Structural Geotechnical Report
Traffic Signal Structures

Chicago to St. Louis High Speed Rail
Hoff Road, Mile Post 46.64
Elwood, Illinois
Will County

IDOT PTB 890-172
DOT# 290492F

Project Design Engineer
AECOM
345 East Ash Avenue
Decatur, Illinois 62526

Geotechnical Consultant
GSG Consultants, Inc.

312-733-6262

September 18, 2015

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Appendices

1.0 Introduction

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the design of traffic signal structure foundations at the intersection of Illinois Route 53 and Hoff Road, Elwood, Illinois. The proposed improvement is part of the Chicago to St. Louis High Speed Rail project. The purpose of the investigation was to explore and characterize the subsurface soil and groundwater conditions to determine engineering properties of the subsurface soil, and develop design and construction recommendations for the traffic signal structure foundations. Figure 1 shows the project location map.

Figure 1: Project Location Map, from USGS Topography Quadrangle of Elwood IL

1.1 Project Information

Based on design information and drawings provided by AECOM, GSG understands that five (5) new traffic signal structures will be installed as part of the improvements to the intersection of Illinois Route 53 and Hoff Road. One soil boring was drilled for each of the new structures at locations provided by AECOM. It is anticipated that each of the new traffic signal foundations will be designed according to Illinois Department of Transportation (IDOT) and Bureau of Design and Environment's Highway Standards.

1.2 Existing Subsurface Information

GSG reviewed several published documents in an effort to determine the regional geological setting in the area of the Site. The subject area is located in the southwest portion of Will County, Illinois. The surficial geologic deposits in this area are typically glacial drift deposited during the Wisconsin Glacial Age. This project is located geographically in the Rockdale Moraine, part of the Valparaiso Morainic System of the Yorkville Member of the Wedron Group. This moraine is primarily silty, sandy, or gravelly till with local areas of silty clayey till, many lenses of poorly sorted gravel, and abundant small kames. This formation overlies the Silurian Elwood Bedrock Formation which consists of interbedded layers of dolomite with depths ranging from 50 to 80 feet.

The project area is approximately 5 miles south of the Sandwich Fault Zone. The Sandwich fault zone is one of the longest fault zones in Illinois and extends northwesterly approximately 85 miles between Manhattan in Will County to Oregon in Ogle County. The fault zone has a maximum displacement of approximately 800 feet at its midpoint in southeastern DeKalb County and is approximately ½ to 2 miles in width

2.0 Subsurface Exploration Program

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The subsurface exploration program was performed in accordance with applicable IDOT geotechnical manuals and procedures.

2.1 Subsurface Site Investigation

A subsurface investigation was conducted September 8th, 2015. This investigation included advancing a total of five (5) soil borings, one at each of the proposed traffic signal locations. All borings were advanced to depths of 25 to 40 feet below existing ground surface. The actual locations of the soil borings are shown in **Soil Boring Location Plan (Appendix A)**. Table 1 below presents a list of the borings completed for the new traffic signals.

Table 1 – Summary of Subsurface Exploration Borings

Soil Boring	Northing (ft)	Easting (ft)	Depth (ft)	Existing Ground Elevation
FB-1	1721479.5309	1043566.8366	25	630.46
FB-2	1721457.6510	1043685.8979	25	631.14
FB-3	1721561.4491	1043734.4447	25	632.33
FB-4	1721472.7763	1043839.3169	40*	631.01
FB-5	1721572.1243	1043903.3096	40*	632.68

* Borings were drilled for traffic sign, culvert, and retaining wall

The soil borings were drilled using a truck mounted Diedrich D-50 drill rig, equipped with 3¼-inch I.D. hollow stem augers. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained using a split spoon soil sampler at 2.5 foot intervals to depths of 25 feet or 30 feet, and 5 foot intervals thereafter. GSG's field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities, and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester and a calibrated

hand penetrometer in accordance IDOT procedures and requirements. Representative soil samples were collected from each sample interval, and were placed in jars and returned to the laboratory for further testing and evaluation. GSG field crew also measured the ground elevation using an automatic level and a bench mark at the intersection of Illinois 53 and Hoff Road. The existing ground surface elevations shown in the soil boring logs are based on field survey completed by GSG field crew using a bench mark CP 166 with an elevation of 632.86 feet MSL.

2.2 Laboratory Testing Program

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed culvert. The lab testing program included Moisture Content (AASHTO T-265), Atterberg Limits (AASHTO T-89/90), Particle Size Analysis, Organic Content (AASHTO T-267), and Dry Unit Weight. The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (1999), and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO and the Illinois Division of Highways (IDH) classification systems. The results of the laboratory testing program are shown along with the field test results in the **Soil Boring Logs (Appendix B)** and in the **Laboratory Test Results (Appendix C).**

2.3 Subsurface Soil and Groundwater Conditions

The subsurface soil conditions were developed based on the results of both the site investigation and laboratory results. Detailed descriptions of the subsurface soils, as well as the surface elevations, are provided on the Soil Boring Logs**.** The existing ground surface elevations shown on the soil boring logs are based on the field survey conducted by GSG field crew. The soil boring logs provide specific conditions encountered at each boring location, including soil descriptions, stratifications, penetration resistance, elevations, location of the samples, water levels (when encountered), and laboratory test data. Variations in the general subsurface soil profile were noted during the drilling activities. The stratifications shown on the boring logs represent the conditions only at the actual boring location and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

Water levels were checked in each boring to determine the general groundwater conditions present at the site, and were measured while drilling and after the boring was completed.

Water level readings were made in each borehole at times and under conditions shown on the boring log and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, climatic conditions, or other factors not evident at the time measurements were made and reported herein. If water levels were not found in a borehole at the time of drilling, the color transition of soils from brown to gray may be used as an estimate of the location of the long term water table. The color change is based on oxidation of the material that exists above the water table.

