STRUCTURAL GEOTECHNICAL REPORT
20th STREET BRIDGE OVER FAP ROUTE 301 (US 20)
SN 101-0188
SECTION 4HBR
IDOT JOB P-92-056-04
WINNEBAGO COUNTY, ILLINOIS

for

McDonough Associates, Inc.

180 North Stetson Avenue, Suite 1500

Chicago, IL 60601

(312) 946-8600

submitted by

Wang Engineering, Inc.

1145 North Main Street

Lombard, IL 60148

(630) 953-9928

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7. Prepared by Wang Engineering, Inc. 1145 N Main Street Lombard, IL 60148	**Contributor(s)** Author: Samuel Sugiarto, P.E. QC/QA: Jerry W.H. Wang, PhD, P.E. PM: Corina T. Farez, P.E.	**Contact Phone Number** (630) 953-9928 ext 18
9. Prepared for McDonough Associates, Inc. 180 North Stetson Avenue Suite 1500 Chicago, IL 60601	**Design / Structural Engineer** Mirza G. Baig, M.E., P.E.	**Contact Phone Number** (312) 946-7188

10. Abstract

The existing 20th Street Bridge over US 20 (SN 101-0116) will be removed and replaced with a two-span structure with integral abutments and a pier. The new bridge (SN 101-0188) will be 11 feet wider than the existing in order to accommodate a proposed bike path. This report provides geotechnical recommendations for the design of the proposed bridge foundations and approach embankment.

In descending order, the general lithologic succession encountered in the borings includes: 1) soft to medium stiff sandy loam to silty loam; 2) medium stiff to very stiff silty clay to silty loam; and 3) loose to very dense sandy loam till with fine sand to sandy gravel interbeds. The bridge is not associated with a waterway, and therefore scour is not a concern. The site classifies in the Seismic Class D.

The approach embankments have total approximate heights of 25 feet or 3 feet higher than the existing embankment top elevations. The side and end slopes will be graded at 1:2 (V:H). External stability analyses show sufficient factors of safety. We estimate the consolidation settlement will be 0.4 inches.

The structures should be supported on driven piles. We provide pile tip elevations and lengths for various pile capacities using metal shell piles 14-inch diameter with 0.25- and 0.31-inch walls and H-piles 12x53 and 14x73. Geotechnical parameters for lateral pile analyses are also provided. Traffic will be detoured during construction; thus temporary support by means of sheet piling will not be required.

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

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McDONOUGH ASSOCIATES INC.

1.0 INTRODUCTION

This report presents the results of subsurface investigation, laboratory testing, and geotechnical evaluations for the proposed replacement of the 20th Street Bridge over US Route 20 (US 20) in Winnebago County, Illinois.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands a new two-span structure with integral abutments, and a pier is proposed to replace the existing structure. The back-to-back abutment bridge length will measure 208.3 feet with span lengths of 105.8 and 102.5 feet. The proposed out-to-out bridge width will measure 45.8 feet, which will allow for two 12.0-foot wide roadway, two 4.0-foot wide shoulders, two 1.6-foot wide rails and a 10.6-foot wide bike path. The proposed bridge grade elevation will be raised 3.6 feet from the existing bridge, and the west side of the bridge will be widened approximately 12 feet to accommodate the bike path, resulting in a maximum embankment height of 10 feet. The proposed north and south abutments will be moved back roughly 5 to 7 feet behind the existing abutments. The embankment side slopes, as well as the proposed concrete slope walls, will be at 1:2 (V:H). During bridge construction, traffic will be detoured, and the 20th Street will be closed to traffic.

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 new bridge foundations.

1.2 Existing Structure

The existing four-span 20th Street Bridge (SN 101-0116) was built in 1963. The substructures consist of pile bent abutments supported by concrete piles and piers supported by timber piles. The back-to-

back abutment measures 197.0 feet long, and the out-to-out bridge deck width is 33.8 feet

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project area is located in southeast of Winnebago County, south of the City of Rockford. On the USGS *Rockford South Quadrangle* map, the 20th Street Bridge over US 20 is located in the NE ¼, Section 12, Tier 43 North, Range 1 East. A *Site Location Map* is presented as Exhibit 1.

The following review of the 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, thus, to confirm the dependability and consistency of the present subsurface investigation results. For the study of the regional geologic framework, Wang considered the northwestern Illinois area in general and southeast of Winnebago County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

2.1 Physiography

Southern Winnebago County is part of the Rock River Hill Country characterized by subdued rolling hill-lands cut by river alluviated valleys (Leighton et al. 1948). The project area is located in the Rock River Valley upper terrace. At the 20th Street Bridge over US 20 level, the ground surface elevation ranges from 796 to 800 feet.

2.2 Surficial Cover

The surficial cover is made of Illinoian Episode deposits (Argyle facies of Winnebago Formation and Glasford Formation). The Argyle facies of the Winnebago Formation includes till deposits exceptionally sandy, pinkish, massive and calcareous, with thicknesses from few feet to as much as of 50 feet (Willman et al., 1975, Hansel, 1996). Underneath, the Glasford Formation includes tills, and intercalated gravel, sand, and silt outwash deposits, with 35 feet thickness in its typical section (Willman et al., 1975). The geotechnical characteristics of the Glasford Formation deposits consists of low moisture content, high blow counts and low compressibility (Bauer et al., 1991).

2.3 Bedrock

The bridge site is located in an area where elevations to the top of the bedrock may measure approximately 625 feet NGVD. The site is underlain by Ordovician bedrock, dolomites and shales of the Maquoketa Group and dolomites of the Galena Group (Stravers et al., 2006; Willman et al., 1975).

None of the borings reached the bedrock.

No underground mines are known in the area. The nearest quarry is located about 7.0 miles southeast of the project site.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed glacial till consisting of sandy loam tills (Winnebago Formation) underlain by intercalated layers of sandy gravel, sand and silt (Glassford Formation).

3.0 METHODS OF INVESTIGATION

The following section outlines the subsurface and laboratory investigations performed by IDOT.

3.1 Subsurface Investigation

The subsurface investigation was performed by IDOT in March and April of 2004. The investigation consists of five borings designated as Borings B-1a through B-5a. Borings B-3a and B-4a were drilled from the approached embankment near the existing north and south abutments. Borings B-1a, B-2a and B-5a were drilled from US 20 grade elevation, near the existing Pier 3, Pier 1, and Pier 2, respectively. The borings were terminated at depth ranging from 46.5 to 56.5 feet below ground surface (bgs).

Soils in Borings B-1b and B-2b were sampled at 2.5-foot intervals throughout. The *IDOT Boring Logs* (see Appendix A) include stations, offsets and elevations measured with respect to reference points on the existing structure. Wang adjusted the station, offset and elevation data to match the preliminary TSL plan. The boring location information is shown in *Wang Adjusted Boring Logs* (Appendix B) and the locations are shown in *Boring Location Plan* (Exhibit 3).

IDOT soil boring logs include visual-manual soil classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests, and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration. Groundwater observations were made during drilling operation.

3.2 Laboratory Testing

The boring logs show moisture content test results (AASHTO T 265) on cohesive soil. The soils are classified according to the IDH Soil Classification System. Laboratory test results are shown on the

boring logs (Appendices A and B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented on the attached boring logs (Appendices A and B) 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

In descending order, the general lithologic succession encountered in the borings includes: 1) soft to medium stiff sandy loam to silty loam; 2) medium stiff to very stiff silty clay to silty loam; and 3) loose to very dense sandy loam till with fine sand to sandy gravel interbeds.

(1) Soft to Medium Stiff Sandy Loam to Silty Loam.

Borings B-3a and B-4a which were drilled from 20th Street embankment have ground surface elevations roughly 20 to 22 feet higher than Borings B-1a, B-2a and B-5a. The embankment is likely to be man-made fill. IDOT boring logs describes the 20th Street embankment consists of soft to medium stiff, brown and black sandy loam to silty loam. The sandy loam to silty loam layer has Qu values ranging from 0.30 to 0.90 tsf, averaging 0.54 tsf; N-values of 3 to 37 blows/foot, averaging 8 blows/foot; and moisture content (MC) values of 9 to 18%, averaging 12%. In cohesive soils, low Qu values usually correspond to high moisture content. However, the recorded soil properties contradict with this relationsip due to the low percentage of clay content (less than 30% according to IDH classification). Our analyses consider it as loose granular soils.

(2) Medium Stiff to Very Stiff Silty Clay to Silty Loam.

Starting from elevation 780 to feet, the borings encountered 5- to 10-foot thick, medium stiff to very stiff, brown and black very stiff silty clay to silty loam. The soils have Qu values ranging from 0.70 to 2.70 tsf, averaging 1.15 tsf; N-values of 6 to 20 blows/foot, averaging 11 blows/foot; and MC values of 13 to 27%, averaging 21%. We consider them as cohesive.

(3) Loose to Very Dense Sandy Loam Till with Fine Sand to Sandy Gravel Interbeds.

Beneath the silty clay to silty loam layer, the borings encountered loose to very dense, brown sandy loam till with fine sand to sandy gravel interbeds to the boring termination depths. The soils have N-

values ranging from 5 to 100 blows/foot, averaging 34 blows/foot; Qu values of 0.40 to 6.70 tsf, averaging 2.00 tsf; and MC values of 6 to 16%, averaging 10%. Shear failure mode was recorded on the unconfined compressive strength tests. In general, we consider the soils as granular; but when N-values are greater than 30 blows/foot, and Qu values are greater than 3.0 tsf, we have considered the soils as hard till (IDOT 1999) in our engineering analyses.

4.2 Groundwater Conditions

Groundwater was encountered during drilling at elevations ranging from 751 to 761 feet. Upon drilling completion, no groundwater elevation was recorded. In our analyses, we consider groundwater table at 761 feet elevation.

4.3 Seismic Design Considerations

The soils within the top 100 feet have an average N-value of 25 blows/foot, classifying the site in Seismic Site Class D (AASHTO 2008; Method B). The project location belongs to Seismic Performance Zone 1. The seismic spectral acceleration parameters recommended for design in accordance with the 2008 *Interim Revisions* of the AASHTO *LRFD Design Specifications* are summarized in Table 1 (AASHTO 2008).

Table 1: Seismic Design Parameters for 20th Street over US 20

Spectral Acceleration Period (sec)	Spectral Acceleration Coefficient[1)] (% g)	Site Factors	Design Spectrum for Site Class D[2)] (% g)
0.0	PGA= 3.9	F_{pga}= 1.6	A_s= 6.3
0.2	S_1= 8.4	F_a= 1.6	S_{DS}= 13.4
1.0	S_2= 3.3	F_v= 2.4	S_{D1}= 7.9

1) Spectral acceleration coefficients based on Site Class B

2) $A_s = PGA*F_{pga}$; $S_{DS}= S_1*F_a$; $S_{D1}= S_2*F_v$

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. Shallow foundations and drilled shafts are not appropriate for the proposed integral abutments (IDOT 2012). The new integral abutment should be supported on driven piles.

For the proposed pier, either metal shell piles (MSP) or H-piles may be used. Shallow foundations are not recommended for the pier since the loose to medium dense sandy loam till underlying the pier does not provide sufficient bearing capacity. Wang does not recommend drilled shaft for the pier because the sandy loam till layer does not provide consistent bearing values. This situation will make it difficult to determine the bearing layer during construction.

5.1 Approach Embankments and Slabs

Wang has performed settlement and global stability analyses for the approach embankments and slabs based on the soil conditions encountered in the borings and preliminary geometry presented on the TSL plan.

5.1.1 Settlement

The estimated maximum fill height along the widened portion of the embankment is 10.0 feet. The consolidation settlement is mainly caused by the medium stiff to very stiff silty clay to silty loam (Layer 2, Section 4.1). Using soil consolidation parameters obtained from correlation to the measured moisture contents, we estimate the consolidation settlement of 0.4 inches. Therefore, we do not envision any long-term settlement concerns for construction of the approach slabs and downdrag load allowances will not be required for foundation piles (Section 5.2).

5.1.2 Global Stability

The global stability of the side and toe slopes was analyzed based on the soil profile described in Section 4.1 and the information provided in the preliminary TSL. The slopes for the proposed approach embankments are anticipated at 1:2, and the maximum slope height will be about 25.0 feet. The slopes require a minimum factor of safety (FOS) of 1.5. Global Stability analyses were performed with SLIDE 5.0, and evaluation exhibits are presented in Appendix C.

The majority of embankment consists of loose to very loose sand to sandy loam. Considering the

proposed concrete slope walls, shallow sloughing failures are not anticipated for the end slopes. Table 2 presents the summary of global stability analyses. The estimated FOSs meet the IDOT required FOS.

Table 2: Summary of Global Stability Evaluations

Structures	End/Side Slope	Condition of Soil Properties	Appendix #	Factor of Safety
South Abutment	End Slope	Undrained	C-1	1.6
	End Slope	Drained	C-2	1.5
	Side Slope	Undrained	C-3	1.7
	Side Slope	Drained	C-4	1.5
North Abutment	End Slope	Undrained	C-5	1.7
	End Slope	Drained	C-6	1.5
	Side Slope	Undrained	C-7	2.1
	Side Slope	Drained	C-8	1.5

5.2 Foundation Recommendation

5.2.1 Driven Piles

The preliminary factored loads on the substructures provided by McDonough Associates are shown in the Table 3.

