GEOTECHNICAL REPORT

Project Name & Address: Government Center Tower
740 7th Avenue West
Durand, WI 54736

Property Information: NE ¼ of the NW ¼,
Section 28, T25N, R13W
City of Durand,
Pepin County,
Wisconsin

Client: Pepin County
740 7th Avenue West
Durand, WI 54736

Consultant: Edge Consulting Engineers, Inc.
624 Water Street
Prairie du Sac, Wisconsin 53578
Contact: Arlen Ostreng
Phone: (608) 644-1449

Edge Project Number: 19848

Date: December 21, 2018

Andrew Porn
Geotechnical Specialist

Date

Arlen Ostreng, P.E.
Geotechnical Manager

Date
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SECTION 1
INTRODUCTION

1.1 PROJECT INFORMATION

This report summarizes the results of a geotechnical exploration conducted by Edge Consulting Engineers, Inc. (Edge Consulting) for Pepin County, who is proposing to construct a new 180-foot self-support telecommunications tower on a parcel of land located at 740 7th Avenue West in the City of Durand in Pepin County, Wisconsin. Proposed equipment will be located near the base of the proposed tower within a fenced compound. A street map showing the location of the proposed tower site is available in Figure 1. The location of the proposed project site on the Durand South, Wisconsin United States Geological Survey (USGS) 7.5 Minute Quadrangle is shown in Figure 2. Based on an inspection of the quadrangle map and detailed site survey, the site is located at an approximate elevation of 832 feet above mean sea level. A site plan depicting the proposed project has been included as Figure 3. Site photos have also been included in Figure 4.

1.2 PURPOSE OF REPORT

The investigative activities of this report were conducted for the purposes of providing geotechnical engineering design parameters, soil characteristics, tower and equipment structure foundation recommendations, and site development recommendations with respect to the proposed improvements. This assessment was completed in conformance with client directed protocols, and utilizing the judgment of the geotechnical engineer.

1.3 SCOPE OF SERVICES

The scope of services for this project included research of reference materials and field exploration. Section 5 contains a list of references consulted in the preparation of this report. The scope of services for this report was determined predominantly by client supplied standards.

Field exploration consisted of advancing one boring in the vicinity of the proposed tower base to a depth of 40 feet, or until auger refusal. Edge Consulting reviewed the boring logs, the recovered soil samples, and laboratory testing results (if any) to determine the engineering characteristics of the soils at or near the proposed tower location. This report summarizes the field exploration results and provides recommendations related to suitable foundation types and depths, allowable bearing pressure, and estimates of foundation settlement.
SECTION 2
EXPLORATION RESULTS

2.1 REFERENCE RESEARCH & BACKGROUND

Review of United States Department of Agriculture NRCS (Natural Resource Conservation Service) Web Soil Survey for Pepin County indicates natural site soils are classified as "265C" (Garne loamy sand). These soil types are typically somewhat excessively drained that are steeply sloping and consist of eolian sands over loamy residuum. The soils are typically classified as SM or CL on the Unified Soil Classification System. The risk of corrosion to uncoated steel is high and for concrete is moderate. Edge Consulting reviewed the "Thickness of Unconsolidated Material in Wisconsin" map prepared by the Geologic and Natural History Survey. This map indicates that the anticipated depth to bedrock is between 50 and 100 feet with underlying bedrock consisting of sandstone, dolomite, and shale of the Trempealeau, Tunnel City, and Elk Mound Groups.

2.2 TOPOGRAPHY

The existing topography of the subject site is steeply sloping with surface water generally flowing to the west. Existing slopes are approximately 3-6%. Site drainage is adequate, and no standing water was observed during drilling operations.

2.3 FIELD EXPLORATION

Geotechnical Drilling Contractors (GDC) performed the field drilling services for the project. One standard penetration test (SPT) soil boring was advanced to a depth of 35 feet below grade surface (bgs) due to auger refusal. Drilling was completed on December 5, 2018. The boring was advanced using a rotary drill rig. Representative soil samples were obtained using a standard 2-inch diameter split spoon sampler in general accordance with ASTM D 1586-08, “Standard Method for Penetration Tests and Split-Barrel Sampling of Soils”. A description of this procedure is available in Appendix C of this report. Split spoon sampling was performed by collecting 18 inch samples at 2.5-foot intervals to a depth of 15 feet and 5 foot intervals thereafter.

