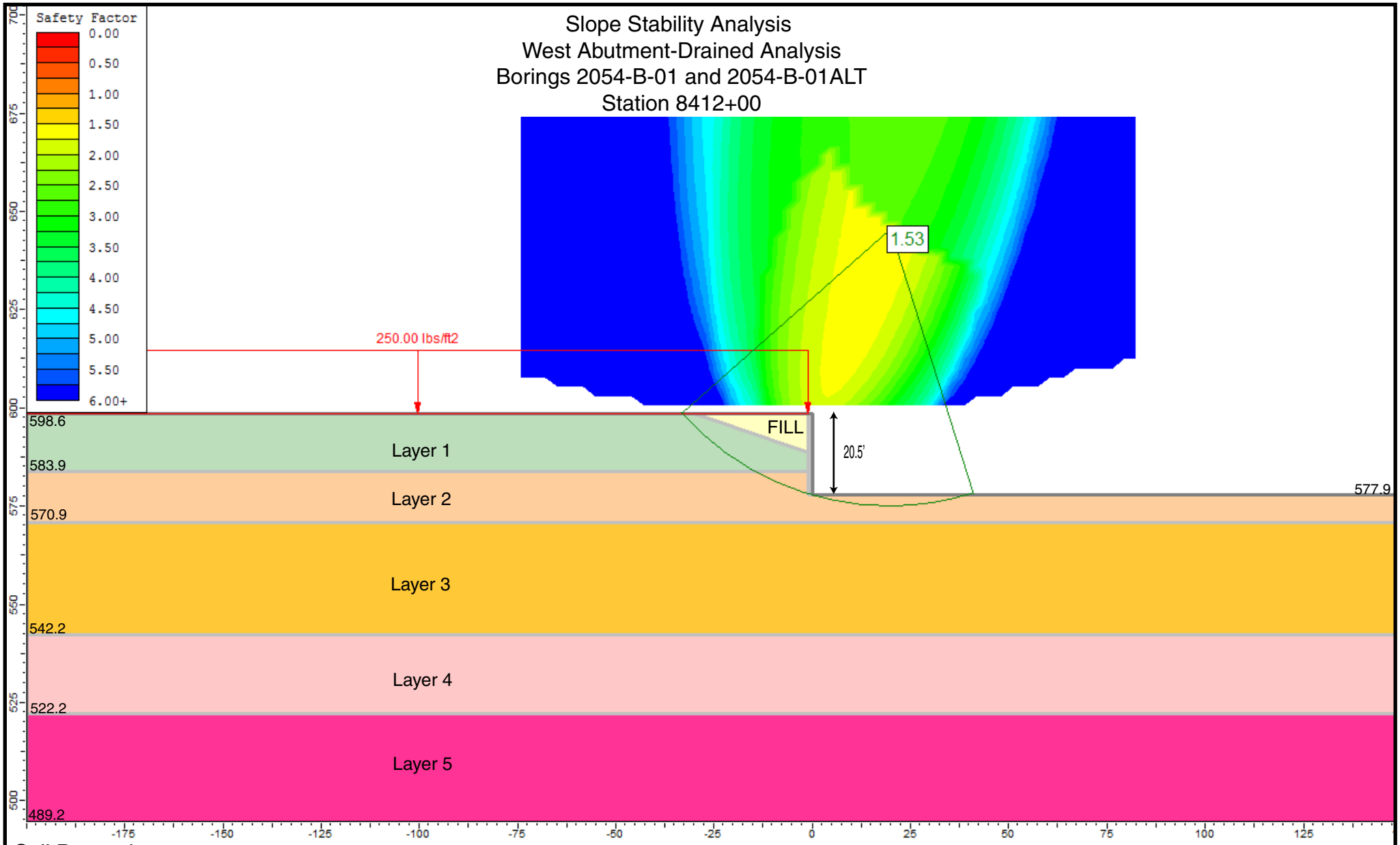
FOR AECOM | **1100-04-01**

Slope Stability Analysis
West Abutment-Drained Analysis
Borings 2054-B-01 and 2054-B-01ALT
Station 8412+00