Table 3: Preliminary Factored Loads for 45.8-Foot Wide

Substructures	Factored Loads
North and South Abutments	Vertical (P) = 1,990 Kips
	Horizontal (H) = 105 Kips
	Moment (M) = 780 Kips-feet
Pier	P = 4,500 Kips
	H = 410 Kips
	M = 3,350 Kips-feet

After a discussion with IDOT Bureau Bridge and Structure, the application of 14-inch diameter MSP to support the integral abutments is allowed in this structure. IDOT specifies the maximum nominal required bearing ($R_{N\,MAX}$) for each pile and states the factored resistance available (R_F) for steel H-piles

and MSP should be based on a geotechnical resistance factor (Φ_G) of 0.55 (AASHTO 2010; IDOT 2012). Nominal tip and side resistance were estimated using the empirical equations presented in *AGMU Memo 10.2* (IDOT 2012). The R_F estimates are governed by the relationship $R_F = \phi_G R_N - \phi_G(DD_R+S_C+L_{iq})I_G - (\gamma_p)(\lambda_{IS})DD$. There are no significant fill sections to be included in the design and the long-term consolidation settlement will be 0.4-inch; therefore we do not anticipate downdrag loads on the piles.

The R_F, R_N, estimated pile tip elevations, and lengths for 12x53 and 14x73 sizes H-piles and 12- and 14-inch diameter MSP with various wall thicknesses are summarized in Tables 4 through 8. We include the 12-inch diameter MSP lengths and resistances for abutments in case the abutment type is changed to stub abutment. The lengths shown in the tables include a 2-foot pile embedment and 3-foot pile encasement for the abutments. At the piers, the pile lengths only include 1-foot pile embedment. Wang recommend that both abutments and the pier be supported on 14-inch diameter MSPs with either 0.25-inch walls or 0.312-inch walls. Due to the dense granular material, the MSP should be fitted with conical shoes. The H-piles are less preferable because longer piles will be required. If H-piles are desired, the Designer should contact us to obtain pile length estimations at deeper depths. Pile tables generated by the *IDOT Pile Length Calculations* are presented in Appendix D.

Table 4: Estimated Pile Lengths and Tip Elevations for HP12x53 Steel H-Piles

Structure Unit	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment	793.5	225	0.0	0.0	124	54	741.5[1)]
Pier 1	773.3	145	0.0	0.0	80	45	729.3[1)]
North Abutment	790.7	255	0.0	0.0	140	42	750.7
		291	0.0	0.0	160	43	749.7
		327	0.0	0.0	180	46	746.7[1)]

1) At boring termination depth.

Table 5: Estimated Pile Lengths and Tip Elevations for HP14x73 Steel H-Piles

Structure Unit	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment	793.5	255	0.0	0.0	140	52	743.5
		273	0.0	0.0	150	54	741.5[1)]
Pier 1	773.3	145	0.0	0.0	80	43	731.3
		182	0.0	0.0	100	45	729.3[1)]
North Abutment	790.7	255	0.0	0.0	140	40	752.7
		291	0.0	0.0	160	41	751.7
		327	0.0	0.0	180	42	750.7[1)]

1) At boring termination depth.

Table 6: Estimated Pile Lengths and Tip Elevations for MSP 12-inch Diameter with 0.25-inch Wall

Structure Unit	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment	793.5	255	0.0	0.0	140	34	761.5
		291	0.0	0.0	160	36	759.5
		327	0.0	0.0	180	37	758.5
		355[1)]	0.0	0.0	195	38	757.5
Pier 1	773.3	182	0.0	0.0	100	23	751.3
		218	0.0	0.0	120	26	748.3
		255	0.0	0.0	140	39	735.3
		291	0.0	0.0	160	41	733.3
North Abutment	790.7	255	0.0	0.0	140	34	758.7
		291	0.0	0.0	160	35	757.7

Structure Unit	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
		327	0.0	0.0	180	36	756.7
		355[1)]	0.0	0.0	195	37	755.7

1) At the maximum nominal bearing ($R_{N\,max}$).

Table 7: Estimated Pile Lengths and Tip Elevations for MSP 14-inch Diameter with 0.25-inch Wall

Structure Unit	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment	793.5	255	0.0	0.0	140	30	765.5
		291	0.0	0.0	160	32	763.5
		327	0.0	0.0	180	34	761.5
		364	0.0	0.0	200	36	759.5
Pier 1	773.3	218	0.0	0.0	120	23	751.3
		255	0.0	0.0	140	25	749.3
		291	0.0	0.0	160	36	738.3
		327	0.0	0.0	180	41	733.3
North Abutment	790.7	255	0.0	0.0	140	32	760.7
		291	0.0	0.0	160	33	759.7
		327	0.0	0.0	180	34	758.7
		364	0.0	0.0	200	34	758.7

Table 8: Estimated Pile Lengths and Tip Elevations for MSP 14-inch Diameter with 0.312-inch Wall

Structure Unit	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment	793.5	327	0.0	0.0	180	34	761.5
		364	0.0	0.0	200	36	759.5
		400	0.0	0.0	220	38	757.5
Pier 1	773.3	327	0.0	0.0	180	41	733.3
		400	0.0	0.0	220	41	733.3
North Abutment	790.7	327	0.0	0.0	180	34	760.7
		364	0.0	0.0	200	34	759.7
		400	0.0	0.0	220	35	757.7

Due to the possible conflict with the existing pile foundations at the north abutment, the proposed piles should be carefully placed and the following note should be stated on plan drawings.

"Space proposed piles at the North Abutment to miss the existing piles."

5.2.2 Lateral Loading

Lateral loads on all piles and shafts should be analyzed for maximum moments and lateral deflections. Recommended lateral soil modulus parameters and soil strain parameters required for analysis via the p-y curve method are included in Table 9.

Table 9: Recommended Soil Parameters for Lateral Load Pile Analysis

Soil Type (Layer)	Total 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} (%)
Loose Sandy Loam to Silty Loam (1)	120	0	28	10	--
Medium Stiff to Very Stiff Silty Clay to Silty Loam (2)	120	1,000	0	300	0.8

Soil Type (Layer)	Total 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} (%)
Loose Sand to Sandy Loam (3)	120[1)]	0	29	10	--
Medium Dense Sand to Sandy Loam (3)	125[1)]	0	32	45	--
Dense Sand to Sandy Loam (3)	130[1)]	0	34	85	--
Very Dense Sand to Sandy Loam (3)	135[1)]	0	36	140	--
Hard Till (3)	130[1)]	0	33	60	--

1) The value should be deducted by 62.4 pcf for soils below groundwater level.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

All vegetation, surface topsoil, existing pavement, and debris should be cleared and stripped where approach embankment 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 6.4.

6.2 Stage Construction

We understand that traffic will be detoured during construction, thus the existing abutment removal will not require temporary retaining wall. Temporary excavation slopes along the embankment or at the pier should be graded no steeper than 1:2. The specific excavation geometry should be checked for stability prior to construction.

6.3 Excavation and Dewatering

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.

Groundwater was encountered at depths deeper than the base of the required excavations. We do not

anticipate any dewatering concerns for the required excavations. During times of heavy precipitation, any water allowed to accumulate in open excavations should be immediately removed by sump-pump.

No utility conflicts were identified that would impact the foundation design. However, the Contractor should ensure there are no utility conflicts with the final design and construction program.

6.4 Filling and Backfilling

Fill material to attain the final design elevations should be structural fill material. Coarse aggregate of IDOT gradation CA-6 or pre-approved, compacted, cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (IDOT 2012). The fill material should be free of organic matter and debris. The onsite clayey soils have plasticity too high to be considered for structural fill unless improvement measures (e.g., treatment with lime additive), are taken to lower the plasticity. Structural fill should be placed in lifts and compacted according to Section 205, *Embankment* (IDOT 2012).

All backfill materials must be pre-approved by the site engineer. To backfill the abutments and pier we recommend porous granular material, such as crushed stone or crushed gravel that conforms to the gradation requirements specified in IDOT Articles 1004.01 or 1004.05 (IDOT 2012). Backfill material should be placed and compacted in accordance with the Section 205, *Embankment* (IDOT 2012) and the IDOT *Bridge Manual* (IDOT 2012). Estimated design parameters for granular structural backfill materials are presented in Table 10.

Table 10: Estimated Granular Backfill Parameters

Soil Description	Porous Granular Material Backfill
Unit Weight	125 pcf
Angle of Effective Internal Friction	32°
Active Earth Pressure Coefficient	0.31
Passive Earth Pressure Coefficient	3.26
At-Rest Earth Pressure Coefficient	0.5

6.5 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.

6.6 Pile Installation

Driven piles shall be furnished and installed according to the requirements of Section 512, *Piling* (IDOT 2012) and steel piles shall be according to AASHTO M270, Grade 50. Wang recommends a minimum of one test pile be performed at each abutment and pier location. Test piles should be driven to 110 percent of the nominal required bearing indicated above in Tables 4 through 8 of Section 5.2.1. Due to anticipated hard driving conditions in Layer 3, we recommend the piles be driven with a metal shoe.

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 McDonough Associates, Inc. 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.

Samuel Sugiarto, P.E.
Geotechnical Engineer

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

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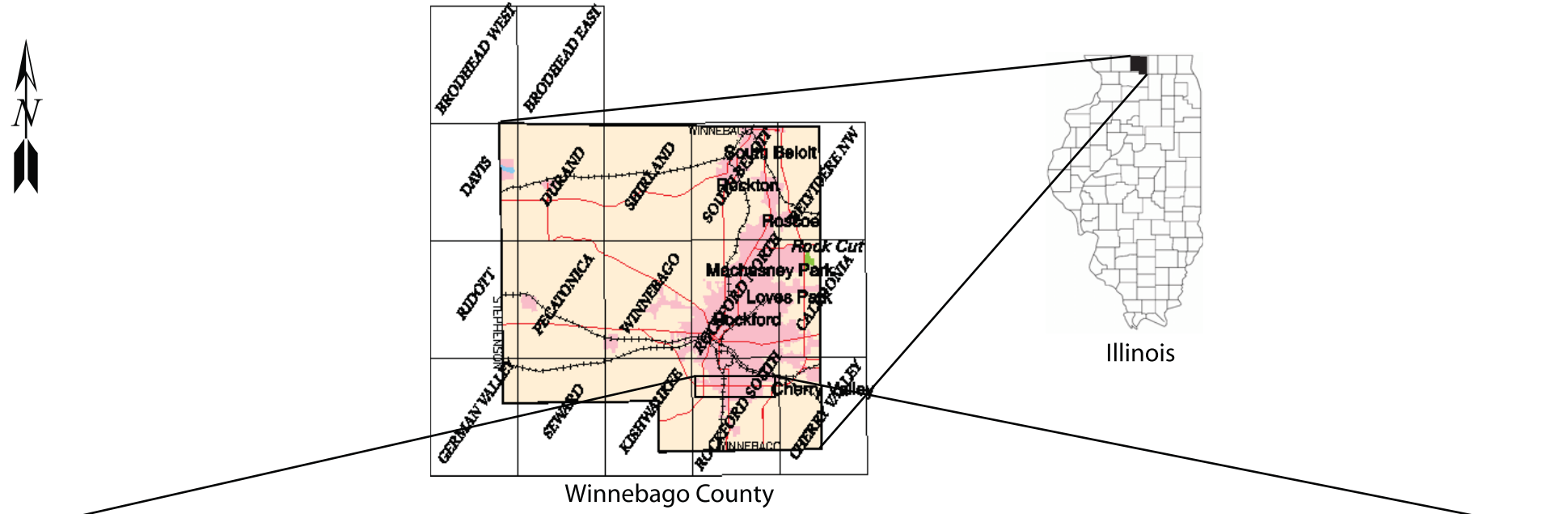
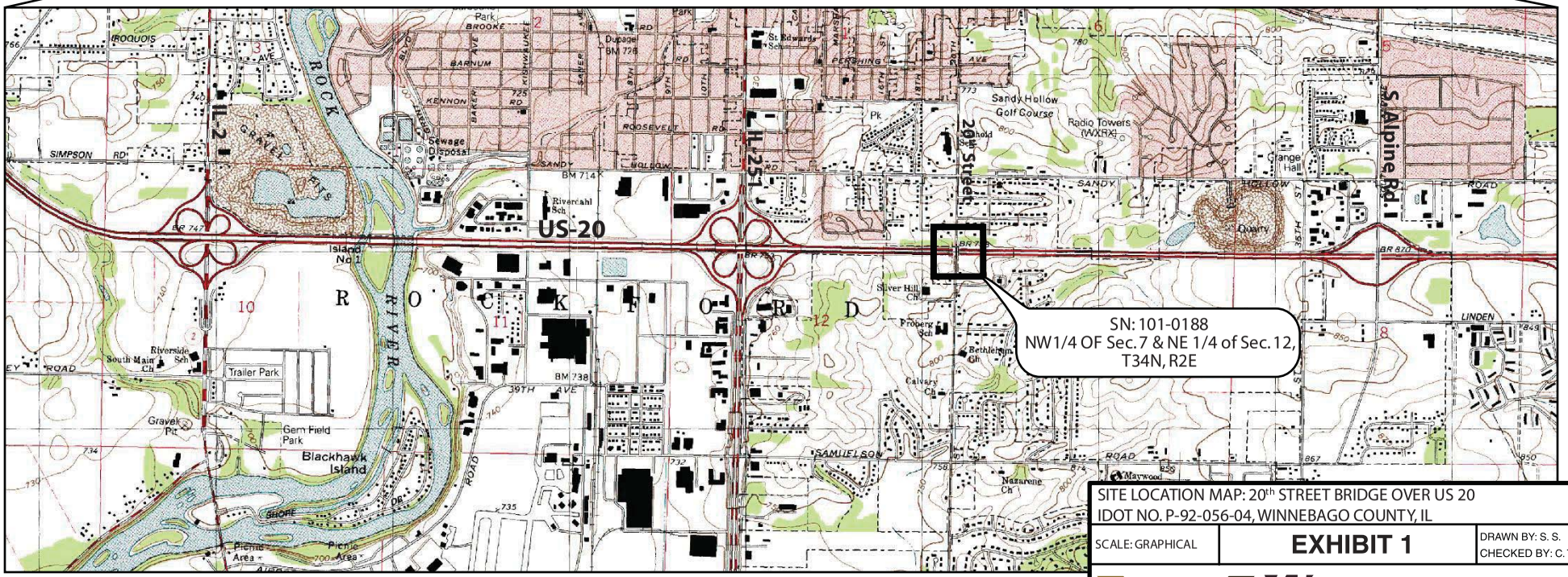
EXHIBITS