The drill crew chief visually and manually classified samples in the field in accordance with ASTM D 2487-06. The field personnel then collected representative soil samples from each split spoon and placed these samples in glass jars for further examination and verification of the field classification by a geotechnical engineer. The soil boring logs located in Appendix A contain pocket penetrometer readings, standard penetration measurements, soil classification information and other pertinent information.

Upon completion of drilling, the soil borings were abandoned in accordance with Chapter NR 141, Wisconsin Administrative Code.
2.4 SUBSURFACE CONDITIONS

One soil boring was completed at the site. Boring B-1 was drilled as close to the proposed tower center location as was possible. Subsurface soils were noted to consist of 4 inches of topsoil followed by medium dense sand to 8 feet bgs. This was followed by stiff to very stiff sandy clay to 15 feet bgs and weathered sandstone to the end of boring and auger refusal at 35 feet bgs. The approximate location of the boring is depicted in Figure 3. The boring log is available in Appendix A.

2.5 BEDROCK

Weathered sandstone was initially encountered at 15 feet bgs at the proposed tower center. This material was drillable until auger refusal was met at 35 feet bgs.

2.6 FROST DEPTH AND COVER

According to the ANSI/TIA -222-G standards, frost depth for the area is expected to be 80 inches. It is recommended that all tower foundation elements, not bearing directly on solid rock or otherwise protected from frost, be founded at or below this depth to adequately protect against frost heave. Similarly, foundations for equipment buildings larger than 400 sq.ft. shall also extend below the frost line of the locality, be constructed on solid rock or be otherwise protected from frost in accordance with Section 1809.5 of the International Building Code (IBC).

2.7 WATER LEVEL OBSERVATIONS

Groundwater was not encountered during this investigation.

2.8 LABORATORY TESTING

Edge Consulting utilized a Bluelab® soil pH pen to obtain a pH reading of 5.7 from a collective soil sample obtained at the tower center from 5 to 6.5 feet bgs. The pH level was obtained in accordance with ASTM G51-95(2005) “Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing”.

A soil resistivity test was also completed on the same collective soil sample using a MC Miller soil box in conjunction with a Nilsson Model 400 Soil Resistance Meter to obtain a resistance reading of 190,000 OHM-cm. The soil resistance test was collected in accordance with ASTM G57-95a (Reapproved 2001) “Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method”.
SECTION 3
ANALYSIS & RECOMMENDATIONS

3.1 FOUNDATIONS

3.1.1 Proposed Tower

Based upon the information obtained during this investigation, Edge Consulting recommends the use of a standard spread footing (mat) or individual pad and pier footings at each of the tower legs to support the proposed tower. It is recommended that either tower foundation should bear on existing medium dense sand soils at a minimum depth of 7 feet below existing grade surface. A complete listing of soil properties for use in foundation design is contained in Appendix B.

3.1.2 Equipment Support Structure

Edge Consulting recommends the use of conventional strip footings or an engineered floating slab for an equipment building foundation. Strip footings should have a minimum width of 12 inches. Strip footings for structures larger than 400 sq.ft. should extend to below the frost line of the locality or 48 inches below finished grade, whichever is greater. Footings bearing directly on solid rock above this depth or insulated by other means are also acceptable forms of frost protection.

If a floating slab foundation system is utilized, the slab should be designed in accordance with ACI 302.1R80 practice. Concrete floor slabs may be constructed on exposed subgrade or new compacted fill. In all cases, the exposed subgrade beneath new fill or the proposed floor slab should be compacted to 90% - 95% of the Modified Proctor maximum dry density (ASTM D1557). A minimum of 8 inches of compacted granular fill, or free draining gravel (ASTM C33, Size 57 concrete aggregate), should be located immediately beneath any floor slabs.

If an elevated equipment platform or building is to be utilized, Edge Consulting recommends supporting these structures with the use of individual drilled piers. Drilled piers for elevated equipment platforms and buildings should extend below the frost line of the locality or 48 inches below finished grade, whichever is greater.

3.2 SITE AND FOUNDATION DRAINAGE

Positive site drainage should be provided to reduce infiltration of surface water into the backfills around the perimeters of tall proposed structures. All grades should slope away from these structures. Edge Consulting recommends that the top of tower foundation elements extend a minimum of 12 inches above the final site surface.
3.3 SITE PREPARATION & FILL RECOMMENDATIONS

The following general site preparation and fill recommendations are provided for the development of this site.