The following sections present a detailed description of the subsurface conditions at each structure location.

Traffic Signal FB-1

Boring FB-1 was drilled near the southwest corner of the UPRR and Hoff Road intersection at an approximate surface elevation of 630.46 feet. The boring noted 6 inches of asphalt pavement at the surface. Below the pavement, the boring noted crushed aggregate material to a depth of 2.5 feet below the surface underlain by cohesive fill material consisting of clay to a depth of 5 feet below the ground surface. Underneath the fill materials the boring noted native cohesive soils consisting of very stiff to hard brown and gray silty clay to a depth of 16.5 feet and very stiff gray silty clay to the termination depth of 25 feet below the surface. The cohesive materials encountered had unconfined compressive strengths ranging from 1.5 to 5.0 tsf.

Groundwater was not encountered while drilling or immediately after drilling; however, based on the color transition from brown to gray, it is anticipated that the long term water table may be at an elevation 613.96 feet.

Traffic Signal FB-2

Boring FB-2 was drilled near the southwest corner of the Illinois Route 53 and Hoff Road intersection at an approximate surface elevation of 631.14 feet. At the surface, the boring noted 1 foot of crushed aggregate material consisting of sand and gravel. Underneath the surficial layer the boring noted cohesive fill material consisting of clay to a depth of 4.5 feet underlain by native granular soils consisting of medium dense sand with gravel to a depth of 7.5 feet below the surface. Under the native sand, the boring noted native cohesive soils consisting of hard brown and gray silty clay to a depth of 18.5 feet and very stiff gray silty clay to the boring termination depth of 25 feet below the surface. The native cohesive materials encountered had unconfined compressive strengths ranging generally from 1.5 to 6.7 tsf.

While drilling, groundwater was encountered at a depth of 4.5 feet (el. 626.64) below the surface perched within the granular fill layer. Groundwater was not encountered immediately after drilling. Based on the color transition from brown to gray, it is anticipated that the long term water table be at an elevation 612.64 feet.

Traffic Signal FB-3

Boring FB-3 was drilled in the northwest corner of the Illinois Route 53 and Hoff Road intersection at an approximate surface elevation of 632.33 feet. At the surface, the boring noted 1 foot of crushed aggregate material. Underneath the surficial layer, the boring noted cohesive fill materials consisting of clay to a depth of 5 feet below the surface. Under the fill material, the boring noted native cohesive soils consisting of stiff dark gray and black clay to a depth of 9 feet below the surface. The native clay layer was followed by very stiff to hard brown and gray silty clay to a depth of 17 feet and very stiff to hard gray silty clay to the boring termination depth of 25 feet below the surface. The cohesive materials encountered had unconfined compressive strengths ranging generally from 1.5 to 5.0 tsf.

Groundwater was not encountered while drilling or immediately after drilling however, based on the color transition from brown to gray, it is anticipated that the long term water table may be at an elevation 615.33 feet.

Traffic Signal FB-4

Boring FB-4 was drilled near the southeast corner of the Illinois Route 53 and Hoff Road intersection at an approximate surface elevation of 631.03 feet. At the surface, the boring noted 2.5 feet of crushed aggregate material. Underneath the surficial layer the boring noted cohesive fill materials consisting of clay to a depth of 5 feet below the surface. Below the fill material, the boring noted native soils consisting of very stiff brown and gray clay to a depth of 14 feet and very stiff to hard gray silty clay to a depth of 29 feet below the surface. A stiff silt was noted underneath the native silty clay layer to a depth of 35 feet underlain by very stiff gray clay to the boring termination depth of 40 feet below the existing surface. The cohesive materials encountered had unconfined compressive strengths ranging generally from 2.0 to 5.0 tsf.

While drilling, groundwater was encountered at a depth of 17.5 feet (el. 613.51) below the surface within a thin layer of sand and gravel noted in the boring. Groundwater was not encountered immediately after drilling. Based on the color transition from brown to gray, it is anticipated that the long term water table could be as high as elevation 617.01 feet.

Traffic Signal FB-5

Boring FB-5 was near the northeast corner of the Illinois Route 53 and Hoff Road intersection at an approximate surface elevation of 632.68 feet. At the surface, the boring noted 2 feet of crushed aggregate material. Underneath the surficial layer the boring noted cohesive fill materials consisting of clay to a depth of 5feet below the surface. Below the fill material the boring noted native cohesive soils consisting of very stiff brown and gray clay to a depth of 11 feet below the surface. The native clay layer was followed by very stiff to hard brown and gray silty clay to a depth of 18.5 feet and very stiff to hard gray silty clay to the boring termination depth of 25 feet below the existing surface. The cohesive materials encountered had unconfined compressive strengths ranging generally from 1.0 to 5.0 tsf.

While drilling, groundwater was encountered at a depth of 6.5 feet (el. 626.18) below the surface. Groundwater was not encountered immediately after drilling. Based on the color transition from brown to gray, it is anticipated that the long term water table could be at an elevation 614.18 feet.

3.0 Geotechnical Analysis and Recommendations

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed structures based on the results of the field exploration, and laboratory testing. It is recommended that all of the proposed traffic signal structure foundations are designed according to the IDOT and Bureau of Design and Environment Highway Standards.

3.1 Seismic Parameters

The seismic hazard for the site was analyzed per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRFD Bridge Design Specifications.

The Seismic Soil Site Class was determined per the requirements of All Geotechnical Manual Users (AGMU) Memo 9.1, Design Guide for Seismic Site Class Determination, and the "Seismic Site Class Determination" Excel spreadsheet provided by IDOT. A global Site Class Definition was determined for this project, and was found to be Soil Site Class C. The Seismic Performance Zone (SPZ) was determined using Figure 2.3.10-3 in the IDOT Bridge Manual, and was found to be Seismic Performance Zone 1.