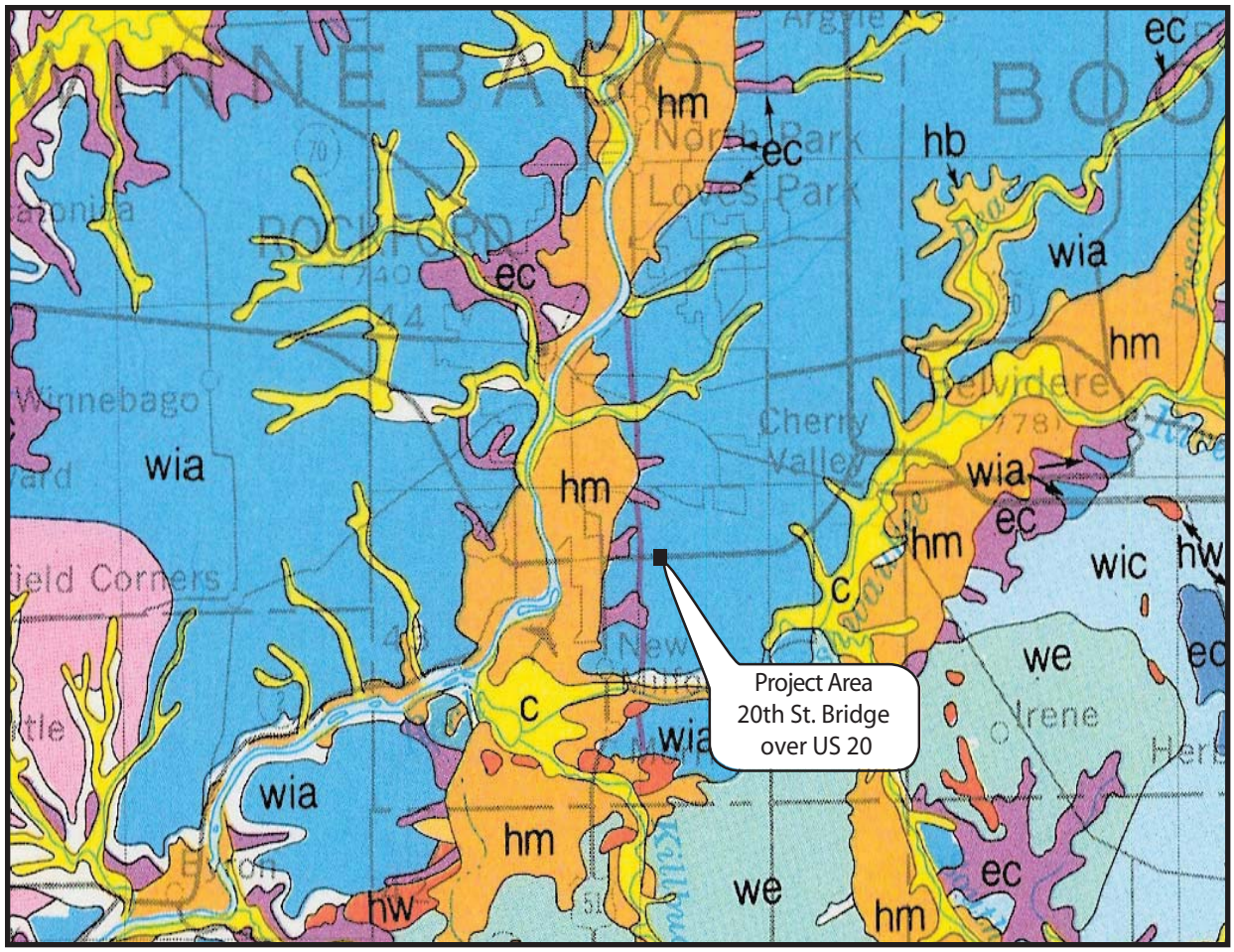
0.0 0.2 0.4 0.6 0.8 1.0 Miles

SITE LOCATION MAP: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: S. S. CHECKED BY: C. T. F.

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

FOR McDONOUGH ASSOCIATES, INC. **201-37-01**



LEGEND

Post Glacial Deposits

c — **Cahokia Alluvium,**
Deposits in floodplaines and channels of modern rivers and streams; mostly poorly sorted silt and sand, with local deposits of sandy gravel.

Glacial Cover

WISCONSIN EPISODE (75,000 - 10,000 Y.B.P.)

MASON GROUP

ec — **Equality Formation, Carmi Facies**
Largely quiet-water lake sediments; dominantly well bedded silt, locally laminated and containing thin beds of clay; local lenses of sand and sandy gravel along beaches.

hm — **Henry Formation, Mackinaw Facies**
Sand and gravel, generaly well sorted and evenly bedded; deposits in valleys; mostly glacial outwash in terraces -- remnants of valley trains; includes similar deposits in glacial sluiceways

hb — **Henry Formation, Batavia Facies**
Sand and gravel, well sorted; deposits in uplands; deposits of gracial meltwaterrivers and streams in outwash palins

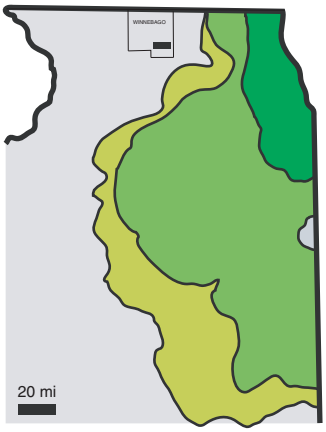
hw — **Lemont Formation**
Rockdale Moraine, Mostly gray to dark gray clayey till, locally silty clayey till; containes abundandt small pebbles, local lendes of silt and less commonly lenses of sand and gravel.

ILLINOIS EPISODE (180,000 - 125,000 Y.B.P.)

we — **Esmond Till Member**
Gray and calcareous, the upper part of the till is silty, and the lower part is more cleyey; rarely exceeds 25 feet thick.

wia — **Winnebago Formation, Argyle Till facies**
Exceptionally sandy, pinkish tan, masive, and calcareous till.

REGIONAL GEOLOGY



Wedron Group

- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

SITE AND REGIONAL GEOLOGY: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL	**EXHIBIT 2**	DRAWN BY: C.L.M. CHECKED BY: L.M.I.

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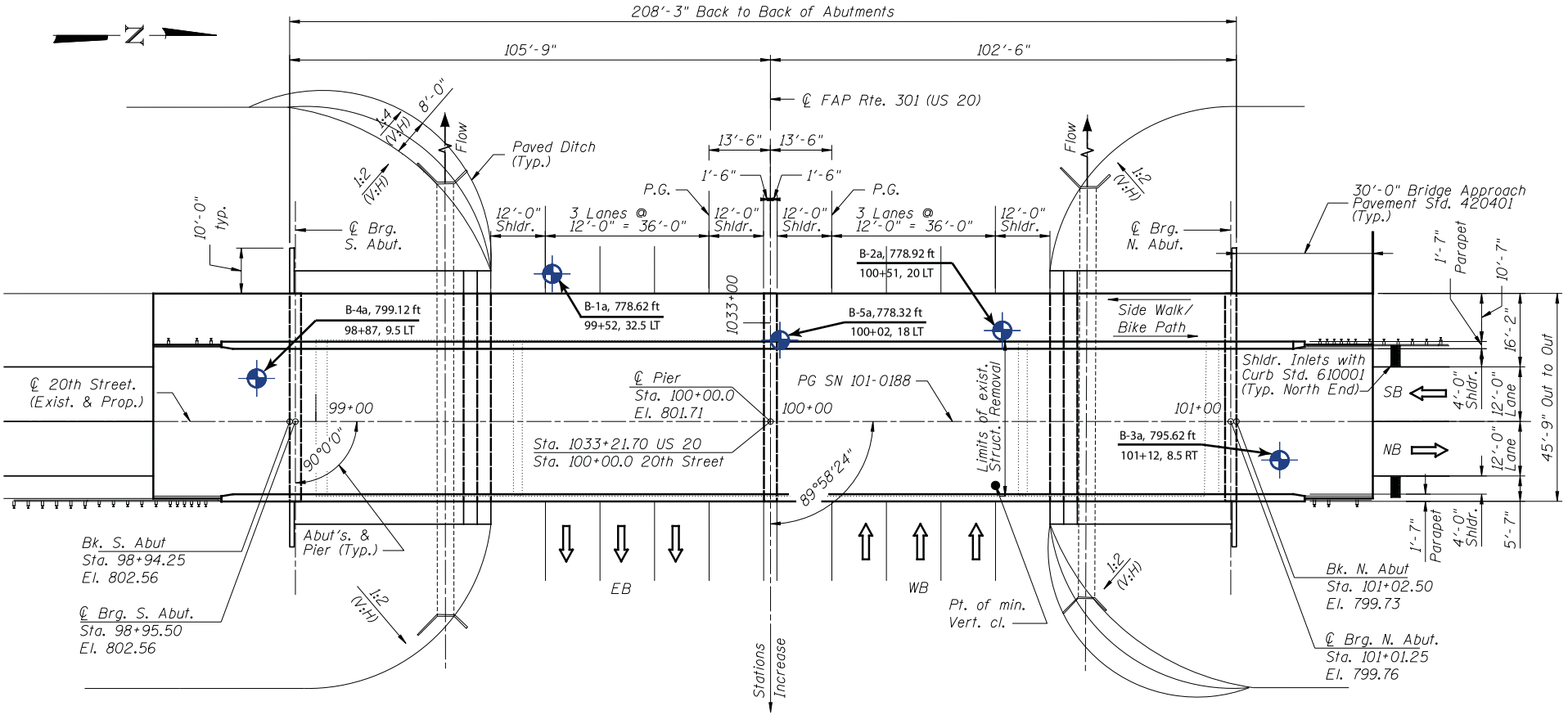

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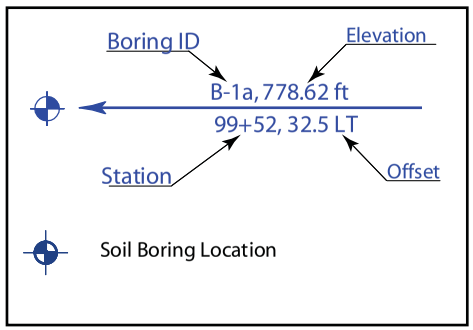

BORING LOCATION PLAN: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

EXHIBIT 3

DRAWN BY: A.A.K.
CHECKED BY: S.S.