- All vegetation, root-mat, topsoil, and any other soft or unsuitable material should be stripped from the areas of all proposed improvements. The removed material should be placed outside of any proposed improvement areas. These materials should not be utilized for backfill purposes.
- Removal of unsuitable fill material should be conducted within the footprint of the proposed improvements. Any construction debris should be removed from the site. The remaining material may be used as fill in other "non load bearing" areas of the site outside of the equipment pad, tower compound and road bed footprints.
- All areas requiring engineered fill should be brought up to grade. Engineered fill material should consist of clean well graded granular material containing less than 15% by weight passing the No. 200 sieve. This material should be placed in thin lifts not exceeding 8 inches in a loose thickness and compacted to 90% to 95% of the maximum dry density, as determined by ASTM D 1557, Modified Proctor test. Fill areas under footings should be extended from each side of the outermost location of the footing at a rate of 1 foot width for every 1 foot of fill depth. Fill placement activities should be performed in the presence of a qualified geotechnical engineer.
- Once final grade for footing placement has been established, density tests and/or examination by a geotechnical engineer should be performed in the footing trenches prior to footing placement to confirm that the material has achieved an adequate degree of compaction.
- Foundation and wall construction should follow in accordance with the structural engineers requirements.
- Once the prescribed curing time has been achieved, installation of any required perimeter drainage system and backfill may be initiated. Backfill of foundation walls may consist of onsite or imported granular material. Backfill should be installed in a maximum of 12 inch lifts and compacted to a 92% of the maximum dry density (D1557).

3.4 EXCAVATION SLOPE RECOMMENDATIONS

It is expected that short term slopes of 1:1 can be maintained in the soils encountered at this site. However, construction practices should follow all federal, state and local regulations regarding safety standards for all excavation activities.

Construction site safety is the sole responsibility of the Contractor. Edge Consulting assumes no liability for Contractor’s construction activities, construction site safety, or interpretation of information provided within this report. Such responsibility shall neither be implied nor inferred.
3.5 **SOIL BEARING CAPACITY**

The recommended maximum presumptive net bearing capacity of medium dense sand soils at depths between 1 and 8 feet bgs is 3,000 psf. Foundation systems designed for these capacities should experience a total settlement of less than 1 inch, with a differential settlement of less than half this amount. All bearing values should be considered allowable. A factor of safety of 2.0 has been assumed.

3.6 **LATERAL EARTH PRESSURE**

Edge Consulting utilized Rankine methodology to determine the foundation earth pressure parameters. Recommended values for passive lateral earth pressure based on soil depth are available in Appendix B. All calculated values are considered ultimate. It is assumed that a minimum factor of safety of 2.0 will be incorporated at the time of foundation design.

3.7 **FRICTIONAL SKIN RESISTANCE**

Included in Appendix B are recommended values for compressive frictional skin resistance for this site. These resistances are assumed to occur between concrete foundation elements and existing site soils. All calculated values are considered ultimate. It is assumed that a minimum factor of safety of 2.0 will be incorporated at the time of foundation design. For uplift and pull-out type calculations, it is further recommended that the uplift frictional skin resistance be considered as 2/3 of the listed compressive values.

3.8 **SPECIAL DESIGN CONSIDERATIONS**

Based upon the proposed site grading plans for this site, the dimension from top of concrete at the tower anchor bolt setting to the foundation base should be a minimum of 8 feet to account for existing site contour, proposed filling, drainage and frost protection.

The proposed tower is located within soils with relatively high resistivity readings. It is recommended that an enhanced grounding system be implemented at this site which may include the use of chemical ground rods, tight ground rod spacing pattern and/or low-resistivity grounding backfill.
3.9 SPECIAL CONSTRUCTION CONSIDERATIONS

The contractor should review the proposed tower foundation design with the site construction plans prior to ordering foundation reinforcing steel. The tower foundation should be designed such that the top of concrete extends 12-inches above the proposed compound finished grade. In addition, the foundation base should extend to a minimum of 7 feet below existing grade. If the plans do not reflect this condition, please contact the project manager and foundation designer.