The AASHTO Seismic Design Parameters program was used to determine the peak ground acceleration coefficient (PGA), and the short (S_{DS}) and long (S_{D1}) period design spectral acceleration coefficients for each of the proposed structures. For this section of the project, the S_{DS} and the S_{D1} were determined using 2014 AASHTO Guide Specifications as shown in Table 2. Given the site location and materials encountered, the potential for liquefaction is minimal.

Table 2 – Seismic Parameters

Building Code Reference	PGA	S_{DS}	S_{D1}
2014 AASHTO Guide for LRFD Seismic Bridge Design	0.058g	0.127g	0.069g

3.2 Soil Parameters

GSG determined the geotechnical parameters to be used for the project design based on the results of field and laboratory test data on individual boring logs as well as our experience. Unit weights, friction angles and shear strength parameters were estimated using corrected standard penetration test (SPT) results using published correlations for N values for the fill and cohesionless soils and in-situ and laboratory test results for cohesive soils. The SPT values were corrected for hammer efficiency. The hammer efficiency correction factor considers the use of a safety hammer/rope/cat-

head system, generally estimated to be 60% efficient. Thus, correlations should be based upon what is currently termed as N60 data. The efficiency of the automatic hammer used for this exploration was estimated to be approximately 105% based on previous efficiency testing of the drill rigs equipped with such equipment. The correction for hammer efficiency is a direct ratio of relative efficiencies as follows:

$$N60 = N * (91/60)$$

* Where the N value is the field recorded blow counts.

3.3 Traffic Signal Foundations

GSG understands that five (5) traffic signal structures will be installed at various locations within the project limit. It is understood that all of the proposed foundation designs will adhere to the requirements of the IDOT Highway Standard included in IDOT Highway Standard 878001-10 (Appendix D) . The foundation diameters range from 30 to 42 inches, and the depths range from 10 to 25 feet. The geotechnical criteria for use of the standard foundation details specify that the foundation shaft length and diameter should be designed based the mast arm length, soil composition and average strength. The criteria for the application of the standard detail states that the foundations only apply to sites which have cohesive soils along the length of the shaft with an average unconfined compressive strength (Qu) greater than 1.0 tst. For all other sites the Bureau of Bridges and Structures should be consulted for a revised design.

Based on the soil exploration and testing program, crushed aggregate material was found within the upper 1 to 2.5 feet of soil in all of the borings within the frost penetration depth. The lateral resistance of the upper 3.5 feet of soils in the frost penetration zone and should be neglected in design. Due to the presence of predominately high strength cohesive soils within the borings, the foundation standards should still be applied for each traffic signal location with the exception of the traffic signal located near FB-2. The Bureau of Bridges and Structures should be contacted to verify that the standard details can be applied for FB-2 and or provide a revised design.

The soils information shown in Table 3 was used to design to verify foundations for each traffic signal. Soils must be visually inspected at each location to match those identified in the boring logs; if different soils are encountered during construction the engineer must be notified to provide a revised design.

Table 3 – Soils Summary Information Table Data

Structure and Boring ID	Predominate Soil Type Within Upper 10 Feet	Soil Consistency	Average Strength of Upper 10 ft (Q_u in tsf)
FB-1	Cohesive	Stiff	1.65
*FB-2	Cohesive/Granular	Stiff	2.65
FB-3	Cohesive	Stiff	1.88
FB-4	Cohesive	Stiff	1.75
FB-5	Cohesive	Stiff	1.88

*3 foot granular soil layer was noted within the upper 10 feet

Most of the borings contain predominately cohesive material within the upper 10 feet. Granular fill material was observed in all the borings. The average cohesive strengths at each location represent the straight averages of both the cohesive and granular layers. FB-2 contains medium dense sand at depths between 4.5 and 7.5 feet followed by stiff to very stiff clay to a depth of 25 feet. The strength of the upper sand layer is higher than 1.0 TSF required by the IDOT standard.

GSG recommends consulting with IDOT Bureau of Bridges and Structures regard the proposed signal structure at FB-2. If a special design is required, the design soil parameters for each of the traffic signal location FB-2 is provided in Table 4.

Table 4 – Lateral Resistance Soil Parameters for FB-2

Elevation below existing grade	Soil Description	In-situ Unit Weight (pcf)	Drained Friction Angle (phi)	Undrained Shear Strength (psf)	Subgrade Modulus (pci) k_{py}	Horizontal Strain Factor e50
	New Engineered Fill	120	30	n/a	90	n/a
Surface to 626.64	Existing Black/Brown Clay Fill	120	26	2,000	1,000	0.007
626.46 to 623.64	Existing Brown and Gray Sand, with siilt and gravel	120	30	n/a	90	n/a
623.64 to 612.64	Very Stiff to Hard Brown/Gray Silty Clay, trace gravel	135	26	6,000	2,000	0.004
612.64 to 606.14	Very Stiff Gray Silty Clay, trace gravel	144	28	2,500	1,250	0.005

- The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * \mathrm{z}$
- Where k_{py} is the subgrade modulus given in the table and z is the distance from the surface to the center point of the layer in inches.

Drilled shafts for the proposed traffic signal structure are normally loaded laterally by wind forces. The ability of the shaft to resist the wind loads is dependent on the size of the shaft diameter and the passive pressures that develop in the soils along the shaft. Lateral loads on the drilled shafts should be analyzed for the maximum moments and lateral deflections. Software such as L-Pile and COM624 are normally used to determine the required shaft depth to resist the lateral loads, and the actual maximum moment and the anticipated shaft deflection. If the shaft deflection is excessive or

if the embedment is inadequate to provide “fixity”, the shaft embedment could be increased to help address these issues. The shaft diameter should be increased if the deflection or the maximum moment is higher than the shaft designed resistance.