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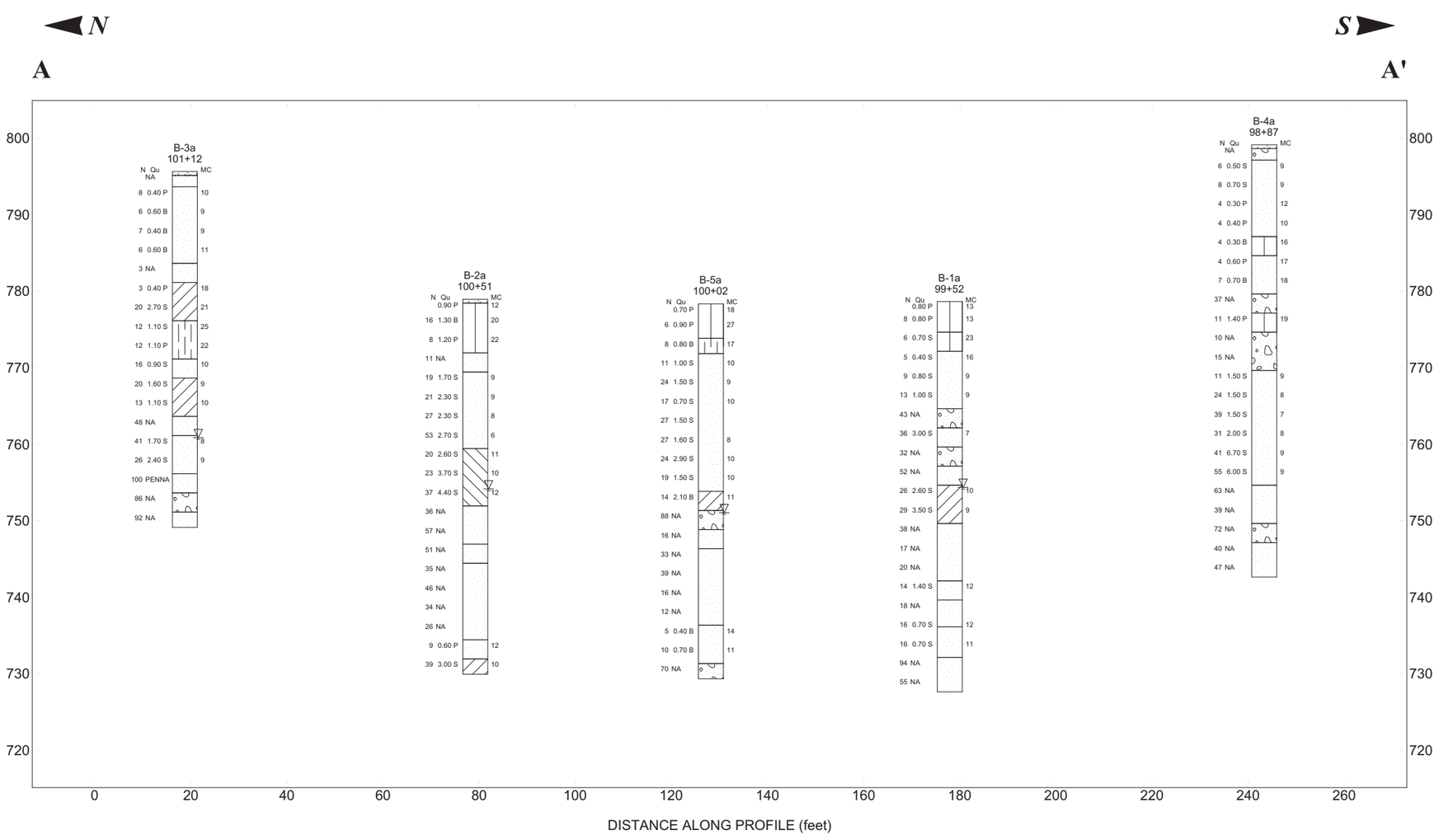
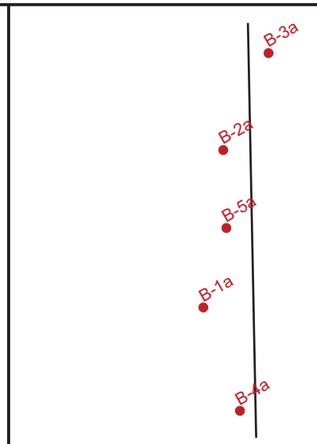
FOR McDONOUGH ASSOCIATES, INC.

201-37-01



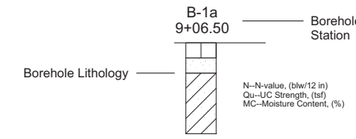
Lithology Graphics

- IDH Silt, Silty Loam
- IDH Sand, Sandy Loam
- Gravelly sand, sandy gravel
- IDH Sandy Clay, Sandy Clay Loam
- Pavement
- IDH Clay
- IDH Silty Clay, Silty Clay Loam



Site Map Scale 1 inch equals 95 feet

Explanation:



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

Horizontal Scale (feet)

Vertical Exaggeration: 1.5x

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

Section Name A-A'
Soil Profile

WEI SINCE 1982

20th St. over US 20
Winnebago County

JOB NUMBER	PLATE NUMBER
201-37-01	EXHIBIT 4

WEI 11X17 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/9/11

APPENDIX A

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 3/31/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th Street (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 594+32.73 on Bypass, 10+00 20th St.

BORING NO. B-1a
Station 10+48
Offset 32.50ft Rt CL 20th St.
Ground Surface Elev. 80.5 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 56.0 ft ▼
Upon Completion Wash ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
		0.8 P	13	MEDIUM black SILTY LOAM under ASPHALT shoulder
78.50				
	2 4 4	0.8 P	13	MEDIUM black SILTY LOAM with GRAVEL
77.00				
-5	2 3 3	0.7 S	23	MEDIUM brown SILTY LOAM with ORGANICS
74.50				
	3 2 3	0.4 S	16	SOFT tan SANDY LOAM with GRAVEL
72.00				
-10	3 4 5	0.8 S	9	MEDIUM tan SANDY LOAM with GRAVEL
69.50				
	2 5 8	1.0 S	9	Same as above
66.50				
-15	8 24 19			DENSE tan well-cemented SAND & GRAVEL
64.00				
	14 18 18	3.0 S	7	VERY STIFF tan SANDY LOAM TILL
61.50				
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	7 14 18			DENSE tan well-cemented SAND & GRAVEL *(continued)*
59.50				
	52 28 24			VERY DENSE tan fine grained SAND with LIMESTONE fragments
56.50				
▼ -25	13 13 13	2.6 S	10	VERY STIFF tan SANDY CLAY TILL
54.50				
	4 10 19	3.5 S	9	VERY STIFF tan SANDY CLAY TILL
51.50				
-30	11 17 21			DENSE tan fine grained SAND
49.50				
	17 4 13			MEDIUM tan fine grained SAND
47.00				
-35	7 10 10			MEDIUM tan fine grained SAND
44.00				
	5 6 8	1.4 S	12	Begin Wash STIFF tan SANDY LOAM TILL
41.50				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 3/31/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th Street (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 594+32.73 on Bypass, 10+00 20th St.

BORING NO. B-1a
Station 10+48
Offset 32.50ft Rt CL 20th St.
Ground Surface Elev. 80.5 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 56.0 ft ▼
Upon Completion Wash ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Wash MEDIUM tan fine grained SAND *(continued)*		5 9 9		
	39.00			
MEDIUM tan SANDY LOAM TILL		6 8 8	0.7 S	12
	37.00			
MEDIUM gray SANDY LOAM TILL	-45	2 2 14	0.7 S	11
	34.00			
VERY DENSE tan fine grained SAND with some LIMESTONE fragments		30 39 55		
	32.00			
VERY DENSE tan very fine grained SAND	-50	24 21 34		
	29.50			
End of Boring	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/1/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th Street (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 594+32.78 Bypass 20, 10+00 20th St.

BORING NO. B-2a
Station 9+49
Offset 20.00ft Rt CL 20th St.
Ground Surface Elev. 80.8 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 55.8 ft ▼
Upon Completion Wash ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
		0.9 P	12	Asphalt MEDIUM black SILTY LOAM
78.30				
	5 6 10	1.3 B	20	STIFF black/brown SILTY LOAM
76.80				
-5				
	2 3 5	1.2 P	22	STIFF brown SILTY LOAM
73.80				
	9 5 6			MEDIUM tan fine SAND
71.30				
-10				
	7 9 10	1.7 S	9	STIFF tan SANDY LOAM TILL
69.30				
	8 10 11	2.3 S	9	VERY STIFF tan SANDY LOAM TILL
66.80				
-15				
	8 12 15	2.3 S	8	Same as above
64.30				
	14 23 30	2.7 S	6	Same as above
61.80				
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	8 10 10	2.6 S	11	VERY STIFF tan SANDY CLAY TILL
59.30				
	11 9 14	3.7 S	10	Same as above
56.80				
▼-25				
	8 16 21	4.4 S	12	HARD tan SANDY CLAY TILL with SAND lenses
53.80				
	8 15 21			DENSE tan fine grained SAND
51.80				
-30				
	17 26 31			Begin Wash VERY DENSE tan fine grained SAND
49.30				
	23 26 25			VERY DENSE tan SAND with some GRAVEL
46.80				
-35				
	14 16 19			DENSE tan fine SAND
44.30				
	12 20 26			Wash Same as above
41.80				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/1/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th Street (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 594+32.78 Bypass 20, 10+00 20th St.

BORING NO. B-2a
Station 9+49
Offset 20.00ft Rt CL 20th St.
Ground Surface Elev. 80.8 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 55.8 ft ▼
Upon Completion Wash ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Wash DENSE tan coarse grained SAND		12 15 19		
39.30				
Wash MEDIUM tan fine SAND		10 12 14		
36.30	-45			
MEDIUM tan SANDY LOAM TILL		4 4 5	0.6 P	12
34.30				
VERY STIFF tan/pink SANDY CLAY TILL		7 15 24	3.0 S	10
31.80				
End of Boring	-50			
	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/5/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th Street (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 592+32.73 Bypass, 10+00 20th St.

BORING NO. B-3a
Station 8+88
Offset 8.50ft Lt CL 20th St.
Ground Surface Elev. 97.5 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 62.5 ft ▼
Upon Completion Dry ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Asphalt
				MEDIUM tan to brown SAND
95.50				
	1 3 5	0.4 P	10	SOFT brown SANDY LOAM
93.50				
-5				
	2 4 2	0.6 B	9	MEDIUM brown SANDY LOAM with GRAVEL
91.00				
	1 2 5	0.4 B	9	SOFT tan SANDY LOAM TILL
88.50				
-10				
	1 2 4	0.6 B	11	MEDIUM tan SANDY LOAM TILL
85.50				
	1 1 2			VERY LOOSE brown SAND
83.00				
-15				
	1 1 2	0.4 P	18	SOFT black SANDY LOAM TILL
81.00				
	4 8 12	2.7 S	21	VERY STIFF black SANDY LOAM
78.50				
-20				
	3 5 7	1.1 S	25	STIFF black SILTY CLAY
76.00				
	2 5 7	1.1 P	22	STIFF dark gray SILTY CLAY with some GRAVEL
73.50				
-25				
	3 6 10	0.9 S	10	MEDIUM tan SANDY LOAM with GRAVEL
71.00				
	7 9 11	1.6 S	9	STIFF tan/gray SANDY CLAY TILL
68.50				
-30				
	6 7 6	1.1 S	10	STIFF gray/tan SANDY CLAY TILL
65.50				
	13 23 25			DENSE tan fine SAND with LIMESTONE fragments
63.00				
▼-35				
	13 22 19	1.7 S	8	STIFF tan SANDY LOAM TILL with LIMESTONE fragments
61.00				
	6 12 14	2.4 S	9	VERY STIFF tan SANDY LOAM TILL
58.00				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/5/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th Street (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 592+32.73 Bypass, 10+00 20th St.

BORING NO. B-3a
Station 8+88
Offset 8.50ft Lt CL 20th St.
Ground Surface Elev. 97.5 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 62.5 ft ▼
Upon Completion Dry ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
VERY DENSE reddish/tan medium grained SAND		30 45 55		
	56.00	100/11" PEN		
VERY DENSE reddish/tan coarse SANDY GRAVEL		37 42 44		
	53.50			
	-45			
VERY DENSE tan fine grained SAND		29 38 54		
	51.00			
End of Boring				
	-50			
	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/21/04

ROUTE FA 301 **DESCRIPTION** P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th St. (IL 251) **LOGGED BY** C. Jenkins

SECTION 4 HB **LOCATION** Southwest Rockford - NE, **SEC.** 12, **TWP.** 43N, **RNG.** 1E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO.
Station 592+32.73 Bypass, 10+00 20th St.

BORING NO. B-4a
Station 11+13
Offset 9.50ft Rt CL
Ground Surface Elev. 101.0 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter None ft
Upon Completion Dry ft
After ____ **Hrs.** ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Asphalt
				MEDIUM tan SAND & GRAVEL
99.00				
	2			MEDIUM tan SANDY LOAM with
	2	0.5	9	GRAVEL
	4	S		
97.00				
-5				
	3			Same as above
	4	0.7	9	
	4	S		
94.50				
	1			SOFT tan SANDY LOAM
	2	0.3	12	
	2	P		
92.00				
-10				
	1			SOFT tan SANDY LOAM with
	2	0.4	10	some GRAVEL
	2	P		
89.50				
	1			SOFT gray/black SILTY LOAM
	2	0.3	16	with some GRAVEL
	2	B		
87.00				
-15				
	0			MEDIUM brown/gray SANDY SILT
	2	0.6	17	with some GRAVEL
	2	P		
84.50				
	1			MEDIUM brown SANDY LOAM
	3	0.7	18	
	4	B		
81.50				
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	3			DENSE brown SAND & GRAVEL
	8			
	29			
79.00				
	5			STIFF black SILTY LOAM
	4	1.4	19	
	7	P		
76.50				
-25				
	7			LOOSE tan SANDY GRAVEL
	5			
74.50	5			
	5			MEDIUM tan SANDY GRAVEL
	6			
	9			
71.50				
-30				
	3			STIFF tan/pink SANDY LOAM
	4	1.5	9	TILL
	7	S		
69.50				
	8			STIFF tan SANDY LOAM TILL
	10	1.5	8	
	14	S		
67.00				
-35				
	13			Same as above
	17	1.5	7	
	22	S		
64.50				
	16			Same as above
	14	2.0	8	
	17	S		
62.00				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/21/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th St. (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 592+32.73 Bypass, 10+00 20th St.

BORING NO. B-4a
Station 11+13
Offset 9.50ft Rt CL
Ground Surface Elev. 101.0 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter None ft
Upon Completion Dry ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
HARD tan SANDY LOAM TILL		12		
		17	6.7	9
	59.50	24	S	
Same as above		15		
		22	6.0	9
		33	S	
	56.50			
	-45			
VERY DENSE tan/gray fine SAND		11		
		22		
	54.50	41		
DENSE tan fine grained SAND		15		
		17		
	52.00	22		
	-50			
VERY DENSE tan/orange SANDY GRAVEL		20		
		34		
	49.50	38		
DENSE tan fine grained SAND		13		
		17		
	47.00	23		
	-55			
DENSE tan medium grained SAND		8		
		18		
	44.50	29		
End of Boring				
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/22/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th St. (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 594+32.78 Bypass 20, 10+00 20th St.