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ (deg.)
FILL	New IDOT FILL	125	100	30
1	Loose to M.Dense SAND FILL	115	0	30
2	M. Stiff CLAY to SILTY CLAY	115	50	30
3	Soft to M.Stiff CLAY to SILTY CLAY	115	50	30
4	Stiff to V. Stiff SILTY CLAY	120	100	32
5	Dense to V.Dense SANDY LOAM to GRAVELLY SAND	125	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRIDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-7** | DRAWN BY: A. Hamad, CHECKED BY: A. Kurnia

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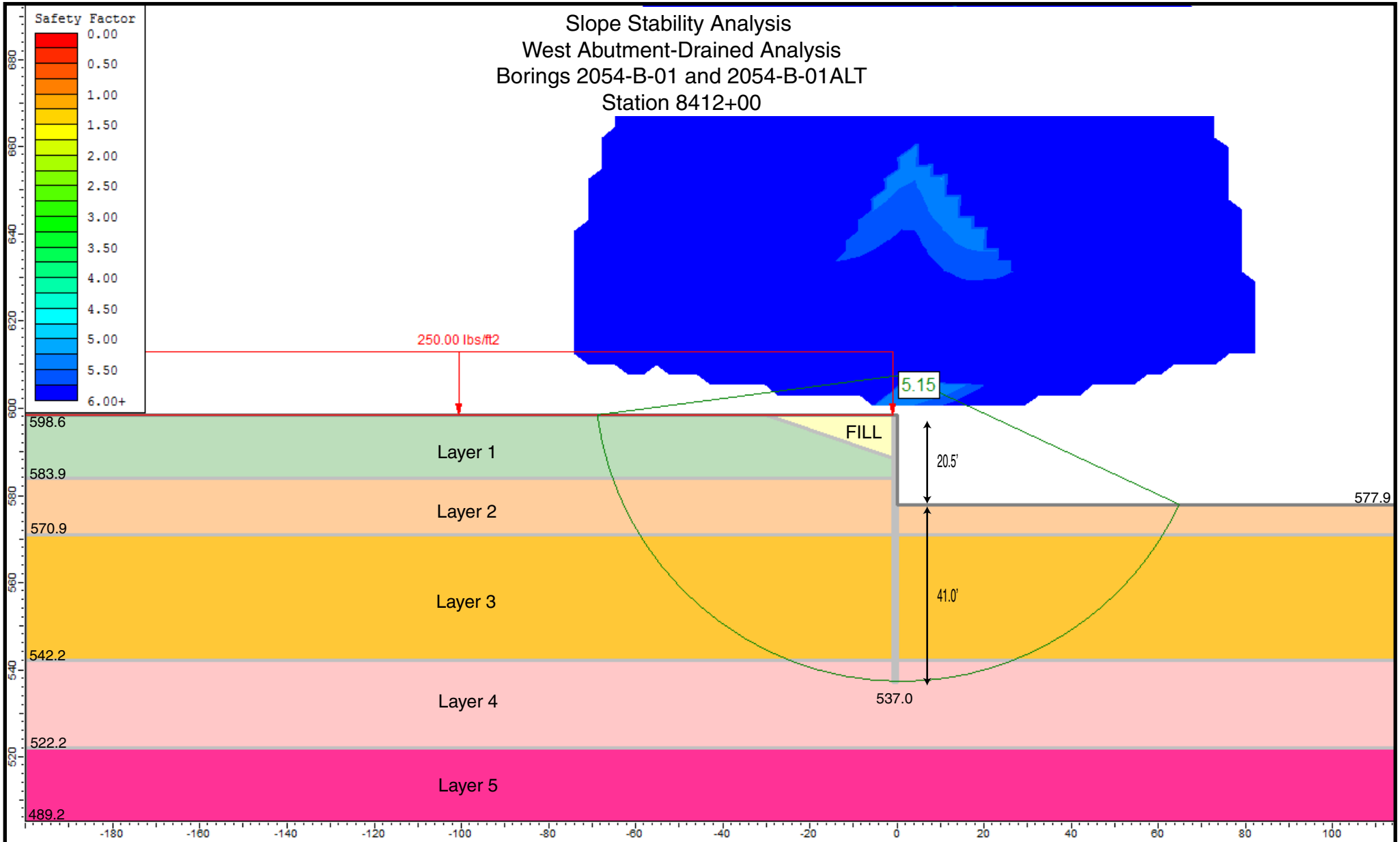
FOR AECOM | **1100-04-01**

Slope Stability Analysis
West Abutment-Drained Analysis
Borings 2054-B-01 and 2054-B-01ALT
Station 8412+00



