Memo

Date: June 14th, 2017

To: Josie Tayse, Project Manager
Metro Traffic

From: Hossana Teklyes, Asist. Foundation Engineer
Office of Materials and Road Research

Concur: Rich Lamb, Foundations Engineer
Office of Materials and Road Research

Subject: SP 8825-562, (Metro District)
Four Overhead Signs located at TH35 NB, TH94 WB & TH10EB)
Foundations Investigation and Recommendations

1.0 Project Description
This report provides a Foundations Investigation and Recommendations for four overhead signs (Simple Span). The overhead sign will be placed along TH 35 NB, TH94 WB, and TH10 EB.

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Structure Type</th>
<th>Borings(Soundings)</th>
<th>TH</th>
<th>Stationing</th>
</tr>
</thead>
<tbody>
<tr>
<td>OH I35-217</td>
<td>Simple Span</td>
<td>T05</td>
<td>TH 35 NB</td>
<td>1683+00</td>
</tr>
<tr>
<td>OH I35-218</td>
<td>Simple Span</td>
<td>(C07)</td>
<td>TH35 NB</td>
<td>1717+15</td>
</tr>
<tr>
<td>OH I94 - 687</td>
<td>Simple Span</td>
<td>T01 &amp; T02</td>
<td>TH94 WB</td>
<td>70+20</td>
</tr>
<tr>
<td>OH US10-112</td>
<td>Simple Span</td>
<td>T03 &amp; T04</td>
<td>TH10 EB</td>
<td>747+00</td>
</tr>
</tbody>
</table>

Table 1: Overhead Sign Type & Locations

2.0 Field Investigation and Foundation Conditions
Six Standard Penetration Tests (SPT) and One Cone Penetration Test (CPT) were advanced in May and June of 2017 by MnDOT close to the locations of overhead sign posts. Copies of the SPT Borings and CPT Sounding logs are included with this report.

The foundation soils at the proposed overhead sign posts locations can generally be categorized as
medium dense to dense Sandy soils. Water was encountered in borings T03 and T04 (TH10 EB) at 9-11 ft. below existing ground (approximate ground elevation ranging from 894 – 895 ft.).

3.0 Foundation Analysis
The overhead sign locations were determined from plans provided by Metro District. The sign location is shown on the attached boring plan. As part of the overhead sign standard drawings (developed in the 1970's), standard foundations were developed to support the signs. These standard foundations consist of two spread footing and two drilled shaft designs to be used on different sign pole sizes (see Drawing ST-3, Standard Overhead Sign Supports Interim Design B).

- **Drilled shafts:**
  - 3 ft. diameter & 23 ft. deep
  - 4 ft. diameter & 29 ft. deep

- **Spread Footings:**
  - 9 ft. x 14 ft.
  - 12.5 ft. x 18 ft.

In addition, the standard foundation notes state the following requirements:

- All spread footings have an allowable design bearing pressure of 1 ¼ tons per square foot
- The drilled shafts have an allowable design lateral bearing pressure of 250 lbs. per square foot per foot of depth

Based on the soils at the proposed sign locations, the overhead signs can be supported on Spread Footing or Drilled shaft.
4.0 Foundation Recommendations
Based on the existing conditions along with an analysis of the project soils, we recommend the following:

1. Topsoil and other organic material be removed from areas where new fill is to be placed.

2. Based on the soils at the overhead sign bases location, the overhead signs can be supported on Spread Footings or Drilled Shafts. The standard sign design supports are shown in drawing ST-3. A copy of Drawing ST-3 is included with this report.

Attachments:  Drawing ST-3
               Boring/Sounding Overhead Sign Plan
               SPT/CPT Index Sheet
               SPT Logs (T01 - T05)  Unique Numbers (82375, 82040, 82034, 82041 & 82035)
               CPT Log (C07)        Unique Number (82536)

cc:               B. Skow
                  E. Peterson
                  T. Clyne

File
OH I35-217
TH35 NB (STA: 1683:00)
TH94 WB  (STA: 70+20)

OH I94-687
This boring was made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since this boring was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. While the Department believes that the information as to the conditions and materials reported is accurate, it does not warrant that the information is necessarily complete. This information has been edited or abridged and may not reveal all the information which might be useful or of interest to the contractor. Consequently, the Department will make available at its offices, the field logs relating to this boring.

Since subsurface conditions outside each borehole are unknown, and soil, rock and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this boring will necessarily be the same as or similar to those shown on this log. Furthermore, the Department will not be responsible for any interpretations, assumptions, projections or interpolations made by contractors, or other users of this log.