BORING NO. B-5a
Station 9+98
Offset 18.00ft Rt CL 20th St.
Ground Surface Elev. 80.2 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 52.7 ft ▼
Upon Completion Wash ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM brown SILTY LOAM			0.7 P	18
	77.70			
MEDIUM black SILTY LOAM		2 2 4	0.9 P	27
	76.20			
	-5			
MEDIUM brown SILTY CLAY		2 3 5	0.8 B	17
	73.70			
MEDIUM tan SANDY LOAM TILL with a SAND lens		3 5 6	1.0 S	10
	71.20			
	-10			
STIFF tan SANDY LOAM TILL		14 13 11	1.5 S	9
	68.70			
MEDIUM tan SANDY LOAM TILL		6 8 9	0.7 S	10
	66.20			
	-15			
STIFF tan SANDY LOAM TILL		11 11 16	1.5 S	
	63.70			
Same as above		9 12 15	1.6 S	8
	61.20			
	-20			
VERY STIFF tan SANDY LOAM TILL		8 10 14	2.9 S	10
	58.70			
MEDIUM tan SANDY LOAM TILL with a SAND lens		9 10 9	1.5 S	10
	56.20			
	-25			
VERY STIFF tan SANDY CLAY TILL		4 5 9	2.1 B	11
	53.20			
	▼			
VERY DENSE tan SAND & GRAVEL with LIMESTONE fragments		8 47 41		
	51.20			
	-30			
MEDIUM tan/orange medium to coarse grained SAND		4 6 10		
	48.70			
Begin Wash DENSE tan fine SAND		3 12 21		
	46.20			
	-35			
Same as above		11 16 23		
	43.70			
MEDIUM tan fine grained SAND		6 7 9		
	41.20			
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 4/22/04

ROUTE FA 301 DESCRIPTION P92-056-04 20th Street in Rockford over Bypass 20, 3/4 m. E. of 11th St. (IL 251) LOGGED BY C. Jenkins

SECTION 4 HB LOCATION Southwest Rockford - NE, SEC. 12, TWP. 43N, RNG. 1E

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO.
Station 594+32.78 Bypass 20, 10+00 20th St.

BORING NO. B-5a
Station 9+98
Offset 18.00ft Rt CL 20th St.
Ground Surface Elev. 80.2 ft

Surface Water Elev. None ft
Stream Bed Elev. None ft

Groundwater Elev.:
First Encounter 52.7 ft ▼
Upon Completion Wash ft
After ____ Hrs. ____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
MEDIUM tan fine SAND		4 5 7		
38.20				
SOFT tan SANDY LOAM TILL		2 1 4	0.4 B	14
36.20				
	-45			
MEDIUM tan SANDY LOAM TILL		1 1 9	0.7 B	11
33.20				
VERY DENSE tan SAND & GRAVEL		29 33 37		
31.20				
End of Boring				
	-50			
	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

APPENDIX B

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

BORING LOG B-1a

WEI Job No.: 201-37-01

Client **McDonough and Associates**
Project **20th St. over US 20**
Location **Winnebago County**

Datum: NGVD
Elevation: 778.62 ft
North: ft
East: ft
Station: 99+52
Offset: 32.5 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 stiff, black SILTY LOAM under ASPHALT shoulder with GRAVEL			1		0.80 P	13
					2	2 4 4	0.80 P	13
	774.6							
		Medium stiff, brown SILTY LOAM with ORGANICS	5		3	2 3 3	0.70 S	23
	772.1							
		Soft to medium stiff, tan SANDY LOAM with GRAVEL			4	3 2 3	0.40 S	16
			10		5	3 4 5	0.80 S	9
					6	2 5 8	1.00 S	9
	764.6							
		Dense, tan, well-cemented SAND and GRAVEL	15		7	8 24 19		
	762.1							
		Very stiff, tan SANDY LOAM TILL			8	14 18 18	3.00 S	7
	759.6							
		Dense, tan, well-cemented SAND and GRAVEL	20		9	7 14 18		
	757.1							
		Very dense, tan, fine grained SAND with LIMESTONE fragments			10	52 28 24		
	754.6							
		Very stiff, tan SANDY CLAY TILL	25					
	749.6							
		Medium dense to dense, tan, fine grained SAND	30		13	11 17 21		
					14	17 4 13		
			35		15	7 10 10		
	742.1							
		Very stiff, tan SANDY LOAM TILL			16	5 6 8	1.40 S	12
	739.6							
		Medium dense, tan, fine grained SAND	40		17	5 9 9		
	736.1							
		Medium stiff, tan SANDY LOAM TILL			18	6 8 8	0.70 S	12
			45		19	2 2 14	0.70 S	11
	732.1							
		Very dense, tan, very, fine grained SAND with some LIMESTONE fragments			20	30 39 55		
			50					

GENERAL NOTES

Begin Drilling **03-31-2004** Complete Drilling **03-31-2004**
Drilling Contractor **IDOT** Drill Rig **CME-45 Automatic**
Driller Logger **C. Jenkins** Checked by
Drilling Method **HSA**

WATER LEVEL DATA

While Drilling ▽ **24.50 ft**
At Completion of Drilling ▼ **WASH**
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 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

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

BORING LOG B-1a

WEI Job No.: 201-37-01

Client **McDonough and Associates**
Project **20th St. over US 20**
Location **Winnebago County**

Datum: NGVD
Elevation: 778.62 ft
North: ft
East: ft
Station: 99+52
Offset: 32.5 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	727.6	Boring terminated at 51.00 ft			21	24 21 34		
			55					
			60					
			65					
			70					
			75					

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

GENERAL NOTES

Begin Drilling **03-31-2004** Complete Drilling **03-31-2004**
Drilling Contractor **IDOT** Drill Rig **CME-45 Automatic**
Driller Logger **C. Jenkins** Checked by
Drilling Method **HSA**

WATER LEVEL DATA

While Drilling ▽ **24.50 ft**
At Completion of Drilling ▼ **WASH**
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 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

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

BORING LOG B-2a

WEI Job No.: 201-37-01

Client **McDonough and Associates**
Project **20th St. over US 20**
Location **Winnebago County**

Datum: NGVD
Elevation: 778.92 ft
North: ft
East: ft
Station: 100+51
Offset: 20.0 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	778.4	6-inch thick ASPHALT --PAVEMENT--						
		Medium stiff to stiff, black/brown SILTY LOAM			1		0.90 P	12
					2	5 6 10	1.30 B	20
			5		3	2 3 5	1.20 P	22
	771.9	Medium dense, fine SAND			4	9 5 6		
	769.4	Stiff to very stiff, tan SANDY LOAM TILL	10		5	7 9 10	1.70 S	9
					6	8 10 11	2.30 S	9
			15		7	8 12 15	2.30 S	8
					8	14 23 30	2.70 S	6
	759.4	Very stiff to hard, tan SANDY CLAY TILL with SAND lenses	20		9	8 10 10	2.60 S	11
					10	11 9 14	3.70 S	10
			25 ▽					
					11	8 16 21	4.40 S	12
	751.9	Dense to very dense, tan, fine grained SAND						
					12	8 15 21		
			30		13	17 26 31		
	746.9	Very dense, tan SAND with some GRAVEL			14	23 26 25		
	744.4	Medium dense to dense, tan, fine to coarse grained SAND	35		15	14 16 19		
					16	12 20 26		
			40		17	12 15 19		
					18	10 12 14		
	734.4	Medium stiff, tan SANDY LOAM TILL	45		19	4 4 5	0.60 P	12
	731.9	Very stiff, tan/pink SANDY CLAY TILL			20	7 15 24	3.00 S	10
	729.9	Boring terminated at 49.00 ft	50					

GENERAL NOTES

Begin Drilling **04-01-2004** Complete Drilling **04-01-2004**
Drilling Contractor **IDOT** Drill Rig **CME-45 Automatic**
Driller Logger **C. Jenkins** Checked by
Drilling Method **HSA**

WATER LEVEL DATA

While Drilling ▽ **25.00 ft**
At Completion of Drilling ▼ **WASH**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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WANGENGINC 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

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

BORING LOG B-3a

WEI Job No.: 201-37-01

Client: **McDonough and Associates**
Project: **20th St. over US 20**
Location: **Winnebago County**

Datum: NGVD
Elevation: 795.62 ft
North: ft
East: ft
Station: 101+12
Offset: 8.5 RT

Depth (ft)	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	795.1	6-inch thick ASPHALT --PAVEMENT--					
		Medium dense, tan to brown SAND		1			
	793.6	Soft to medium stiff, tan, brown SANDY LOAM TILL with GRAVEL		2	1 3 5	0.40 P	10
5				3	2 4 2	0.60 B	9
				4	1 2 5	0.40 B	9
10				5	1 2 4	0.60 B	11
	783.6	Very loose, brown SAND		6	1 1 2		
	781.1	Soft to very stiff, black SANDY LOAM TILL		7	1 1 2	0.40 P	18
15				8	4 8 12	2.70 S	21
	776.1	Stiff, black to dark gray SILTY CLAY with some GRAVEL		9	3 5 7	1.10 S	25
20				10	2 5 7	1.10 P	22
	771.1	Medium dense, tan SANDY					
25							
		LOAM with GRAVEL		11	3 6 10	0.90 S	10
	768.6	Stiff, gray/tan SANDY CLAY TILL		12	7 9 11	1.60 S	9
30				13	6 7 6	1.10 S	10
	763.6	Dense, tan, fine SAND with LIMESTONE fragments		14	13 23 25		
	761.1	Stiff to very stiff, tan SANDY LOAM TILL with LIMESTONE fragments		15	13 22 19	1.70 S	8
35 ▽				16	6 12 14	2.40 S	9
	756.1	Very dense, reddish/tan, medium grained SAND		17	30 45 55 100/11	PEN	
40	753.6	Very dense, reddish/tan coarse SANDY GRAVEL		18	37 42 44		
	751.1	Very dense, tan, fine grained SAND		19	29 38 54		
45	749.1	Boring terminated at 46.50 ft					
50							

GENERAL NOTES

Begin Drilling: **04-05-2004** Complete Drilling: **04-05-2004**
Drilling Contractor: **IDOT** Drill Rig: **CME-45 Automatic**
Driller: Logger: **C. Jenkins** Checked by:
Drilling Method: **HSA**

WATER LEVEL DATA

While Drilling ▽ **35.00 ft**
At Completion of Drilling ▼ **WASH**
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 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

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

BORING LOG B-4a

WEI Job No.: 201-37-01

Client: **McDonough and Associates**
Project: **20th St. over US 20**
Location: **Winnebago County**

Datum: NGVD
Elevation: 799.12 ft
North: ft
East: ft
Station: 98+87
Offset: 9.5 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	798.6	6-inch thick ASPHALT --PAVEMENT--			1			
	797.1	Medium dense, tan SAND and GRAVEL						
		Soft to medium stiff, tan SANDY LOAM with some GRAVEL			2	2 2 4	0.50 S	9
			5		3	3 4 4	0.70 S	9
					4	1 2 2	0.30 P	12
			10		5	1 2 2	0.40 P	10
	787.1	Soft, gray/black SILTY LOAM, with some GRAVEL			6	1 2 2	0.30 B	16
	784.6	Medium stiff, brown/gray SANDY LOAM with some GRAVEL	15		7	0 2 2	0.60 P	17
					8	1 3 4	0.70 B	18
	779.6	Dense, brown SAND and GRAVEL	20		9	3 8 29		
	777.1	Stiff, black SILTY LOAM			10	5 4 7	1.40 P	19
	774.6	Loose to medium dense, tan	25					
		SANDY GRAVEL			11	7 5 5		
					12	5 6 9		
	769.6	Stiff to hard, tan/pink SANDY LOAM TILL	30		13	3 4 7	1.50 S	9
					14	8 10 14	1.50 S	8
			35		15	13 17 22	1.50 S	7
					16	16 14 17	2.00 S	8
			40		17	12 17 24	6.70 S	9
					18	15 22 33	6.00 S	9
	754.6	Dense to very dense, tan/gray, fine grained SAND	45		19	11 22 41		
					20	15 17 22		
	749.6	Very dense, tan/orange SANDY	50					

GENERAL NOTES

Begin Drilling: **04-21-2004** Complete Drilling: **04-21-2004**
Drilling Contractor: **IDOT** Drill Rig: **CME-45 Automatic**
Driller: Logger: **C. Jenkins** Checked by:
Drilling Method: **HSA**

WATER LEVEL DATA

While Drilling: ▽ **DRY**
At Completion of Drilling: ▼ **DRY**
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 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

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

BORING LOG B-4a

WEI Job No.: 201-37-01

Client **McDonough and Associates**
Project **20th St. over US 20**
Location **Winnebago County**

Datum: NGVD
Elevation: 799.12 ft
North: ft
East: ft
Station: 98+87
Offset: 9.5 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		GRAVEL			21	20 34 38		
	747.1							
		Dense, tan, fine to medium grained SAND			22	13 17 23		
			55		23	8 18 29		
	742.6							
		Boring terminated at 56.50 ft						
			60					
			65					
			70					
			75					