Special precautions should be taken for earthwork during winter months. Footings or fills should not be placed on frozen soils. Exposed subgrade soil should be adequately protected with insulating blankets.
SECTION 4
LIMITATIONS AND RESTRICTIONS

This report has been prepared to aid in the evaluation of this property for the intended use described herein, and to assist in the design or planning of this project. In the event any changes in the design as outlined herein, or changes in the vertical position or horizontal location of the facility are planned, the conclusions and recommendations contained in this report shall not be considered valid unless such changes are reviewed by Edge Consulting Engineers, Inc.

The analysis and recommendations submitted in this report are our opinions based on the data obtained and subsurface conditions noted from the field investigation described at the locations indicated on the accompanying site plan. This report does not reflect any variations that may occur between, beyond, or below the depths of these test pits or borings. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

The soil report is only for the purposes stated in the contract and may not be sufficient to prepare an accurate bid.

Certain assumptions have been made regarding the foundation design for this site. Edge Consulting Engineers, Inc. should be given the opportunity to review the final foundation design to determine whether the final design necessitates any changes of the recommendations contained in this document. If Edge Consulting is not provided the opportunity for this review, we can assume no responsibility for the misinterpretation or misapplication of these recommendations or for their validity in the event changes have been made to the initial understanding of the project or design content.

There is the possibility that variations in soil conditions will be encountered during construction. In order to permit correlation between soil data in this report and the actual soil conditions encountered during construction, it is required that the soil engineer be retained to perform a review of the excavation prior to foundation placement. Edge Consulting assumes no responsibility for construction compliance with design concepts, specifications, or recommendations unless we have been retained to perform on-site review during the course of construction. Edge Consulting should be contacted immediately if conditions encountered are not consistent with those described.

This report was prepared in accordance with generally accepted soil and foundation engineering practices and makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of the agreement between the Engineer and his client. This report has not been prepared for uses or parties other than those specifically named, or for uses or applications other than those enumerated herein. The report may contain insufficient or inaccurate information for other purposes, applications, building sites, or other uses.
SECTION 5
REFERENCES


Figure 1

Street Maps
Project Number: #19848
Project Info: Pepin County / Government Center Tower
Project Location: 740 7th AVE W., Durand, WI 54736
FIGURE #2
Street Map

Project Number:  #19848
Project Info:  Pepin County / Government Center Tower
Project Location:  740 7th AVE W., Durand, WI 54736
Figure 2

USGS Topographic Quadrangle Map
Proposed Site Location

FIGURE #3
7.5 Minute USGS Quadrangle Map

Project Number: #19848
Project Info: Pepin County / Government Center Tower
Project Location: 740 7th AVE W., Durand, WI 54736
Figure 3

Site Plan
FIGURE #4
Aerial Site Plan

Project Number: #19848
Project Info: Pepin County / Government Center Tower
Project Location: 740 7th AVE W., Durand, WI 54736
**KEYNOTES: (THIS SHEET)**

A. 80' GUY SUPPORT TOWER, SEE SHEET T-201
B. PEPIN COUNTY EQUIPMENT SHELTER
C. CHAIN LINK FENCE
D. UTILITY RACK
E. GENERATOR
F. GROUND MOUNTED 120/240 1P ELEC. XFMR
G. EXISTING 80' GUY SUPPORT TOWER, EXTEND UNDERGROUND ELEC. SERVICE FROM POLE TO XFMR
H. NEW NATURAL GAS SERVICE
I. EXISTING 80' TOWER LOCATED ON GOVERNMENT CENTER ROOF TO BE DECOMMISSIONED AND REMOVED UPON NEW TOWER INSTALLATION. CAREFULLY REMOVE AND SALVAGE ALL EXISTING ANTENNAS FROM EXISTING TOWER FOR REVIEW BY CONTRACTOR. ANY ANTENNAS NOT DESIRED BY CONTRACTOR SHALL BECOME PROPERTY OF THE CONTRACTOR, ITEMS SHALL BE REMOVED FROM DECOMMISSIONED AND REMOVED UPON NEW TOWER INSTALLATION.
J. UNDERGROUND CONDUIT FROM COMPOUND EQUIPMENT SHELTER TO GOVERNMENT CENTER BUILDING; SEE SHEETS A-102 & A-103 FOR CONTINUATION
K. 4" WIDE CONCRETE SIDEWALK; SEE DETAIL D/C-501
L. EX. TREE STUMP TO BE REMOVED TO 24" MIN. BELOW GRADE
M. FIRST OPTIC HAND-HOLED EJUNCTION BOX; DETAIL D/E-503