Water levels recorded on this log should be used with discretion since the use of drilling fluids in borings may seriously distort the true field conditions. Also, water levels in cohesive soils often take extended periods of time to reach equilibrium and thus reflect their true field level. Water levels can be expected to vary both seasonally and yearly. The absence of notations on this log relating to this boring does not necessarily mean that this boring was dry or that the contractor will not encounter subsurface water during the course of construction.

**WATER MEASUREMENT**
- **AB**.........After Bailing
- **AC**.........After Completion
- **AF**.........After Flushing
- **w/C**........with Casing
- **w/M**.........with Mud
- **WSD**.......While Sampling/Drilling
- **w/AUG**.....with Hollow Stem Auger

**MISCELLANEOUS**
- **NA**.........Not Applicable
- **w**.........with
- **w/o**.......without
- **sat**............saturated

**DRILLING OPERATIONS**
- **AUG**........Augered
- **CD**---------Core Drilled
- **DBD**.......Disturbed by Drilling
- **DBJ**.......Disturbed by Jetting
- **PD**........Plug Drilled
- **ST**........Split Tube (SPT test)
- **TW**.......Thinwall (Shelby Tube)
- **WS**........Wash Sample
- **NR**.......No Sample Retrieved

**RELATIVE DENSITY**
- **BPF**.......Battered Plasticity Factor (BPF)
  - **Clay**
  - **silt**
  - **sand**

**SOIL/Rock TERMS**
- **C**.........Clay
- **L**.........Lam
- **S**.........Sand
- **D**.........Dolomite
- **G**.........Gravel
- **Bldr**......Boulder

**DISCONTINUITY SPACING**
- **Fractures**
- **Distance**
- **Bedding**

**DRILLING SYMBOLS**

**SOIL/CORE TESTS**
- **SPT N**.....ASTM D1586 Modified
- **Blows per foot with 140 lb. hammer and a standard energy of 210 ft-lbs. This energy represents 60% of the potential energy of the system and is the average energy provided by a Rope & Cathead system.

**MC**........Moisture Content
**COH**........Cohesion
**v**........Sample Density
**LL**........Liquid Limit
**PI**.........Plasticity Index
**φ**.........Phi Angle
**REC**.......Percent Core Recovered
**RQD**.......Rock Quality Description

**CONSISTENCY - COHESIVE SOILS**
- **BPF**.......Battered Plasticity Factor
- **soft**......0-1
- **firm**......2-4
- **stiff**.....5-8
- **very stiff**...9-15
- **hard**.....16-30
- **very hard**...>60

**COLOR**
- **blk**.........Black
- **wht**........White
- **grn**.........Green
- **brn**.......Brown
- **orang**......Orange
- **yl**.........Yellow
- **dk**.........Dark
- **lt**.......Light
- **IOS**........Iron Oxide Stained

**GRAIN SIZE /PLASTICITY**
- **VF**..........Very Fine
- **pl**.........Plastic
- **F**..........Fine
- **slpl**......Slightly
- **Cr**.........Coarse
- **Clay**
- **Silt**
- **Sand**

**VANE SHEAR TEST**

**WASHED SAMPLE**

**AUGERED PLUG DRILLED**

**SPLIT TUBE SAMPLE**

**THIN WALL SAMPLE**

**CORE DRILLED**

**CORE BREAKS**

**PERCENTAGE OF TOTAL CORE INTERVAL CONSISTING OF UNBROKEN PIECES 4 INCHES OR LONGER**

**CORE SAMPLES**

**VORTEX SHAKE TEST**

**Mn/DOT Triangular Textural Soil Classification System**
### Laboratory Log & Test Results - Subsurface Exploration

#### Unique Number: 82375

**U.S. Customary Units**

<table>
<thead>
<tr>
<th>State Project</th>
<th>Bridge No. or Job Desc.</th>
<th>Trunk Highway/Location</th>
<th>Boring No.</th>
<th>Ground Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>8825-562</td>
<td>Overhead Sign</td>
<td>Interstate Highway TH 10 &amp; 35 &amp; 94</td>
<td>T01</td>
<td>766.2 (DTM)</td>
</tr>
</tbody>
</table>

**Location**
- Ramsey Coord: X=579966 Y=159900 (ft.)
- Latitude (North)=44°57'17.92"
- Longitude (West)=93°04'28.06"

No Station-Offset Information Available

**Drill Machine:** 211304 CME Fat Tire
**Hammer:** CME Automatic Calibrated

**Drilling Completed:** 6/7/17

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.5</td>
<td>Loamy Fine Sand with plastic Sandy Loam seams at 3.0' and 5.0', dark-brown to brown, moist</td>
</tr>
<tr>
<td>16.0</td>
<td>Loamy Very Fine Sand with a plastic Silt Loam seam at 15.0', brown, moist</td>
</tr>
<tr>
<td>17.5</td>
<td>plastic Silt Loam, gray-brown, moist</td>
</tr>
<tr>
<td>19.0</td>
<td>plastic Sandy Loam with a Silty Clay seam, gray to brown, wet</td>
</tr>
<tr>
<td>23.5</td>
<td>Sand and Gravel with stone chips and pieces, browns, damp</td>
</tr>
<tr>
<td>29.4</td>
<td>Loamy Sand and Gravel with stone chips and pieces, reddish-brown to light-brown, wet</td>
</tr>
</tbody>
</table>