GENERAL NOTES

Begin Drilling **04-21-2004** Complete Drilling **04-21-2004**
Drilling Contractor **IDOT** Drill Rig **CME-45 Automatic**
Driller Logger **C. Jenkins** Checked by
Drilling Method **HSA**

WATER LEVEL DATA

While Drilling ▽ **DRY**
At Completion of Drilling ▼ **DRY**
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 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

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

BORING LOG B-5a

WEI Job No.: 201-37-01

Client **McDonough and Associates**
Project **20th St. over US 20**
Location **Winnebago County**

Datum: NGVD
Elevation: 778.32 ft
North: ft
East: ft
Station: 100+02
Offset: 18 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 stiff, brown and black SILTY LOAM			1		0.70 P	18
					2	2 2 4	0.90 P	27
	773.8							
		Medium stiff, brown SILTY CLAY	5		3	2 3 5	0.80 B	17
	771.8							
		Medium to very stiff, tan SANDY LOAM TILL with a SAND lens.			4	3 5 6	1.00 S	10
			10		5	14 13 11	1.50 S	9
					6	6 8 9	0.70 S	10
			15		7	11 11 16	1.50 S	
					8	9 12 15	1.60 S	8
			20		9	8 10 14	2.90 S	10
					10	9 10 9	1.50 S	10
	753.8							
		Very stiff, tan SANDY CLAY	25					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		TILL			11	4 5 9	2.10 B	11
	751.3							
		Very dense, tan SAND and GRAVEL with LIMESTONE fragments			12	8 47 41		
	748.8							
		Medium dense, tan/orange, medium to coarse grained SAND	30		13	4 6 10		
	746.3							
		Medium dense to dense, tan, fine grained SAND			14	3 12 21		
			35		15	11 16 23		
					16	6 7 9		
			40		17	4 5 7		
	736.3							
		Soft to medium stiff SANDY LOAM TILL			18	2 1 4	0.40 B	14
			45		19	1 1 9	0.70 B	11
	731.3							
		Very dense, tan SAND and GRAVEL			20	29 33 37		
	729.3							
		Boring terminated at 49.00 ft	50					

GENERAL NOTES

Begin Drilling **04-22-2004** Complete Drilling **04-22-2004**
Drilling Contractor **IDOT** Drill Rig **CME-45 Automatic**
Driller Logger **C. Jenkins** Checked by
Drilling Method **HSA**

WATER LEVEL DATA

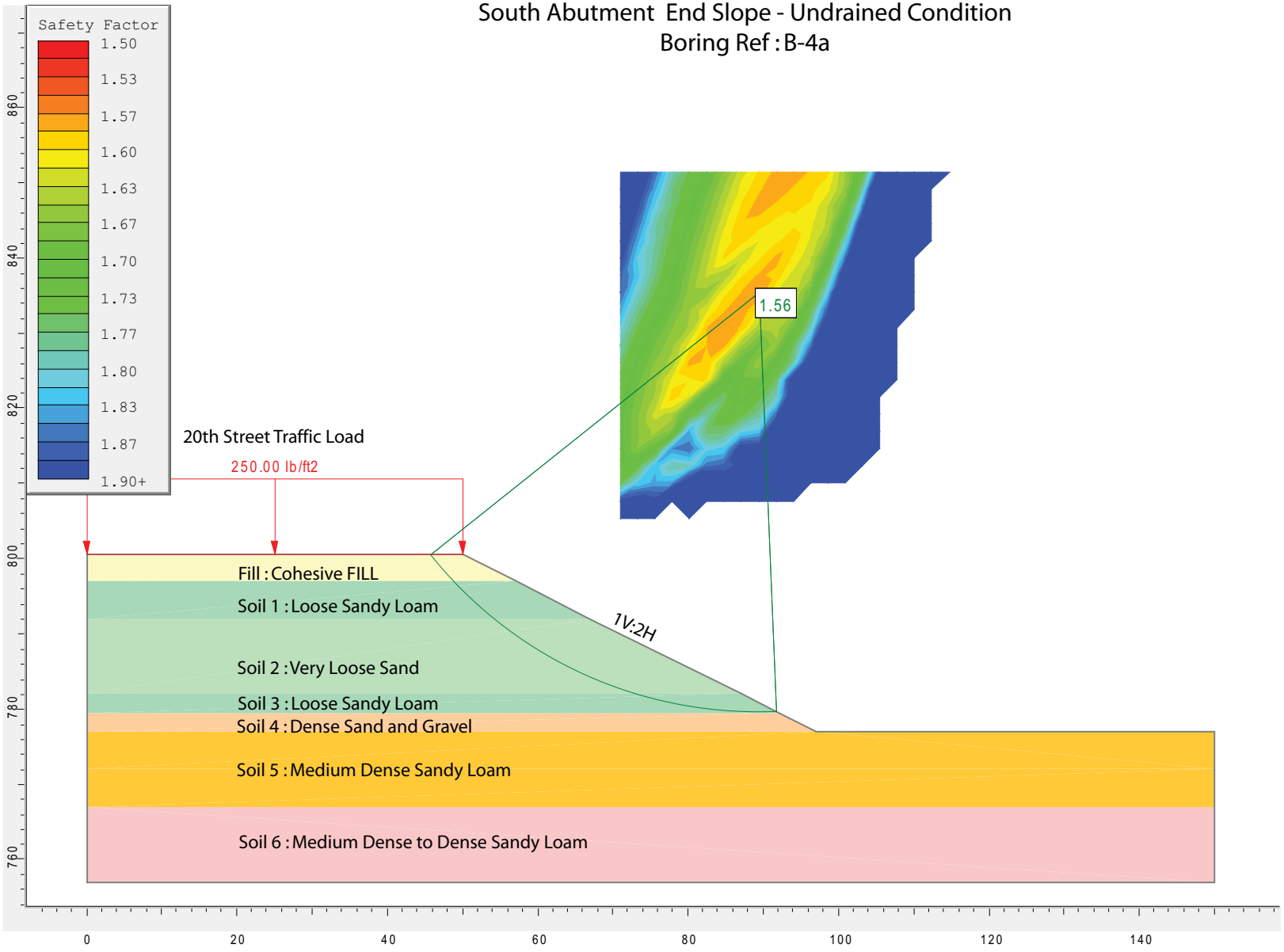
While Drilling ▽ **27.50 ft**
At Completion of Drilling ▼ **WASH**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

WANGENGINC 20TH STREET OVER US 20.GPJ WANGENG.GDT 2/11/11

APPENDIX C

South Abutment End Slope - Undrained Condition
Boring Ref : B-4a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	1000	0
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Loose Sandy Loam	120	0	30
4	Dense Sand and Gravel	130	0	36
5	Medium Dense Sandy Loam	125	0	31
6	Medium Dense to Dense Sandy Loam	130	0	34

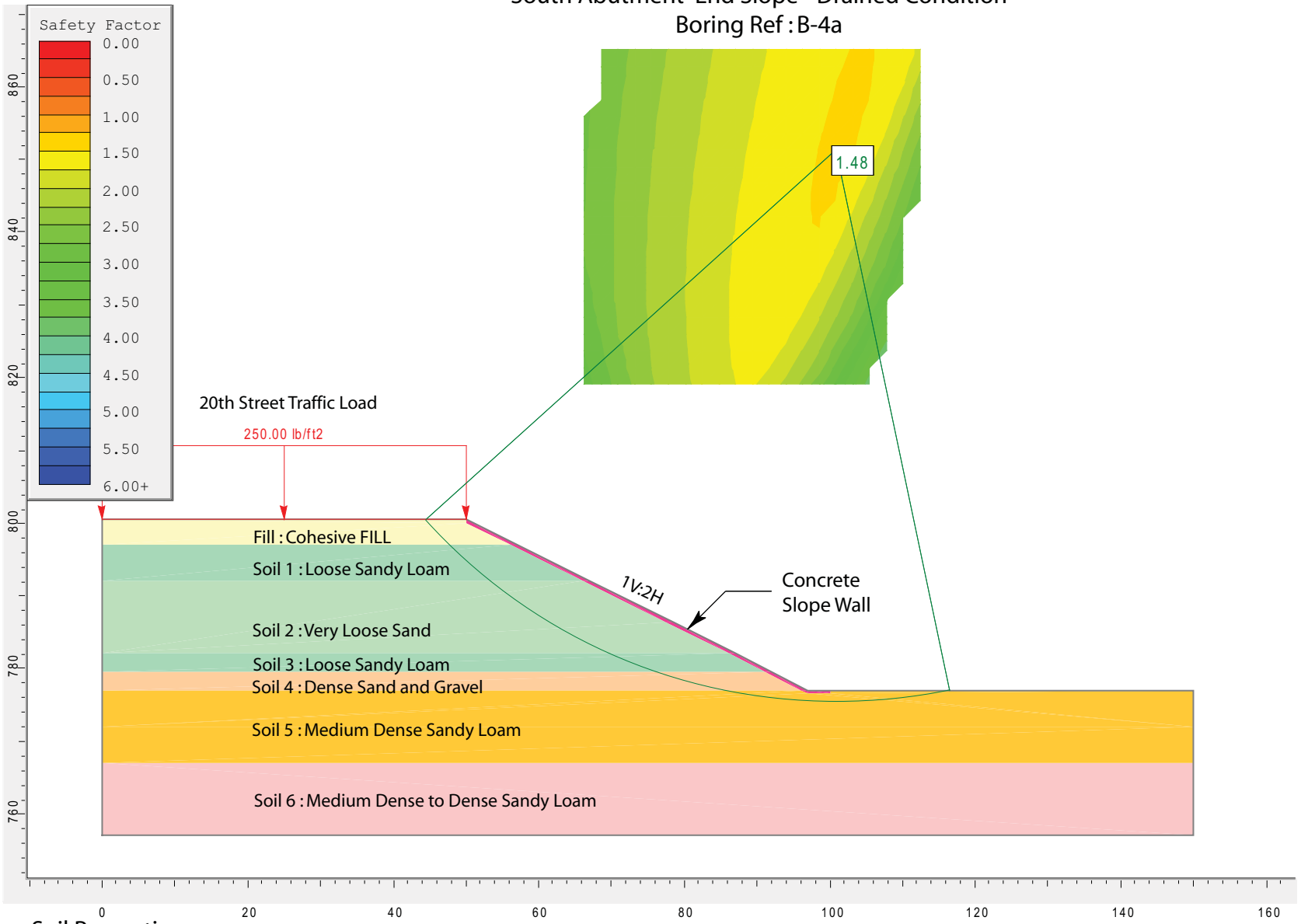
GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-1** | DRAWN BY: A.A.K. CHECKED BY: S.S.

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

FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

South Abutment End Slope - Drained Condition
Boring Ref : B-4a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	75	29
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Loose Sandy Loam	120	0	30
4	Dense Sand and Gravel	130	0	36
5	Medium Dense Sandy Loam	125	0	31
6	Medium Dense to Dense Sandy Loam	130	0	34

GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

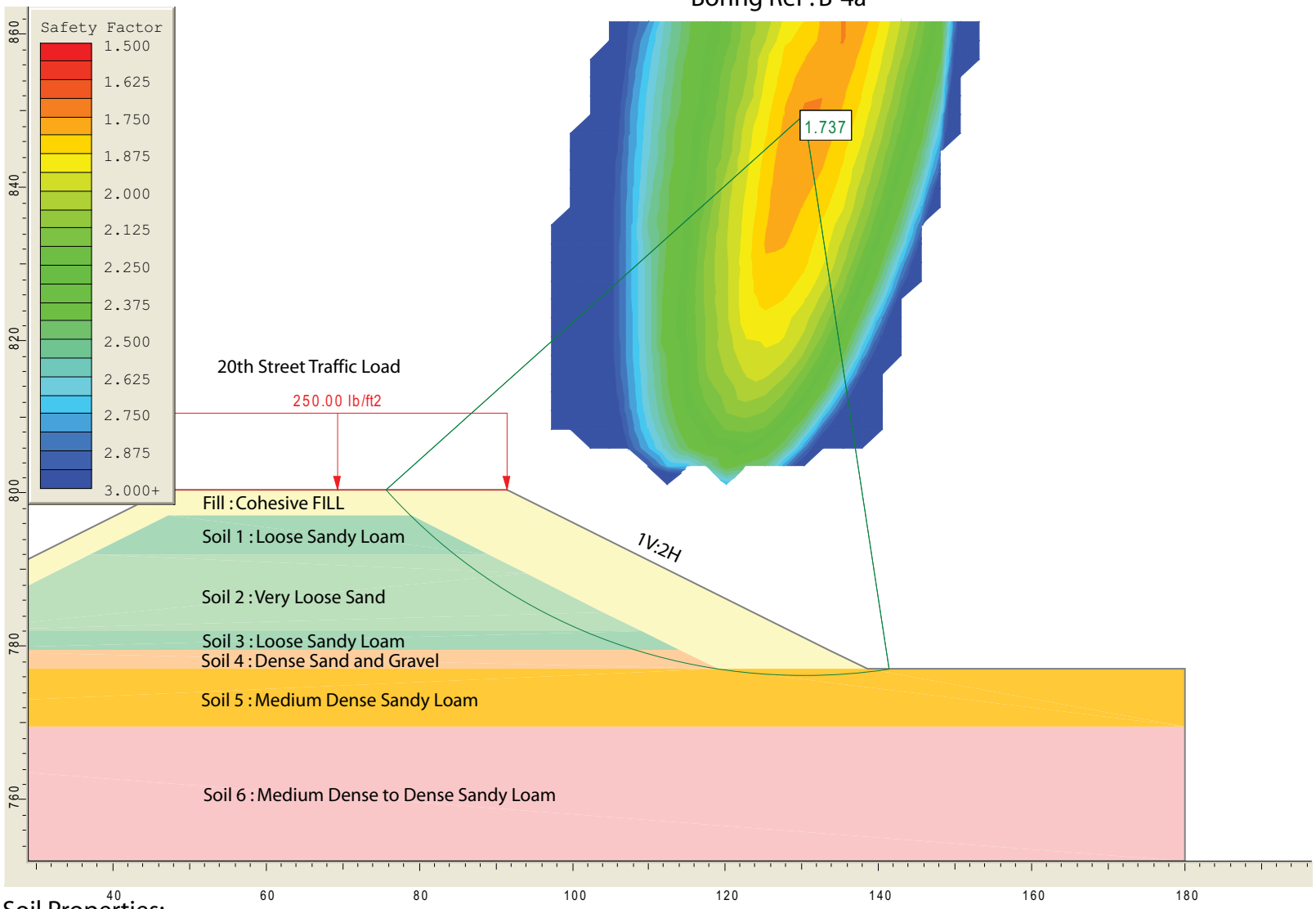
SCALE: GRAPHICAL | **APPENDIX C-2** | DRAWN BY: N.D.B. CHECKED BY: S.S.