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ (deg.)
FILL	New IDOT FILL	125	100	30
1	Loose to M.Dense SAND FILL	115	0	30
2	M. Stiff CLAY to SILTY CLAY	115	50	30
3	Soft to M.Stiff CLAY to SILTY CLAY	115	50	30
4	Stiff to V. Stiff SILTY CLAY	120	100	32
5	Dense to V.Dense SANDY LOAM to GRAVELLY SAND	125	0	36

SLOPE STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, MONROE BRiDGE (SN 016-1700), COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | **APPENDIX D-8** | DRAWN BY: A. Hamad | CHECKED BY: A. Kurnia

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FOR AECOM | **1100-04-01**

APPENDIX E

Wang Engineering

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Geotechnical Design Memorandum

To:	Amish Bhatt, S.E., P.E., Structural Engineer, Midwest Region, AECOM
From:	Andri A. Kurnia, P.E., Geotechnical Engineer
Date:	June 30, 2016
Subject:	Ground surface settlement of existing structures behind abutments
Project:	Circle Interchange – Monroe Bridge (SN016-1700), Chicago, IL
Wang No.	1100-04-01

Introduction

As requested by AECOM, Wang has performed analyses to evaluate the anticipated ground movement on buildings located close to the Monroe Bridge (SN016-1700) abutments.

Based on a preliminary TSL and information provided by AECOM, the existing abutments will be left in place and the proposed abutments will be constructed in front of the existing abutments. However, AECOM requested Wang to perform ground movement analyses assuming there are no existing abutments behind the new abutments.

The proposed abutments will be constructed as secant or tangent pile abutment walls. AECOM provided drawings showing the proposed abutment heights and the distances to the nearby structure (Appendix A). The information on the wall geometries and building locations relative to the new abutment is presented in Table 1.

Table 1: Summary of abutments height and the distance between the building and the abutment

Substructure	Abutment height (feet)	Nearby Building	Distance between abutment and building (feet)
West Abutment	21.25	Crown Plaza	41.67
East Abutment	22.50	Church	44.83

Wang has not received any information of foundation type and dimensions for the two nearby buildings.

Wang performed analyses to check the ground movements near buildings based on the following deflection criteria as follow:

1. Maximum abutment wall deflection of 0.5% of exposed height of abutment (IDOT criteria).
2. Maximum abutment deflection of 1 inch (CDOT criteria, Appendix B).

Our analyses show the maximum ground movement ranges from 0.1 to 0.2 inches for the 1 inch deflection criteria and ranges from 0.135 to 0.225 inches for the 0.5% deflection criteria. The results are summarized in Table 2. Ground movement evaluations are shown in Appendix C.

Table 2: Estimated Ground Movements

Substructure	Abutment Height (feet)	Distance to Building (feet)	Maximum Deflection Criteria (inch)	Estimated Maximum Ground Movement (in)
West Abutment	21.25	41.67 ft. to Crown Plaza	1.275 (0.5% of height)	0.255
			1.0	0.2
East Abutment	22.50	44.83 ft. to Church	1.35 (0.5% of height)	0.135
			1.0	0.1