4.0 Construction Considerations

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (2012). Any deviation from the requirements in the manuals above should be approved by the design engineer.

4.1 Site Excavations

The contractor will be responsible to provide a safe excavation during the construction activities of the project. All excavations should be conducted in accordance with applicable federal, state, and local safety regulations, including, but not limited to the Occupational Safety and Health administration (OSHA) excavation safety standards. Excavation stability and soil pressures on temporary shoring are dependent on soil conditions, depth of excavations, installation procedures, and the magnitude of any surcharge loads on the ground surface adjacent to the excavation. Excavation near existing structures and underground utilities should be performed with extreme care to avoid undermining existing structures. Excavations should not extend below the level of adjacent existing foundations or utilities unless underpinning or other support is installed. It is the responsibility of the contractor for field determinations of applicable conditions and providing adequate shoring for all excavation activities.

4.2 Drilled Shafts Construction

The drilled shaft construction should be completed in accordance with Section 516, Drilled Shafts, in the IDOT Standard Specification for Road and Bridge Construction. The temporary casing construction method should be applied where granular material is present within the proposed shaft depth. The temporary casing will likely be required to prevent caving or excessive deformation of the hole. Drilled shaft construction with the use of a temporary casing should be completed in accordance to article 516.06 (c) in the IDOT Standard Specification for Road and Bridge Construction.

All traffic signal foundations should anticipate the use of a partial or total temporary casing within the upper 2 to 9 feet due to the granular fill layers observed in all of the boring locations. Below depths of 9 feet the Dry Construction Method 516.06(a) can be used. A native sand layer was observed in boring FB-4 between depths of 17.5 feet (el. 613.51) to 18.5 feet (el. 612.51). A temporary casing covering the whole shaft length is recommended for FB-4.

Free water should be removed from the base of the drilled shaft base prior to placing any concrete. The placement method of concrete for the drilled shaft foundation should be based on the amount of water present at the base of the shaft just prior to placing the concrete. Concrete may be placed

using the free fall method, provided less than 2 inches of water is present at the base of the shaft at the time the concrete is being placed. If more than 2 inches of water is present, a tremie should be used in an effort to displace the water to the surface for removal.

GSG recommends that the caisson concrete be ready on site as the drilled shaft excavation is completed, so that the concrete can be placed immediately after completing the excavation. This will reduce the potential of water accumulation in the bottom of the shaft. Bottom cleanliness of the drilled shaft excavation should be observed from the ground surface with the use of flood light or down-hole camera. Workers should not enter the shaft to manually clean the base of the shaft due to safety reasons.

5.0 Limitations

This report has been prepared for the exclusive use of AECOM and its design team, and the Illinois Department of Transportation. The recommendations provided in the report are specific to the project described herein, and are based on the information obtained from the soil boring locations within the proposed project limits. The analyses have been performed and the recommendations have been provided in this report are based on subsurface conditions determined at the location of the borings. This report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

APPENDIX A

SOIL BORING LOCATION PLAN

STA 56+93.28 HOFF RD. =
STA 76+80.64 IL ROUTE 53

UPRR - CONTACT (JOHN JEROME)
PH. (515) 570-1046

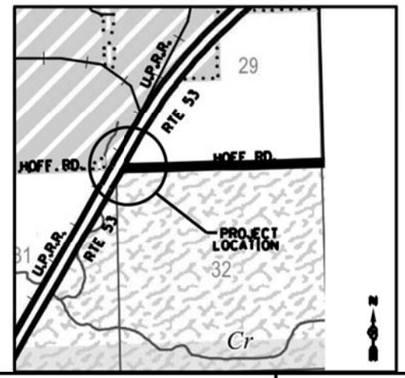
STATE OF ILLINOIS
PH. (847) 705-4000

FB-1
FB-2
FB-3
FB-4
FB-5

HOFF RD.

UPRR

IL ROUTE 53



SOIL BORING LOCATION

N

0 100 200 300

SCALE IN FEET

290492F HOFF ROAD
SOIL BORING LOCATIONS

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USER NAME = *USER*	DESIGNED - NE	REVISED -	
	DRAWN -	REVISED -	
PLOT SCALE = *SCALE*	CHECKED - DE	REVISED -	
PLOT DATE = *DATE*	DATE - 9/18/15	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

290492F HOFF ROAD
SOIL BORING LOCATIONS

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

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
846	DDI HSR 2016-01	WILL	1	1
		CONTRACT NO. 890-172		
	ILLINOIS FED. AID PROJECT			

APPENDIX B

SOIL BORING LOGS

GSG CONSULTANTS, INC.
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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721479.5309 **Easting** 1043566.8366

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-1
Station
Offset
Ground Surface Elev. 630.46 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter NA ft
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
6 inches of Asphalt 24 inches of crushed aggregate base		7				
		9 10		5		
627.96						
Dark Gray to Black, Very Moist FILL: CLAY, trace organics		3				
		3 4	2.0 P	25		
625.46 -5						
Stiff Dark Gray Clay, Very Moist CLAY (CL)		1				
		2 2	1.5 P	31		
622.96						
Very Stiff to Hard Brown and Gray, Moist SILTY CLAY (CL/ML), trace gravel		3				
		4 5	3.1 B	17		
-10						
		4				
		7 8	5.0 B	15		
		4				
		6 8	5.0 B	18		
-15						
		3				
613.96						
Very Stiff Gray, Moist SILTY CLAY (CL/ML), trace gravel		4 6	3.5 B	18		
		3				
		5 7	3.5 B	17		
-20						

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)

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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721479.5309 **Easting** 1043566.8366