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

FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

South Abutment Side Slope - Undrained Condition

Boring Ref : B-4a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	1000	0
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Loose Sandy Loam	120	0	30
4	Dense Sand and Gravel	130	0	36
5	Medium Dense Sandy Loam	125	0	31
6	Medium Dense to Dense Sandy Loam	130	0	34

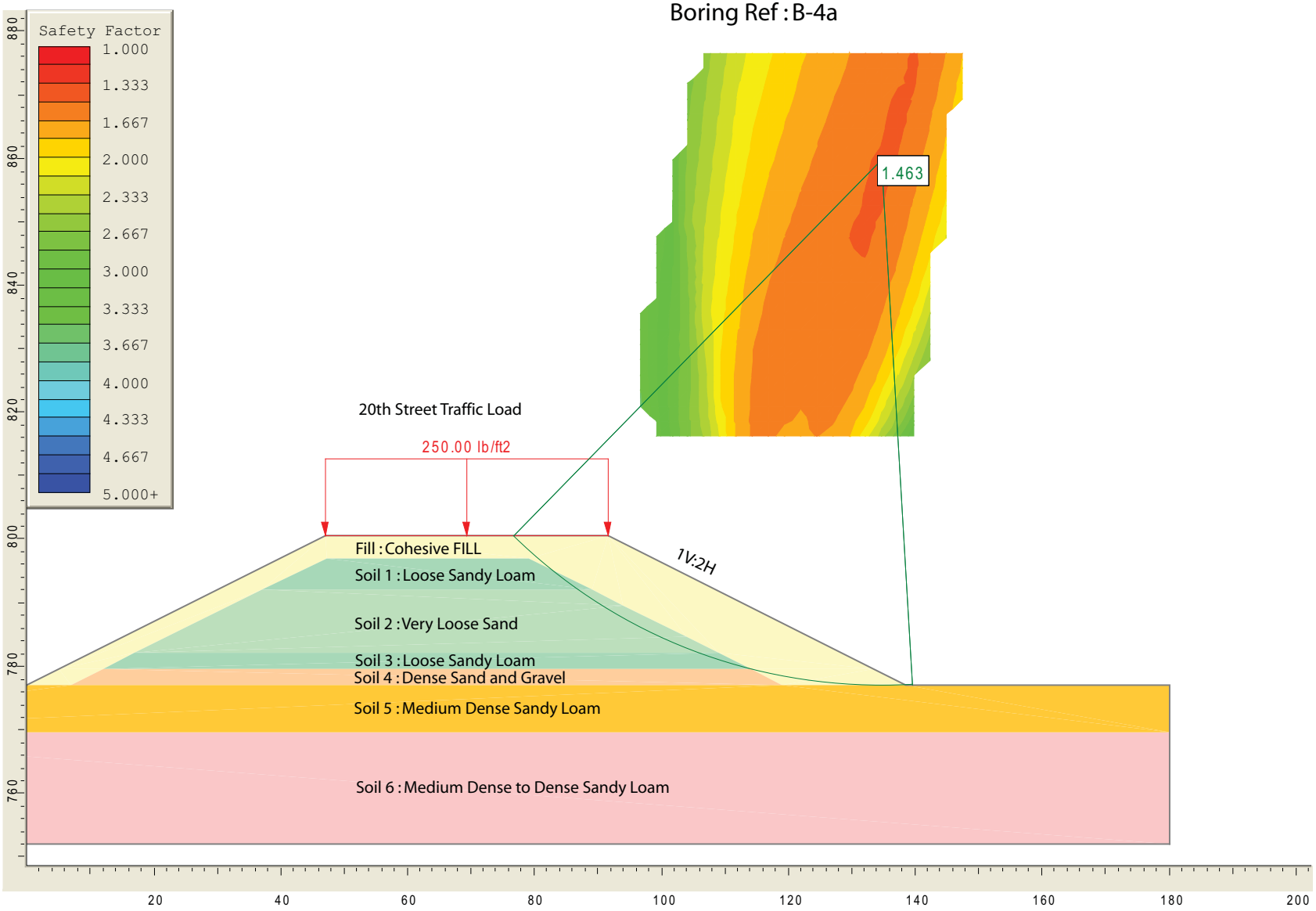
GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-3** | DRAWN BY: N.D.B. CHECKED BY: S.S.

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

FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

South Abutment Side Slope - Drained Condition
Boring Ref : B-4a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	75	29
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Loose Sandy Loam	120	0	30
4	Dense Sand and Gravel	130	0	36
5	Medium Dense Sandy Loam	125	0	31
6	Medium Dense to Dense Sandy Loam	130	0	34

GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-4** | DRAWN BY: N.D.B. CHECKED BY: S.S.

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Lombard, IL 60148
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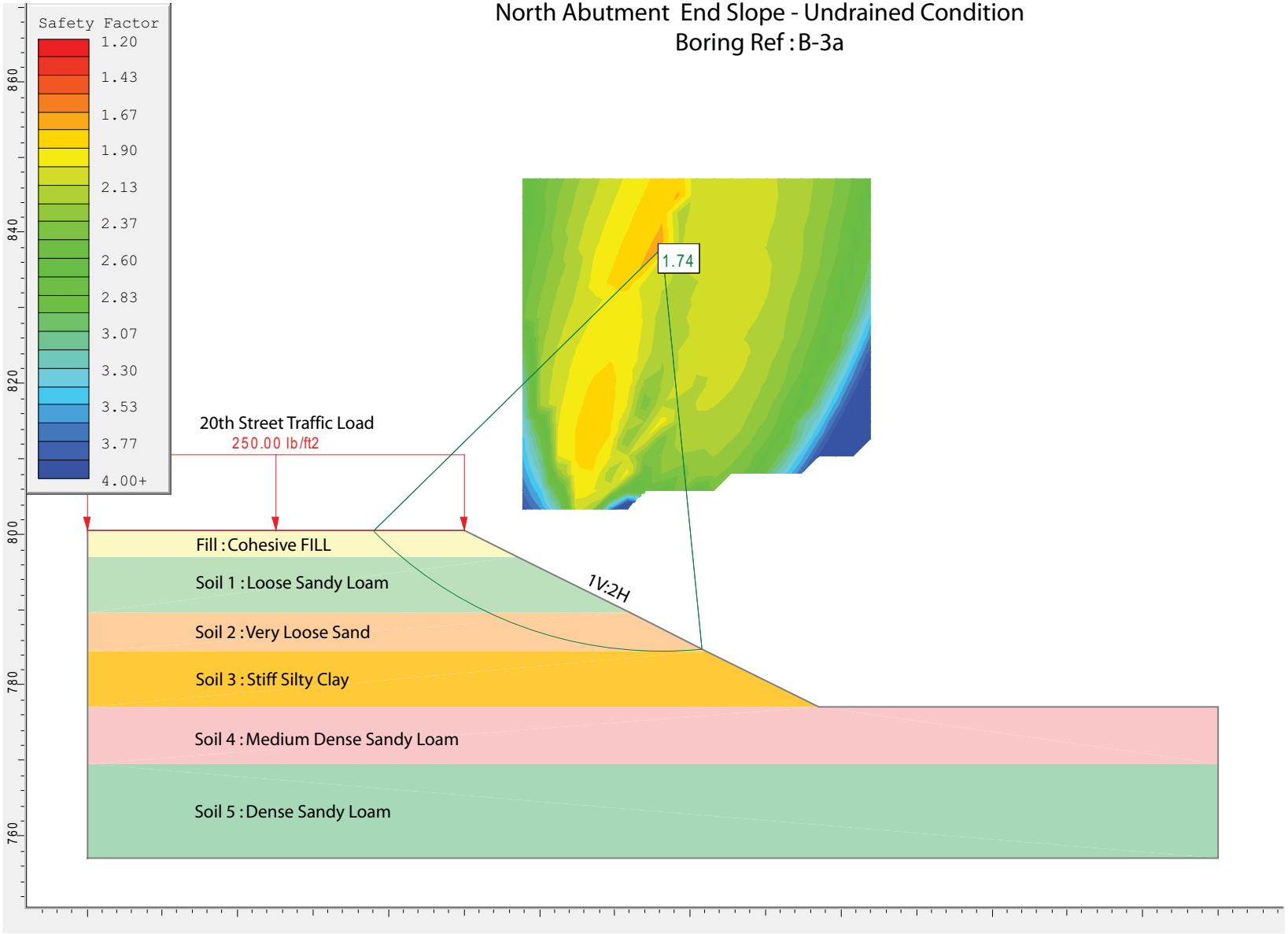
FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

North Abutment End Slope - Undrained Condition
Boring Ref : B-3a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	1000	0
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Stiff Silty Clay	125	1500	0
4	Medium Dense Sandy Loam	125	0	32
5	Dense Sandy Loam	130	0	36

GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-5** | DRAWN BY: N.D.B. CHECKED BY: S.S.

Wang Engineering
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Lombard, IL 60148
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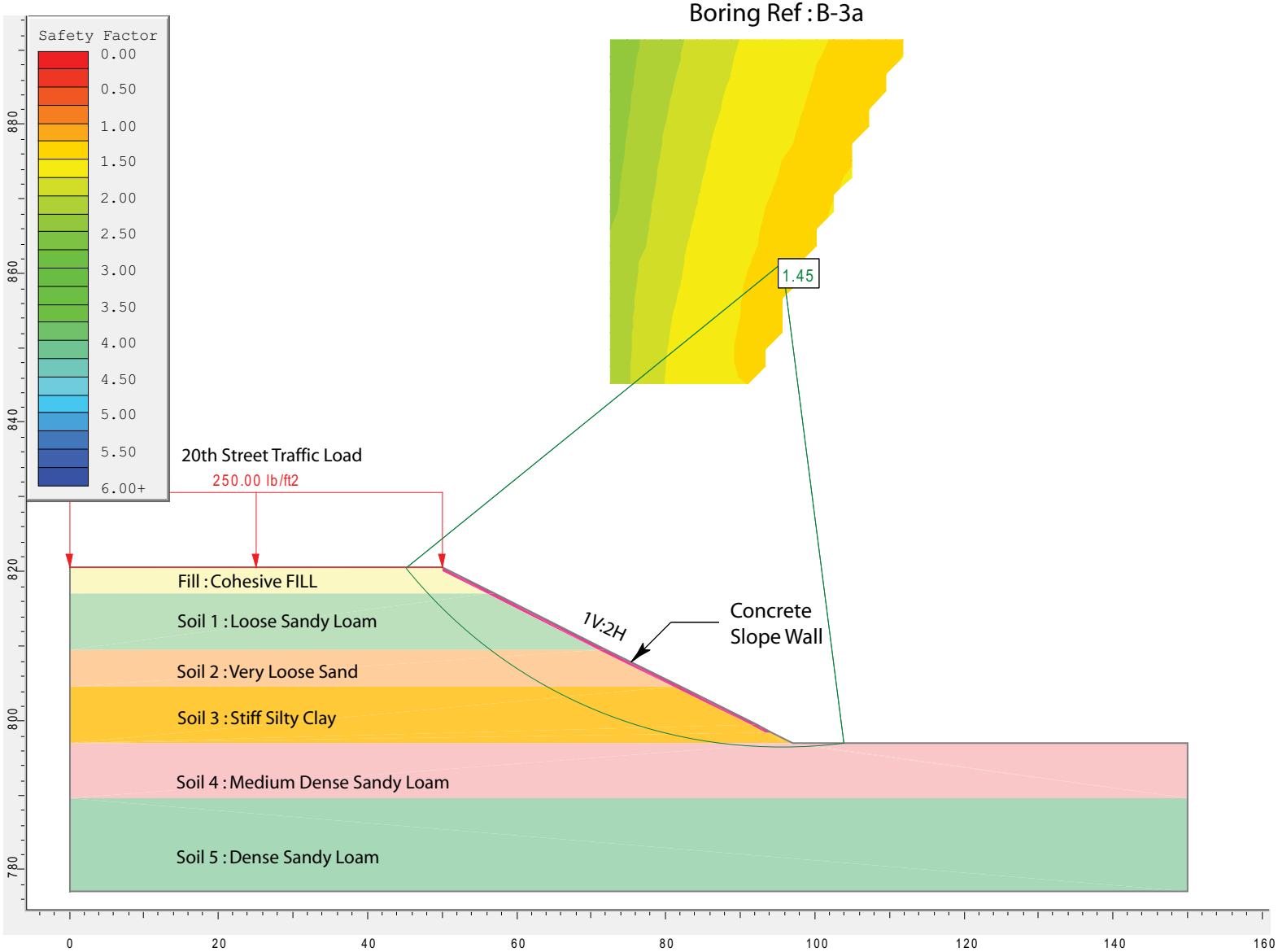
FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

North Abutment End Slope - Drained Condition
Boring Ref : B-3a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	75	29
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Stiff Silty Clay	125	110	29
4	Medium Dense Sandy Loam	125	0	32
5	Dense Sandy Loam	130	0	36

GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-6** | DRAWN BY: N.D.B. CHECKED BY: S.S.