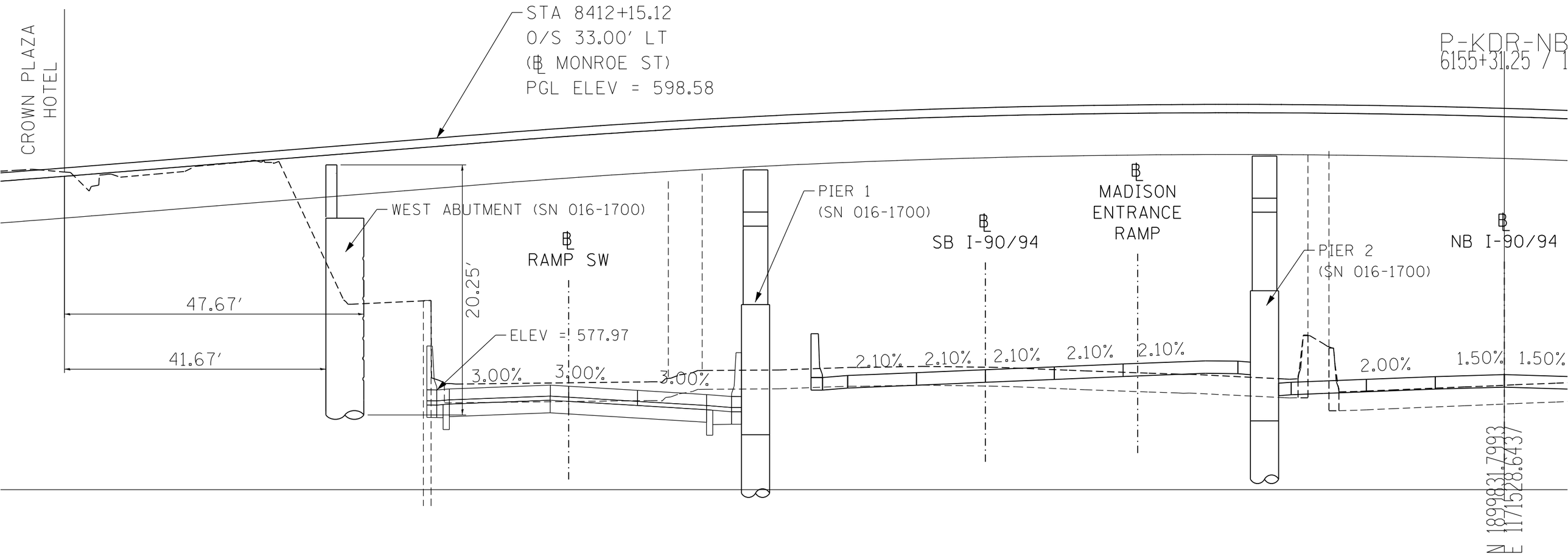
Since Wang is not involve in the construction stage, as precautionary, we recommend the contractor performs preconstruction surveys of the existing Crown Plaza and Church buildings to establish baseline conditions; provide ground survey and inclinometers between abutments and buildings to monitor movements during and after construction; and place wall instrumentation to monitor top of abutment defections.

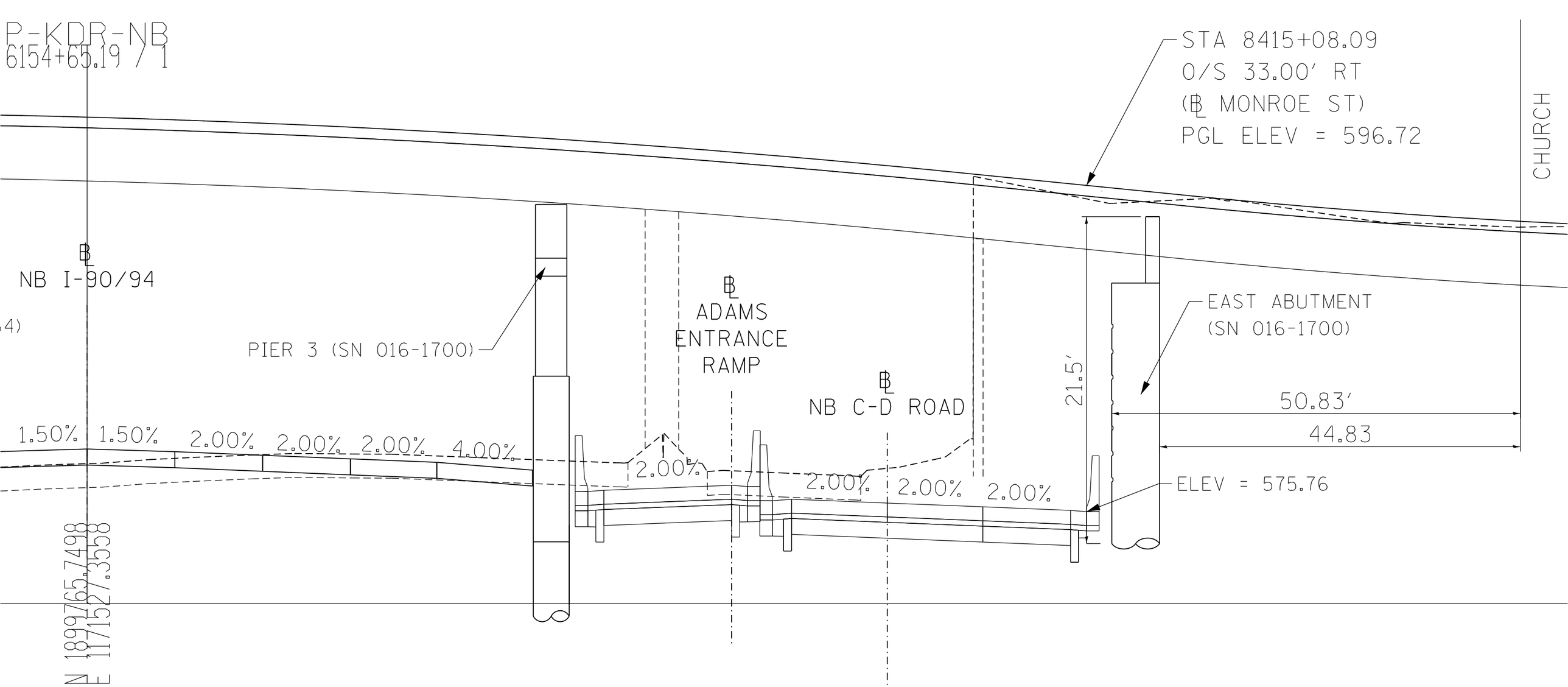
Attachments:

Appendix A - Abutment sections
Appendix B – Wall movement criteria
Appendix C - Ground movement evaluations

Copy To: Dan Manojlovski, AECOM
Corina Farez, Wang Engineering

APPENDIX A


CROWN PLAZA HOTEL
STA 8412+15.12
O/S 33.00' LT
(℄ MONROE ST)
PGL ELEV = 598.58
P-KDR-NB
6155+31.25
WEST ABUTMENT (SN 016-1700)
℄ RAMP SW
PIER 1
(SN 016-1700)
℄ SB I-90/94
℄ MADISON ENTRANCE RAMP
PIER 2
($N 016-1700)
℄ NB I-90/94
20.25'
47.67'
41.67'
ELEV = 577.97
3.00%
3.00%
3.00%
2.10%
2.10%
2.10%
2.10%
2.10%
2.00%
1.50%
1.50%
N 1899831.7993
E 1171528.6437


P-KDR-NB
6154+65.19 / 1
STA 8415+08.09
O/S 33.00' RT
(℄ MONROE ST)
PGL ELEV = 596.72
CHURCH
℄
NB I-90/94
PIER 3 (SN 016-1700)
℄
ADAMS
ENTRANCE
RAMP
℄
NB C-D ROAD
EAST ABUTMENT
(SN 016-1700)
21.5'
50.83'
44.83
ELEV = 575.76
1.50%
1.50%
2.00%
2.00%
2.00%
4.00%
2.00%
2.00%
2.00%
2.00%
N 1899765.7498
E 1171527.3538

APPENDIX B

CHICAGO DEPARTMENT OF TRANSPORTATION

CITY OF CHICAGO

Memorandum

To: CDOT Bridge Designers, Consultants, and Contractors

From: Luis D. Benitez, P.E., S.E. - Chief Bridge Engineer LDB

Subject: Deflection Criteria Policy for Soil Retention Systems

Date: April 13, 2016

All the following deflection requirements shall be met for soil retention systems in the City of Chicago unless specified otherwise.

- The maximum deflection of a permanent soil retention system shall be 1% H (of the retained height) but not greater than 1-inch.
- The maximum deflection of a temporary soil retention system shall be 1.5% H (of the retained height) but not greater than 2-inches.
- When the excavation (temporary or permanent) is within 1:1 (V:H) of an adjacent structure (i.e. bridge/building shallow foundation) the deflection of the Soil Retention System shall be limited to 1/4 inch.
- When the excavation (temporary or permanent) is within 1:1.5 (V:H) of an adjacent structure (i.e. bridge/building shallow foundation) the deflection of the Soil Retention System shall be limited to 1/2 inch.
- When the excavation (temporary or permanent) is within 1:2 (V:H) of an adjacent structure (i.e. bridge/building shallow foundation) the deflection of the Soil Retention System shall be limited to 1 inch.

Please contact Luis D. Benitez, P.E., S.E. at Luis.Benitez@CityofChicago.org or at (312) 744-5807 for any questions pertaining to this policy.