**DEMOLITION NOTES: (THIS SHEET)**

1. ALL DEMOLISHED OR REMOVED ITEMS SHALL BECOME THE PROPERTY OF THE CONTRACTOR. ITEMS SHALL BE REMOVED FROM THE SITE, CAREFULLY REMOVE AND SALVAGED OR DISPOSED OF AT AN APPROVED DEPOT.
2. REMOVAL OF THE EXISTING TOWER SHALL BE COMPLETED AFTER INSTALLATION OF NEW TOWER.

**EXISTING UTILITY POLE DESIGN**
Figure 4

Site Photographs
FIGURE #5
Site Photographs

Project Number: #19848
Project Info: Pepin County / Government Center Tower
Project Location: 740 7th AVE W., Durand, WI 54736
Photograph Date: May 17, 2018
FIGURE #5
Site Photographs

Project Number: #19848
Project Info: Pepin County / Government Center Tower
Project Location: 740 7th AVE W., Durand, WI 54736
Photograph Date: May 17, 2018
Appendix A

Soil Boring Logs
**Project:** Pepin Co (Gov Center Tower)  
**Project Location:** Durand, WI  
**Project Number:** 19848

### Log of Boring B-1

**Sheet 1 of 1**

**Date(s) Drilled:** December 5, 2018  
**Logged By:** D  
**Checked By:** D

**Drilling Method:** Hollow Stem Auger  
**Drill Rig Type:** CME 75  
**Groundwater Level and Date Measured:** Not Encountered ATD  
**Borehole Backfill:** Bentonite/Cuttings

**Drill Bit Size/Type:** 2 inch Split Spoon  
**Drill Rig Type:** CME 75  
**Drilling Contractor:** Geotechnical Drilling Contractors  
**Groundwater Level:** Not Encountered ATD  
**Sampling Method(s):** SPT  
**Hammer Data:** 140 lb, 30 in drop, rope & cathead

**Total Depth of Borehole:** 35 feet bgs  
**Approximate Surface Elevation:** 832 feet MSL

### Material Description

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<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Sample Number</th>
<th>Sampling Resistance, blowcount</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>Graphic Log</th>
<th>Moisture</th>
<th>Cu (ft²)</th>
<th>Recovery (in)</th>
<th>Remarks and Other Tests</th>
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Bottom of Boring and Auger Refusal at 35 feet bgs

**Figure 1**
Project: Pepin Co (Gov Center Tower)  
Project Location: Durand, WI  
Project Number: 19848

Key to Log of Boring

Sheet 1 of 1

<table>
<thead>
<tr>
<th>COLUMN DESCRIPTIONS</th>
<th>MATERIAL DESCRIPTION</th>
<th>FIELD AND LABORATORY TEST ABBREVIATIONS</th>
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<tr>
<td>Elevation, feet</td>
<td>Elevation (MSL, feet)</td>
<td>CHEM: Chemical tests to assess corrosivity</td>
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<td>Depth, feet</td>
<td>Depth in feet below the ground surface.</td>
<td>COMP: Compaction test</td>
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<td>Sample Type</td>
<td>Type of soil sample collected at the depth interval shown.</td>
<td>CONS: One-dimensional consolidation test</td>
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<td>Sample Number</td>
<td>Sample identification number.</td>
<td>LL: Liquid Limit, percent</td>
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<tr>
<td>Sampling Resistance, blows/foot</td>
<td>Number of blows to advance driven sampler foot (or distance shown) beyond seating interval using the hammer identified on the boring log.</td>
<td>PI: Plasticity Index, percent</td>
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<tr>
<td>Relative Consistency</td>
<td>Relative consistency of the subsurface material.</td>
<td>TYPICAL MATERIAL GRAPHIC SYMBOLS</td>
</tr>
<tr>
<td>USCS Symbol</td>
<td>USCS symbol of the subsurface material.</td>
<td>Well graded GRAVEL (GW)</td>
</tr>
</tbody>
</table>

TYPICAL SAMPLER GRAPHIC SYMBOLS

- 2-inch-OD unlined split spoon (SPT)  
- 2.5-inch-OD Modified California w/ brass liners  
- 3-inch-OD California w/ brass rings