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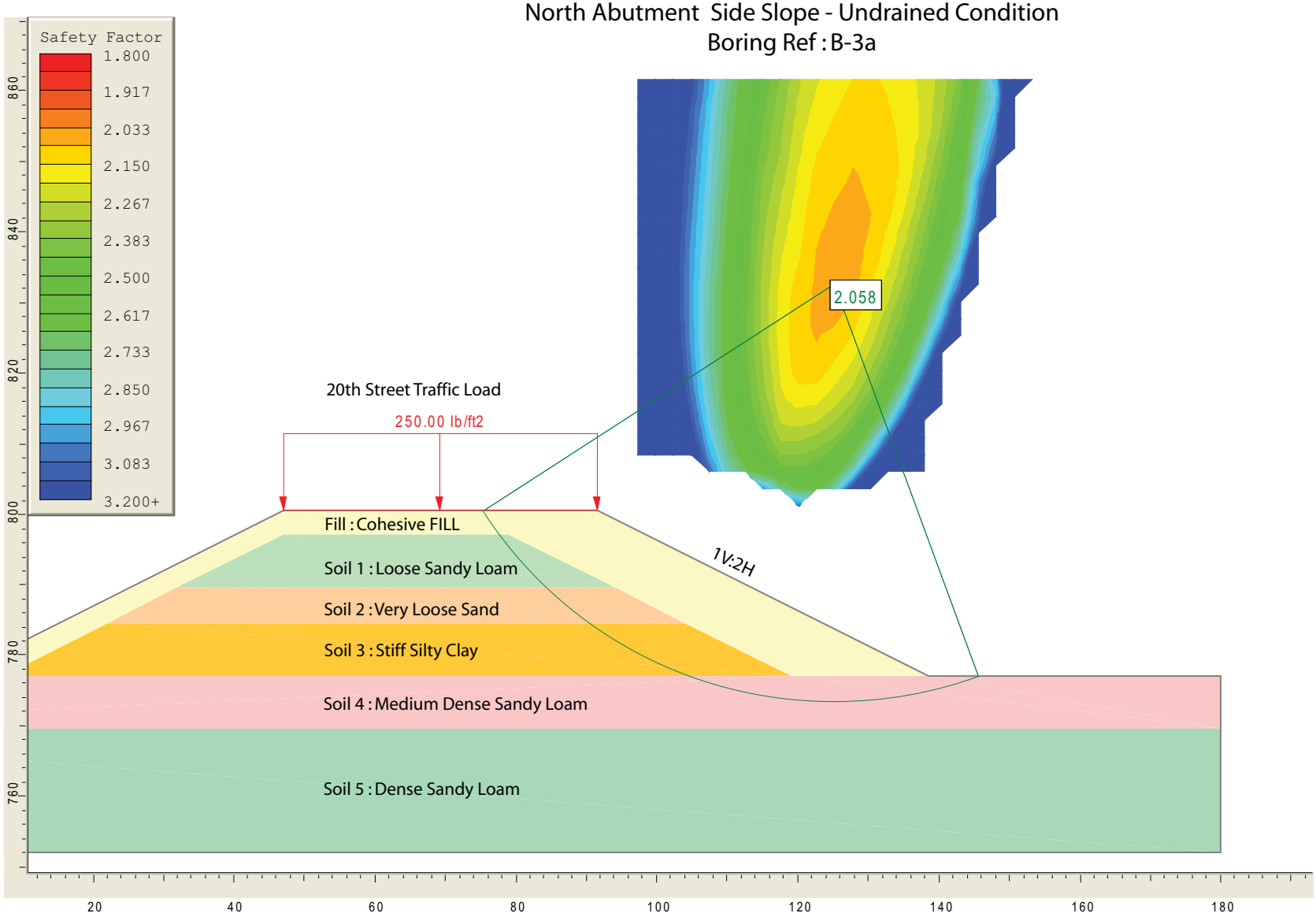
FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

North Abutment Side Slope - Undrained Condition
Boring Ref : B-3a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	1000	0
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Stiff Silty Clay	125	1500	0
4	Medium Dense Sandy Loam	125	0	32
5	Dense Sandy Loam	130	0	36

GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-7** | DRAWN BY: N.D.B. CHECKED BY: S.S.

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Lombard, IL 60148
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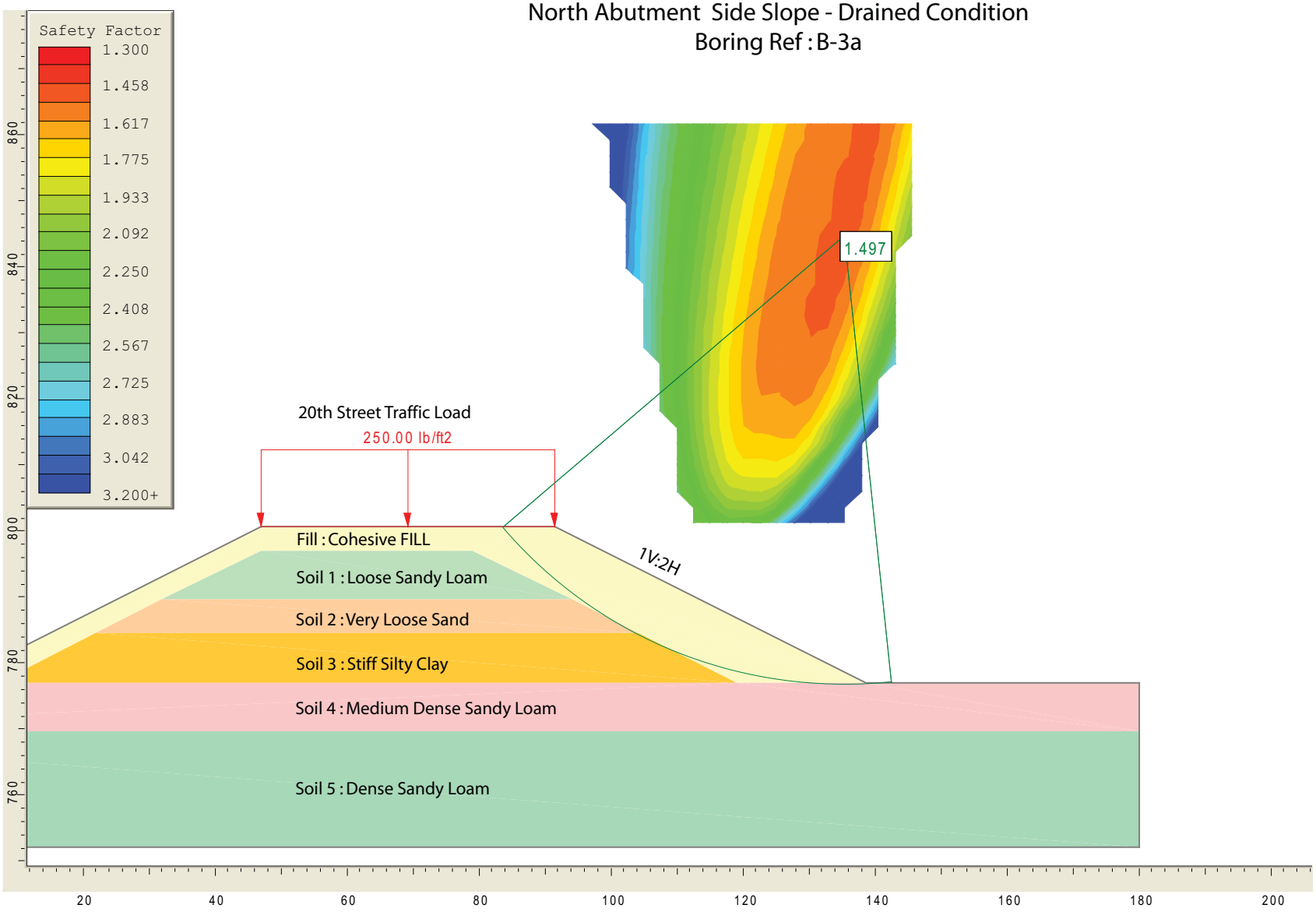
FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

North Abutment Side Slope - Drained Condition
Boring Ref : B-3a



Soil Properties:

Soil ID	Soil Type	Unit Weight (pcf)	Undrained and Drained Parameter C_u (psf)	ϕ (deg.)
Fill	Cohesive Fill	125	75	29
1	Loose Sandy Loam	120	0	30
2	Very Loose Sand	115	0	29
3	Stiff Silty Clay	125	110	29
4	Medium Dense Sandy Loam	125	0	32
5	Dense Sandy Loam	130	0	36

GLOBAL STABILITY ANALYSIS: 20th STREET BRIDGE OVER US 20
IDOT NO. P-92-056-04, WINNEBAGO COUNTY, IL

SCALE: GRAPHICAL | **APPENDIX C-8** | DRAWN BY: N.D.B. CHECKED BY: S.S.

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Lombard, IL 60148
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FOR McDONOUGH ASSOCIATES, INC | **201-37-01**

APPENDIX D

Pile Design Table for South Abutment utilizing Boring #B-4a

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
191	105	29
Metal Shell 12"Φ w/.25" walls		
191	105	29
258	142	34
314	173	37
Metal Shell 14"Φ w/.25" walls		
167	92	27
240	132	29
323	178	34
396	218	37
Metal Shell 14"Φ w/.312" walls		
167	92	27
240	132	29
323	178	34
396	218	37
489	269	39
Steel HP 8 X 36		
151	83	54
Steel HP 10 X 42		
188	104	54

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
193	106	54
Steel HP 12 X 53		
225	124	54
Steel HP 12 X 63		
231	127	54
Steel HP 12 X 74		
234	129	54
Steel HP 12 X 84		
223	123	52
238	131	54

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
173	95	47
238	131	49
256	141	52
273	150	54
Steel HP 14 X 89		
180	99	47
243	134	49
262	144	52
279	154	54
Steel HP 14 X 102		
185	102	47
246	136	49
266	146	52
283	156	54
Steel HP 14 X 117		
192	106	47
251	138	49
272	149	52
289	159	54
Precast 14"x 14"		
58	32	14
Timber Pile		
132	73	29

Pile Design Table for Pier utilizing Boring #B-5a

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
150	82	21
Metal Shell 12"Φ w/.25" walls		
150	82	21
Metal Shell 14"Φ w/.25" walls		
185	102	21
Metal Shell 14"Φ w/.312" walls		
185	102	21
Steel HP 8 X 36		
155	85	45
Steel HP 10 X 42		
193	106	45

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
199	110	45
Steel HP 12 X 53		
182	100	43
231	127	45
Steel HP 12 X 63		
188	104	43
238	131	45
Steel HP 12 X 74		
193	106	43
243	134	45
Steel HP 12 X 84		
198	109	43
247	136	45

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
165	91	41
223	123	43
281	155	45
Steel HP 14 X 89		
167	92	41
230	127	43
289	159	45
Steel HP 14 X 102		
169	93	41
236	130	43
295	162	45
Steel HP 14 X 117		
171	94	41
243	133	43
302	166	45
Precast 14"x 14"		
150	83	8
230	126	11
235	129	21
Timber Pile		
116	64	21

Pile Design Table for North Abutment utilizing Boring #B-3a

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls		
119	66	27
Metal Shell 12"Φ w/.25" walls		
119	66	27
246	135	34
Metal Shell 14"Φ w/.25" walls		
149	82	27
Metal Shell 14"Φ w/.312" walls		
149	82	27
306	168	34
Steel HP 8 X 36		
205	113	47
Steel HP 10 X 42		
217	120	42
253	139	44
266	147	47

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57		
225	124	42
261	143	44
273	150	47
Steel HP 12 X 53		
176	97	39
261	143	42
304	167	44
333	183	47
Steel HP 12 X 63		
183	101	39
269	148	42
312	171	44
340	187	47
Steel HP 12 X 74		
189	104	39
275	151	42
318	175	44
344	189	47
Steel HP 12 X 84		
194	106	39
281	155	42
323	178	44
348	192	47

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73		
216	119	39
318	175	42
369	203	44
402	221	47
Steel HP 14 X 89		
225	124	39
328	180	42
378	208	44
410	225	47
Steel HP 14 X 102		
231	127	39
335	184	42
385	212	44
414	228	47
Steel HP 14 X 117		
174	96	37
239	132	39
344	189	42
394	217	44
421	232	47
Precast 14"x 14"		
189	104	27
Timber Pile		
88	48	27