**Soil Classification:**
- **SPT (N60):**
  - 19: 8%
  - 14: 10%
  - 9: 20%
  - 9: 15%
  - 8: 17%
  - 11: 12%

**Formation:**
- **Other Tests or Remarks:**
  - Hard drilling 24.0'-29.0'
  - sampled on a Boulder / rough drilling at 19.0'

**Boring Details:**
- **Drilling Operation:**
  - Rec (ft)
  - ROD (%)
  - ACL (ft)

**Rock:**
- **Formation or Member:**

**Notes:**
- Bottom of Hole -29.4'
- No water encountered or measured during drilling

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**Index Sheet Code:** 3.0

**Soil Class:** JAH
**Rock Class:**

**Edit:** 6/14/17

G:\GINT\PROJECTS-ACTIVE\8825-562- OVERHEAD SIGN (TH 10 & 35W & 94).GPJ
## Unique Number 82040

### U.S. Customary Units

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
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<tbody>
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<td>4.5</td>
<td>Fine Sand with a little Gravel, brown, moist</td>
</tr>
<tr>
<td>5.0</td>
<td>Loamy Sand and Gravel, brown and moist</td>
</tr>
<tr>
<td>7.0</td>
<td>Loamy Fine Sand, brown, moist to wet</td>
</tr>
<tr>
<td>9.5</td>
<td>Silt with a seam of slightly plastic Silt Loam, brown very moist</td>
</tr>
<tr>
<td>10.0</td>
<td>Silty Clay Loam with few roots, browns, very moist</td>
</tr>
<tr>
<td>12.0</td>
<td>Loamy Sand and Gravel with stone chips 13.5'-19.0', browns, moist to wet</td>
</tr>
<tr>
<td>23.5</td>
<td>Medium-Grained Sand with a thin seam of slightly plastic Silt Loam at 25.0' and a little Gravel at 27.5'; stone chips at 29.5' browns, wet</td>
</tr>
</tbody>
</table>

**Bottom of Hole -29.9''**

No water encountered or measured during drilling.

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**Location**
- Ramsey Coord: X=579980 Y=159981
- Latitude (North)=44°57'18.72" Longitude (West)=93°04'27.86" (ft.)
- No Station-Offset Information Available

**Drilling Machine** GeoProbe
**Hammer** GeoProbe Automatic
**Driller's Notes:** Rough drilling 1.5'-2.5'

**Driller's Notes:** Rough drilling 6.5'-7.5'

**High very fine sand content**

**Driller's Notes:** Rough drilling 13.5'-29.0'

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**State Project** Bridge No. or Job Desc. Overhead Sign
**Trunk Highway/Location** Interstate Highway TH 10 & 35 & 94
**Boring No.** T02
**Ground Elevation** 768.9 (DTM)

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**Index Sheet Code** 3.0
### Laboratory Log & Test Results - Subsurface Exploration

**Unique Number**: 82034

**State Project**: 8825-562

**Bridge No. or Job Desc.**: Overhead Sign

**Trunk Highway/Location**: Interstate Highway TH 10 & 35 & 94

**Boring No.**: T03

**Ground Elevation**: 903.4 (DTM)

**Location**: Anoka Coord: X=517835 Y=129634 (ft.)

**Latitude (North)**: 45°06'59.5"

**Longitude (West)**: 93°11'51.31"

**Drill Machine**: GeoProbe Automatic

**Drilling Completed**: 5/23/17

### Soil and Rock Classification

<table>
<thead>
<tr>
<th>Depth</th>
<th>Soil Class</th>
<th>Rock Class</th>
<th>Lithology</th>
<th>SPT Nø</th>
<th>MC (%)</th>
<th>COH (psf)</th>
<th>Y (pcf)</th>
<th>Formation or Member</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>slightly organic slightly plastic Silt Loam, black, moist</td>
<td></td>
<td></td>
<td>3</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>Loamy Fine Sand with IOS, browns, moist</td>
<td></td>
<td></td>
<td>17</td>
<td>17</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8.5</td>
<td>Very Fine Sand, browns, saturated</td>
<td></td>
<td></td>
<td>8</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.0</td>
<td>Silt, gray, saturated</td>
<td></td>
<td></td>
<td>9</td>
<td>29</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>15.0</td>
<td>Fine Sand with Very Fine Sand at 30.0’, gray, saturated</td>
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<td></td>
<td>31</td>
<td>21</td>
<td></td>
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<tr>
<td>30.5</td>
<td>Bottom of Hole -30.5’ Water measured at 8.5’ with auger</td>
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<td></td>
<td>33</td>
<td>23</td>
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</table>