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-1
Station
Offset
Ground Surface Elev. 630.46 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter NA ft
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
Very Stiff Gray, Moist SILTY CLAY (CL/ML), trace gravel *(continued)*		4				
		5 7	3.1 B	15		
		7				
		6 8	3.5 B	15		
605.46	-25					
End of Boring						
	-30					
	-35					
	-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)

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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721457.651 **Easting** 1043685.8979

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-2
Station
Offset
Ground Surface Elev. 631.14 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter 626.6 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
Gray, Moist FILL: Crushed aggregate 630.14		4				
Black and Brown, Moist FILL: CLAY, trace organics		4 5	3.0 P	16		
		3				
626.64 ▼		1 33	1.5 P	21		
-5 Medium Dense Brown and Gray, Moist SAND, with silt and gravel		4				
623.64		7 8		20		
Hard Brown and Gray, Moist SILTY CLAY (CL/ML), trace gravel		6				
		8 10	6.3 B	17		
-10		5				
		9 14	6.7 B	17		
		5				
		8 10	5.8 B	18		
-15		7				
		8 10	5.5 P	18		
612.64		4				
		5 8	3.1 B	19		
-20						

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)

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tel: 312.733.6262 • fax: 312.733.5612

SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721457.651 **Easting** 1043685.8979

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-2
Station
Offset
Ground Surface Elev. 631.14 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter 626.6 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
Very Stiff Gray, Moist SILTY CLAY (CL/ML), trace gravel *(continued)*		3				
		5 6	2.5 B	18	122.6	
		4				
		7 11	2.5 B	18		
606.14 -25						
End of Boring						
-30						
-35						
-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)

GSG CONSULTANTS, INC.
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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721561.4491 **Easting** 1043734.4447

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-3
Station
Offset
Ground Surface Elev. 632.33 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter NA ft
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)	
							Gray, Moist FILL: Crushed aggregate
631.33							
		5					Black and Brown, Moist FILL: CLAY
		4 5	2.5 P	21			
		3					
		17 14	2.0 P	20			Noted a thin layer of gray sand at 4 feet
627.33							
-5							Stiff Dark Gray to Black, Very Moist CLAY (CH)
		3					
		3 4	1.5 P	44			
		3					
622.83							
		3 3	1.5 P	26			
-10							Very Stiff to Hard Brown and Gray, Moist SILTY CLAY (CL/ML), trace gravel
		3					
		4 7	3.1 B	17	114.6		
		3					
		4 9	3.5 B	16			
-15							
		5					
615.33							
		6 8	5.0 B	16			Very Stiff to Hard Gray, Moist SILTY CLAY (CL/ML), trace gravel
		4					
		6 8	4.2 B	15			
-20							

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)

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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721561.4491 **Easting** 1043734.4447

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-3
Station
Offset
Ground Surface Elev. 632.33 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter NA ft
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
Very Stiff to Hard Gray, Moist SILTY CLAY (CL/ML), trace gravel *(continued)*		4				
		6 7	3.5 B	15		
		6				
		5 8	3.1 B	15		
607.33 -25						
End of Boring						
-30						
-35						
-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)

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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721472.7763 **Easting** 1043839.3169

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-4
Station 76+80
Offset
Ground Surface Elev. 631.01 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter 613.5 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
Gray, Moist FILL: Crushed aggregate		8				
		6 2		6		
628.51						
Black and Brown, Very Moist FILL: CLAY		3				
		3 4	2.0 P	30	92.5	
626.01 -5						
Very Stiff Brown and Gray, Moist CLAY (CL), trace gravel		2				
		3 4	2.5 P	19		
		6				
		4 5	2.5 B	19		
-10						
		3				
		5 7	3.5 B	17	114.8	
		3				
617.01						
Hard Gray, Moist SILTY CLAY (CL/ML), trace gravel		7 8	5.0 B	15		
-15						
		5				
		7 14	5.0 B	15		
613.51 ▼						
Medium Dense Gray, Moist SAND (SP), trace gravel		2				
612.51						
Very Stiff Gray, Moist SILTY CLAY (CL), trace gravel		4 5	3.1 B	17		
-20						

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)

GSG CONSULTANTS, INC.
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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721472.7763 **Easting** 1043839.3169

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-4
Station 76+80
Offset
Ground Surface Elev. 631.01 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter 613.5 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
Very Stiff Gray, Moist SILTY CLAY (CL), trace gravel *(continued)*		3				
		4 7	2.5 B	16	117.2	
		3				
-25		4 7	2.1 B	16		
		3				
		5 7	2.5 B	16		
602.01		4				
Stiff Gray, Moist SILT (ML)		9 11	2.0 P	8	133.1	
-30						
		4				
596.01		9 11		17		
-35						
Very Stiff Gray, Very Moist CLAY (CL)		5				
		6 7	2.1 B	27		
591.01						
-40						

End of Boring

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)

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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721572.1243 **Easting** 1043903.3096

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-5
Station 78+10
Offset
Ground Surface Elev. 632.68 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter 626.2 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)	Description
		4					Gray, Moist FILL: Crushed aggregate
		5 6	3.0 P	16			
630.68							
		4					Black and Gray, Moist FILL: CLAY
		3 4	2.0 P	17			
627.68							
-5		2					Stiff Dark Gray to Brown, Very Moist CLAY (CL) ▼
		1 2	1.0 P	30			
		1					
		1 2	1.5 P	15	99.3		
-10							
621.68							
		3					Very Stiff to Hard Brown and Gray, Very Moist SILTY CLAY (CL/ML), trace gravel
		5 5	2.0 P	20			
		4					
		6 8	5.0 B	30	116.3		
-15							
		4					
		6 7	4.0 P	19			
		4					
614.18							
		7 7	3.1 B	17			
-20							

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)

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SOIL BORING LOG

Date 9/8/15

ROUTE IL Rte. 53 & Hoff Rd. **DESCRIPTION** High Speed Rail Chicago to Quad Cities **LOGGED BY** JAR