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)  
- Water level (after waiting a given time)  
- Minor change in material properties within a stratum  
- Inferred or gradational contact between strata  
- Queried contact between strata

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.
Appendix B

Soil Properties, Calculations
### SOIL PROFILE

**Notes:**
- Groundwater not encountered
- Frost depth is at 7’ BGS
- k, E50 values are for Lpile use only

#### Medium Dense Sand (SP)
(0 to 8 feet BGS)

<table>
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<th>Depth (feet)</th>
<th>Unit Weight (pcf)</th>
<th>Friction Angle (°)</th>
<th>Cohesion (psf)</th>
<th>Effective Stress (psf)</th>
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<td>6</td>
<td>110</td>
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#### Stiff to Very Stiff Sandy Clay (CL)
(8 to 15 feet BGS)

<table>
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<th>Depth (feet)</th>
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<th>Friction Angle (°)</th>
<th>Cohesion (psf)</th>
<th>Effective Stress (psf)</th>
<th>Passive Pressure (psf)</th>
<th>Skin Friction Resistance (psf)</th>
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<tbody>
<tr>
<td>8</td>
<td>115</td>
<td>0°</td>
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<td>4,880</td>
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<td>10</td>
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<tr>
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#### Dense Weathered Sandstone
(15 to 20 feet BGS)

<table>
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<th>Unit Weight (pcf)</th>
<th>Friction Angle (°)</th>
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<th>Effective Stress (psf)</th>
<th>Passive Pressure (psf)</th>
<th>Skin Friction Resistance (psf)</th>
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<tbody>
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<td>1,646</td>
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<tr>
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<td>120</td>
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<td>1,816</td>
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<tr>
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<td>7,877</td>
<td>1,896</td>
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<td>1,974</td>
</tr>
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<td>8,801</td>
<td>2,048</td>
</tr>
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<td>2,048</td>
</tr>
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</table>

#### Very Dense Weathered Sandstone
(20 to 35 feet BGS)

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Unit Weight (pcf)</th>
<th>Friction Angle (°)</th>
<th>Cohesion (psf)</th>
<th>Effective Stress (psf)</th>
<th>Passive Pressure (psf)</th>
<th>Skin Friction Resistance (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
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<td>42°</td>
<td>0</td>
<td>4,085</td>
<td>20,608</td>
<td>2,865</td>
</tr>
</tbody>
</table>
Appendix C

Classification of Soils for Engineering Purposes
**UNIFIED SOIL CLASSIFICATION SYSTEM**

<table>
<thead>
<tr>
<th>Major divisions</th>
<th>Group symbols</th>
<th>Typical names</th>
<th>Laboratory classification criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clayey soils</td>
<td>CP</td>
<td>Clayey soils</td>
<td>Depends on characteristics, as follows.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$D_{10}$, $C_L = \frac{D_{10}}{D_{60}}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Below 1, above 3 for CP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For classification of fine-grained soils and fine fraction of coarse-grained soils.</td>
</tr>
</tbody>
</table>

**Laboratory classification criteria**

- **Above "A" line with P.I. less than 4**
- **Atterberg limits above "A" line with P.I. greater than 7**
- **Not meeting all gradation requirements for GW**
- **Atterberg limits below "A" line or P.I. less than 4**

---

**Graph:**

- **For classification of fine-grained soils and fine fraction of coarse-grained soils.**
- **Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.**
- **Equation of A-line:**
  - $P = 0.73 (LL - 20)$
Penetration Testing Procedure - “N” Values

The penetration testing procedure used for this project followed the requirements of ASTM Specification D 1586-67, “Standard Method for Penetration Tests and Split-Barrel Sampling of Soils”. This procedure involves driving a 2-inch OD standard split spoon sampler 18 inches with a 140-pound hammer free falling a distance of 30 inches. The number of blows required to drive the sampler the final foot was recorded as the Standard “N” Penetration. This N-value is used by Soils Engineers to estimate the strength and compressibility of the soil. After driving, the sampler was returned to the surface and opened. The length of sample (recovery) was measured and the soil was preliminarily classified according to type by a Soils Technician. A representative portion of each sample was then sealed in a glass jar, labeled, and returned to our office for further examination and testing.