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APPENDIX C

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Lombard, Illinois 60148
Phone: (630)-953-9928

Date: 6/29/2016 Sheet: 1 of 5
Calculation By: A.kurnia Approved By: Ali Coring
Project Number: 1100-04-01 Client Name: AECOM
Project Name: Circle Interchange - Monroe Bridge

Ground Movement Estimate - Monroe Bridge.

Purpose: To estimate the surface ground movement at Crown plaza hotel and Church building located at NW and SE caner of Monroe Bridge induced by the movement of the proposed Monroe Bridge Abutments

References:
1) Clough, W. and O'Rourke, T. (1990) "Construction Induced movement of In-situ walls."
2) Ou, C.Y, Hsieh, P.G., and Chiou, D.C. (1993), "Characteristics of ground surface settlement during excavation." Canadian Geotechnical Journal, V.30, P.758-767
3) Wang, J. Xu, and Wang, W. (2005), "Wall and ground movements due to deep excavations in Shanghai soft soil", Journal of Geotech & Geoenviron. Engineering, V.136, P.985-994.

Assumptions:
1) Crown Plaza Building is 41.7 feet away from west Abutment (proposed)
2) Church Building is 44.8 feet away from East Abutment (proposed)
3) Maximum abutment height is 27.25 ft and 22.5 ft For West and East Abt, respectively
4) There is no existing abutment behind the proposed abutment

Notations:
δ_{hm} = Maximum lateral displacement of wall/abutment
δ_v = ground surface settlement
δ_{vm} = maximum ground surface settlement.

Design Criteria

1) Maximum δ_{hm} = 1.0 inch at top of wall (as per CDOT)

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Date: 6/29/2016 Sheet: 2 of 5
Calculation By: A. Kurnia Approved By: AR / Corina
Project Number: 1100-04-01 Client Name: AECOM
Project Name: Circle Interchange - Monroe Bridge

Evaluations:

A. For 1 Inch deflection Criteria

1) Crown Plaza Building (West Abutment)

From Figure 6.14 → Using a ratio $\delta_{um}/\delta_{um} = 1$ (Ref. 2)

Obtain $\delta_{um} = 1.0$ inch

Then, from Figure 11 → for $\frac{di}{H} = \frac{41.7}{21.25} = 1.96$, say 1.9 (Ref 3)

↳ Obtain $\frac{\delta_{VI}}{\delta_{um}} = 0.1$ (Clough and O'Rourke 1990) → Method 1

↳ Obtain $\frac{\delta_{VII}}{\delta_{um}} = 0.2$ (Kung, et.al 2006) → Method 2

$\therefore \delta_{VI} = 0.1 * 1" = 0.1"$

$\delta_{VII} = 0.2 * 1" = 0.2"$

2) Church Building (East Abutment)

$\frac{di}{H} = \frac{44.8}{22.5} = 1.99 \rightarrow$ Say 2.0

Similary → $\delta_{VI} = 0 * 1" = 0"$

$\delta_{VII} = 0.1 * 1" = 0.1"$

B. For 0.5% deflection criteria

Abutment Max deflection → West Abutment = 0.5% * 21.25' = 1.275 inches

East Abutment = 0.5% * 22.5' = 1.35 inches

1) Crown Plaza Building (West Abutment)

$\delta_{VI} = 0.1 * 1.275" = 0.1275"$

$\delta_{VII} = 0.2 * 1.275" = 0.255"$

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Phone: (630)-953-9928

Date: 6/29/2016 Sheet: 3 of 5
Calculation By: A. Kumia Approved By: AS / Corina
Project Number: 1100-04-01 Client Name: AECOM
Project Name: Circle Interchange - Monroe Bridge