SECTION Mile Post 46.64 **LOCATION** **Northing** 1721572.1243 **Easting** 1043903.3096

COUNTY Will **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NA
Station NA

BORING NO. FB-5
Station 78+10
Offset
Ground Surface Elev. 632.68 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft
Groundwater Elev.:
First Encounter 626.2 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

NOTES:

DEPTH (ft)	GRAPHIC LOG	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DRY DENSITY (pcf)	ORGANIC (%)
		3				
		6 8	2.5 B	16		
		3				
		5 8	2.5 B	15	119.1	
-25		3				
		4 5	2.5 B	17		
		4				
		6 9	4.2 B	16		
-30		5				
		6 11	4.2 B	15		
-35		4				
		6 8	3.1 B	24		
592.68	-40					

Very Stiff to Hard
Gray, Moist
SILTY CLAY (CL/ML), trace gravel *(continued)*

End of Boring

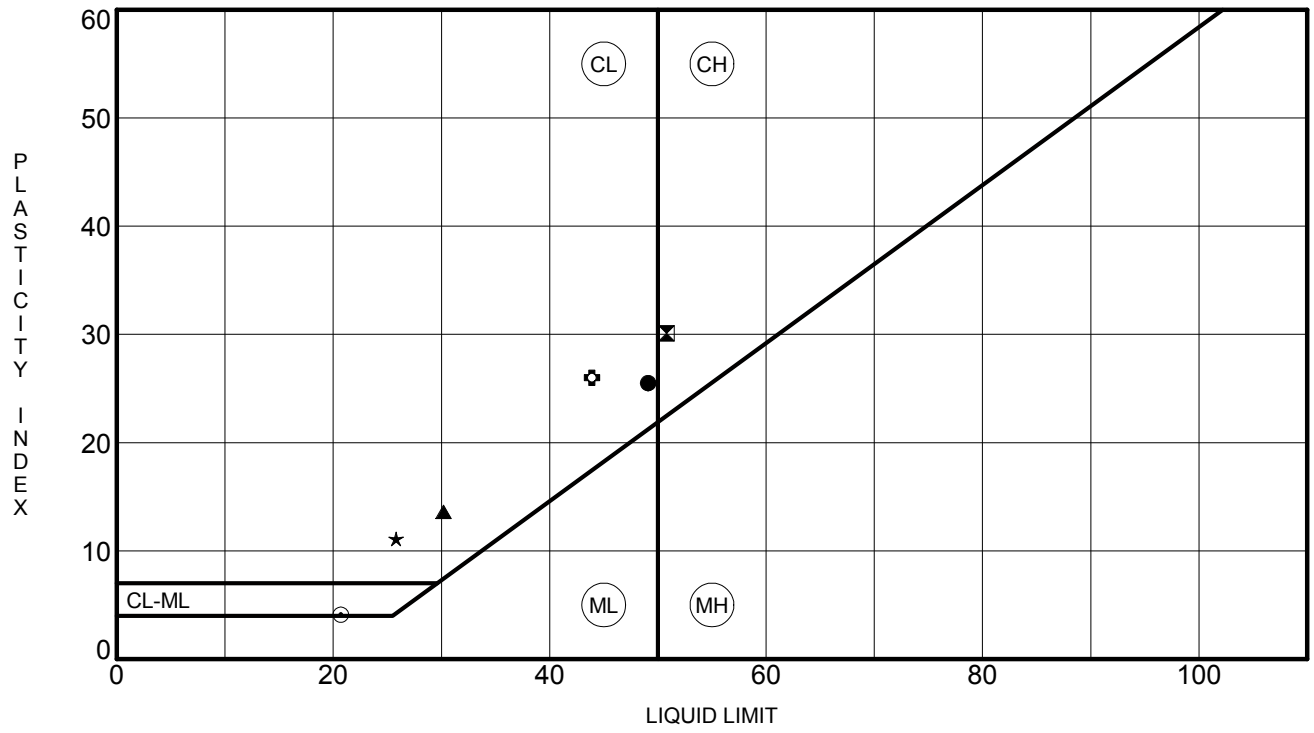
The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

APPENDIX C

LABORATORY TEST RESULTS

Atterberg Limit Results						
Boring ID	**Sample Number**	**Sample Depth (Below Existing Grade)**		**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
		Top (ft.)	Bottom (ft.)			
FB-1	SS-2	3.50	5.00	49.1	23.6	25.5
FB-3	SS-4	8.50	10.00	50.8	20.7	30.1
FB-4	SS-4	8.50	10.00	30.2	16.6	13.6
FB-4	SS-9	21.00	22.50	25.8	14.7	11.1
FB-4	SS-13	33.50	35.00	20.7	16.6	4.1
FB-5	SS-4	8.50	10.00	43.9	17.9	26.0

Organic Content Results				
Boring ID	**Sample Number**	**Sample Depth (Below Existing Grade)**		**Organic Content (%)**
		Top (ft.)	Bottom (ft.)	
FB-2	SS-2	3.50	5.00	3.0



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**FB-1**	**3.50**	**49.1**	**23.6**	**25.5**		
⧓	**FB-3**	**8.50**	**50.8**	**20.7**	**30.1**		
▲	**FB-4**	**8.50**	**30.2**	**16.6**	**13.6**		
★	**FB-4**	**21.00**	**25.8**	**14.7**	**11.1**		
⊙	**FB-4**	**33.50**	**20.7**	**16.6**	**4.1**		
✿	**FB-5**	**8.50**	**43.9**	**17.9**	**26.0**		

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ATTERBERG LIMITS RESULTS

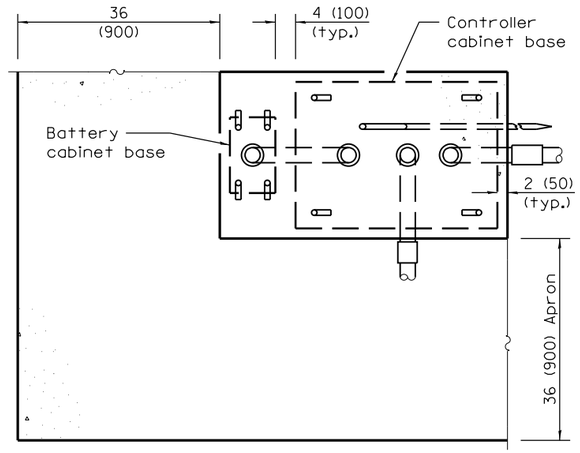
Route: IL Rte. 53 & Hoff Rd.

Section: Mile Post 46.64

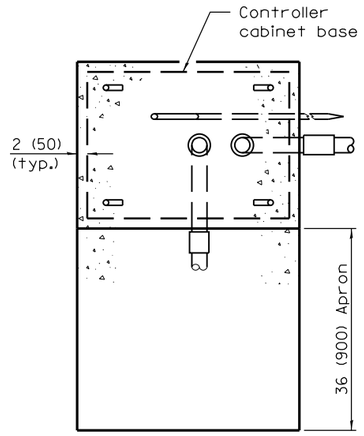
County: Will

APPENDIX D

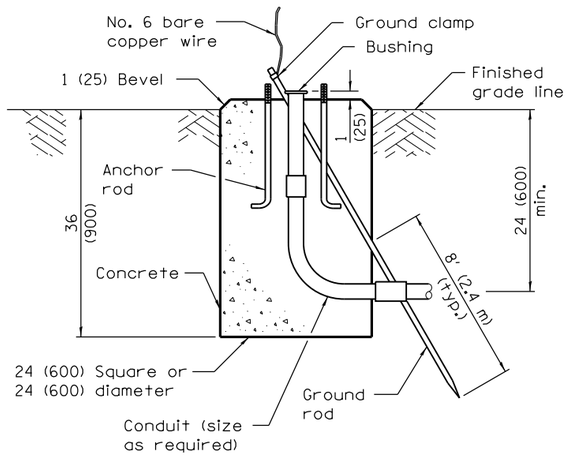
IDOT HIGHWAY STANDARD 878001-10



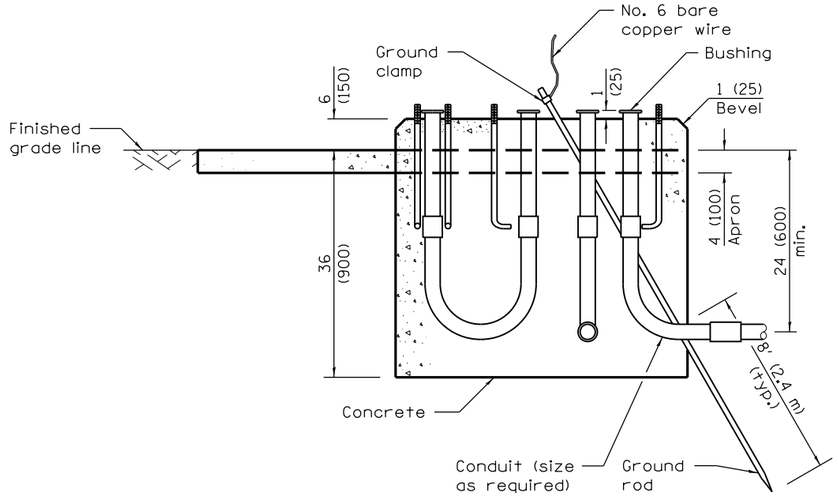
TOP VIEW



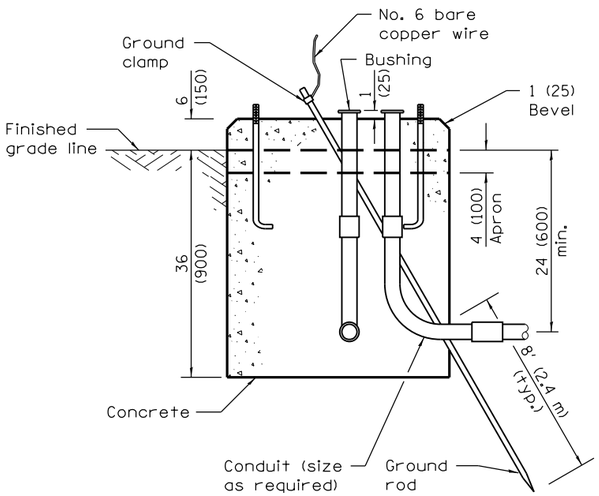
TOP VIEW



TYPE A



TYPE C
FOR GROUND MOUNTED
CONTROLLER CABINET
AND UPS BATTERY CABINET



TYPE D
FOR GROUND MOUNTED
CONTROLLER CABINET

All dimensions are in inches (millimeters)
unless otherwise shown.

Illinois Department of Transportation

APPROVED January 1, 2015
ENGINEER OF OPERATIONS

APPROVED January 1, 2015
ENGINEER OF DESIGN AND ENVIRONMENT

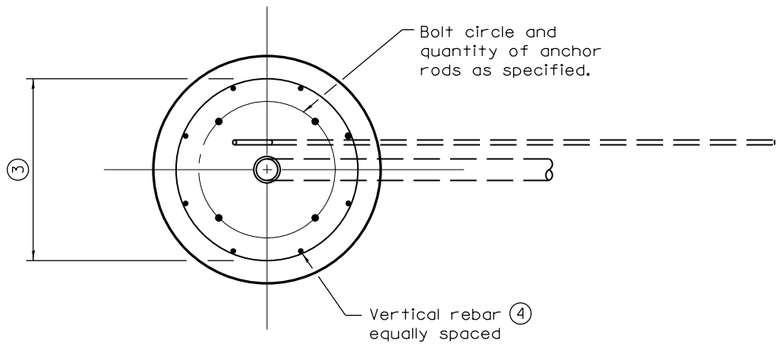
ISSUED 1-1-02

DATE	REVISIONS
1-1-15	Revised TYPE E detail.
1-1-12	Replaced rebar No.'s
	with 'Vertical' for TYPE E
	foundation detail.