2. Church Building (East Abutment)

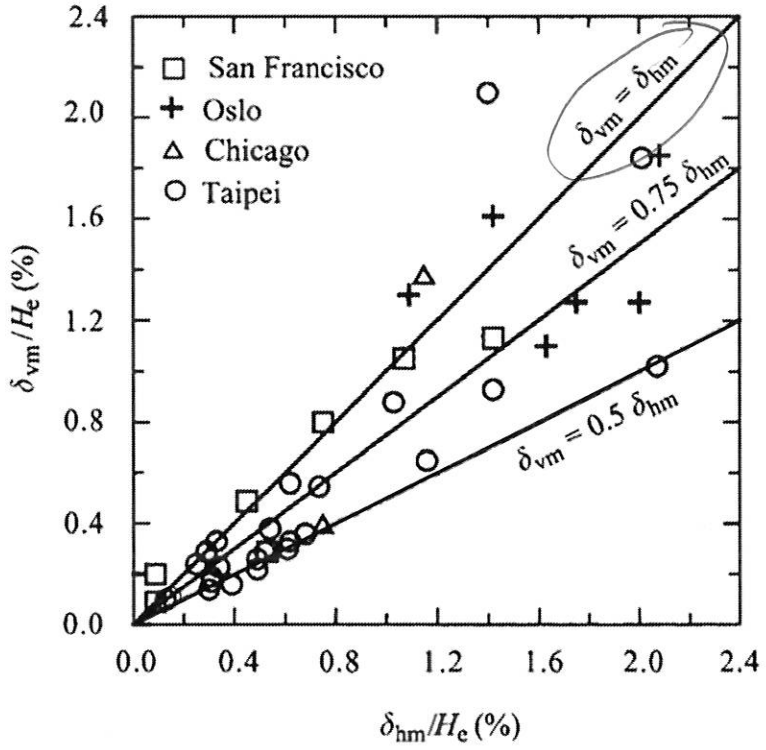
$\delta_{VI} = 0.0 * 1.35'' = 0$

$\delta_{VII} = 0.1 * 1.35'' = 0.135$

Conclusions :

Based on our evaluations, the maximum ground settlements of Crount Plaza and Church buildings ranges from 0.1 to 0.2 inches for 1 inch deflection criteria and ranges from 0.127" to 0.225 inches for 0.5% deflection criteria.

Ground Movement Estimates
Monroe Bridge



$\delta_{vm} = \delta_{hm}$ (conservative)

Figure 6.14 Maximum ground surface settlement and lateral wall deflection (Ou *et al.*, 1993).

Monroe Bridge Ground Movement Estimates

Crown Plaza $= \frac{d_1}{H} = \frac{41.7}{21.25} = 1.96$

Church Building $= \frac{d_1}{H} = \frac{44.8}{22.6} = 1.99$

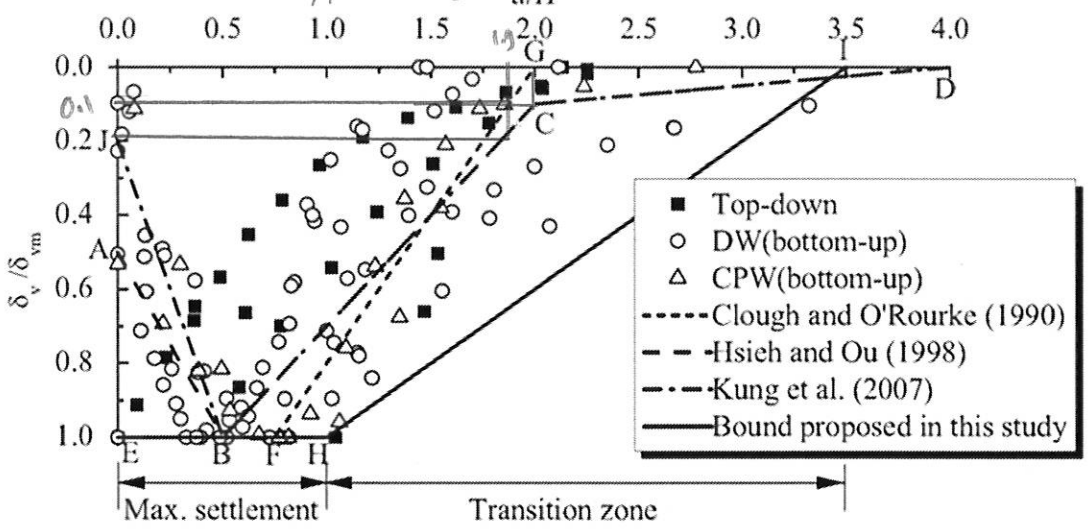


Fig. 11. Relationship between ground settlement normalized by maximum settlement and normalized distance from wall

Crown Plaza → $\frac{\delta vm}{\delta v} = 0.1$ (Clough and O'Rourke) - Method 1

→ $\frac{\delta vm}{\delta v} = 0.2$ (Kung et al 2007) - Method 2

Church Building → $\frac{\delta vm}{\delta v} = 0$ (method 1)

$\frac{\delta vm}{\delta v} = 0.1$ (method 2)