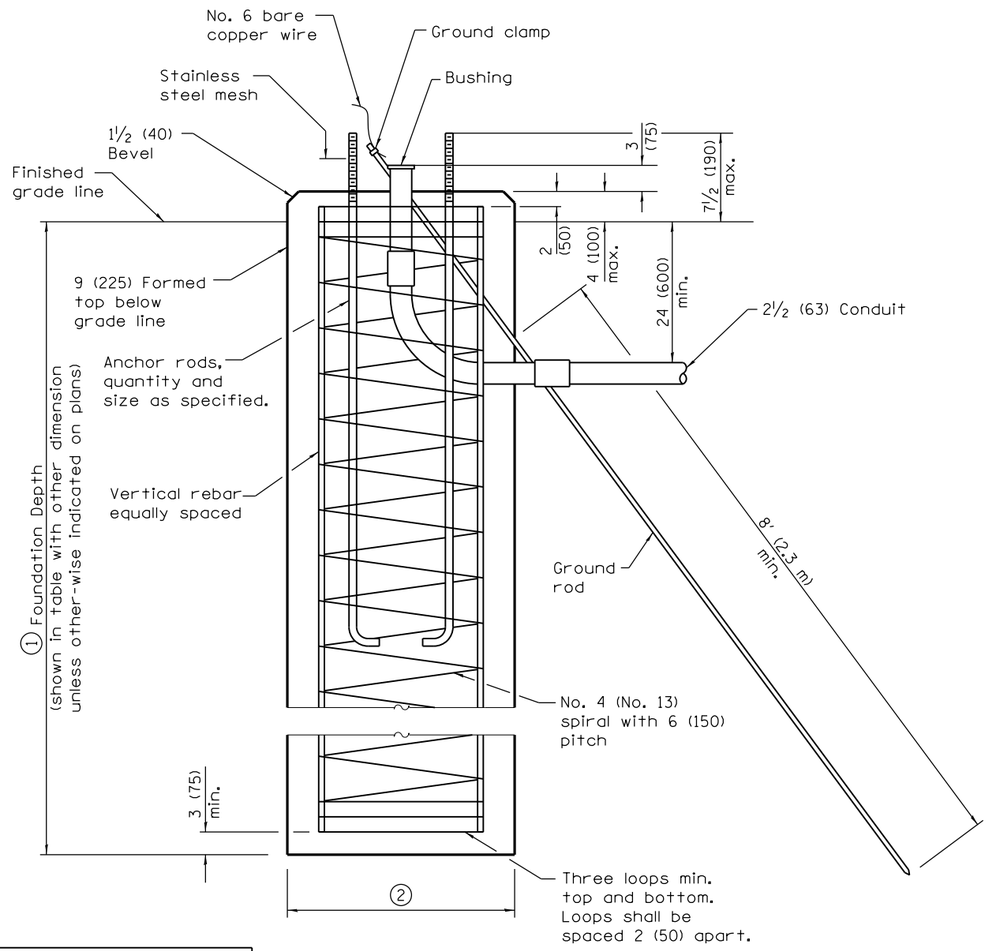
CONCRETE FOUNDATION DETAILS

(Sheet 1 of 2)

STANDARD 878001–10



TOP VIEW



TYPE E

Mast Arm Length	① Foundation Depth •	② Foundation Diameter	③ Spiral Diameter	④ Quantity of Rebars	Size of Rebars
Less than 30′ (9.1 m)	10′-0″ (3.0 m)	30 (750)	24 (600)	8	6 (19)
Greater than or equal to 30′ (9.1 m) and less than 40′ (12.2 m)	13′-6″ (4.1 m)	30 (750)	24 (600)	8	6 (19)
	11′-0″ (3.4 m)	36 (900)	30 (750)	12	7 (22)
Greater than or equal to 40′ (12.2 m) and less than 50′ (15.2 m)	13′-0″ (4.0 m)	36 (900)	30 (750)	12	7 (22)
Greater than or equal to 50′ (15.2 m) and up to 55′ (16.8 m)	15′-0″ (4.6 m)	36 (900)	30 (750)	12	7 (22)
Greater than or equal to 56′ (16.8 m) and less than 65′ (19.8 m)	21′-0″ (6.4 m)	42 (1060)	36 (900)	16	8 (25)
Greater than or equal to 65′ (19.8 m) and up to 75′ (22.9 m)	25′-0″ (7.6 m)	42 (1060)	36 (900)	16	8 (25)

• For standard and combination mast arm assemblies. Foundation depths for standard dual mast arms with the longest arm length upto and including 55′ (16.8 m) shall be increased by 1′ (0.3 m) of that shown in the table, based on the longer of the two arms.

These foundation depths are for sites which have cohesive soils (clayey silt, sandy clay, etc.) along the length of the shaft, with an average Unconfined Compressive Strength (Qu) > 1.0 tsf (100 kpa). This strength shall be verified by boring data prior to construction or with testing by the Engineer during foundation drilling. The Bureau of Bridges & Structures should be contacted for a revised design if other conditions are encountered.

Illinois Department of Transportation

APPROVED January 1, 2015
ENGINEER OF OPERATIONS

APPROVED January 1, 2015
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 1-1-02

CONCRETE FOUNDATION DETAILS

(Sheet 2 of 2)

STANDARD 878001–10