**U.S. Customary Units**

**Index Sheet Code**: 3.0

**Drilling Operation**: PD

**Other Tests or Remarks**: No Station-Offset Information Available

**Soil Class**: JAH

**Rock Class**: Edit: Date: 6/14/17

**Other Tests or Remarks**: No Station-Offset Information Available

**GeoProbe**: Automatic 5/23/17

**Drilling Completed**: 5/23/17

**Soil Class**: JAH

**Rock Class**: Edit: Date: 6/14/17
<table>
<thead>
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<th>Depth (ft)</th>
<th>Soil Classification</th>
<th>SPT (N60)</th>
<th>MC (%)</th>
<th>COH (psf)</th>
<th>Y (%)</th>
<th>Soil Type</th>
<th>Other Tests Or Remarks</th>
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<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Fine Sand, browns, moist</td>
<td>22</td>
<td>17</td>
<td></td>
<td></td>
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<tr>
<td>10.0</td>
<td>Very Fine Sand, gray to wet</td>
<td>20</td>
<td>17</td>
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<td>11.0</td>
<td></td>
<td>14</td>
<td>26</td>
<td></td>
<td></td>
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<td>High Silt content</td>
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<td>15.0</td>
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<td>20.0</td>
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<td>34</td>
<td>24</td>
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<tr>
<td>30.0</td>
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<td>15</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>30.5</td>
<td>Bottom of Hole -30.5'</td>
<td>24</td>
<td>24</td>
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</tr>
</tbody>
</table>

Location: Anoka Coord: X=517860 Y=129740

Latitude (North)=45°07'00.55" Longitude (West)=93°11'50.95"

No Station-Offset Information Available

Ground Elevation 905.2 (DTM)

Drill Machine 205120 CME(LC55) Track

Hammer CME Automatic Calibrated

Drilling Completed 6/1/17

U.S. Customary Units
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
<th>SPT N60</th>
<th>MC (%)</th>
<th>COH (psf)</th>
<th>γ (pcf)</th>
<th>Soil</th>
<th>Rock</th>
<th>Core Breaks</th>
<th>Other Tests Or Remarks</th>
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<tbody>
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<td>0.5</td>
<td>Topsoil with roots, dark-brown, moist</td>
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</tr>
<tr>
<td>7.0</td>
<td>Medium-Grained Sand, brown, damp</td>
<td>8</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
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<td>6</td>
<td>4</td>
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<tr>
<td>10.0</td>
<td>Fine-Grained Sand, brown, damp</td>
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<td>9</td>
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<td>22.0</td>
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<td>7</td>
<td>4</td>
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<td>rough drilling 22.0'-27.0'</td>
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<td>9</td>
<td>3</td>
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<td>8</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>31.5</td>
<td>Bottom of Hole -31.5'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No water encountered or measured during drilling</td>
</tr>
</tbody>
</table>

State Project 8825-562
Bridge No. or Job Desc. Overhead Sign
Trunk Highway/Location Interstate Highway TH 10 & 35 & 94
Boring No. T05
Ground Elevation 1011.2 (DTM)

Drill Machine 209332 GeoProbe
Hammer GeoProbe Automatic
Drilling Completed 5/17/17

Location Dakota Coord: X=508973 Y=193060
Latitude (North)=44°43'37.85" Longitude (West)=93°16'55.72"
No Station-Offset Information Available
This Index sheet accompanies Cone Penetration Test Data. Please refer to the Boring Log Descriptive Terminology Sheet for information relevant to conventional boring logs.

This Cone Penetration Test (CPT) Sounding follows ASTM D 5778 and was made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since this sounding was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. While the Department believes that the information as to the conditions and materials reported is accurate, it does not warrant that the information is necessarily complete. This information has been edited or abridged and may not reveal all the information which might be useful or of interest to the contractor. Consequently, the Department will make available at its offices, the field logs relating to this sounding.

Since subsurface conditions outside each CPT sounding are unknown, and soil, rock and water conditions cannot be relied upon to be constant or uniform, no warrant is made that conditions adjacent to this sounding will necessarily be the same as or similar to those shown on this log. Furthermore, the Department will not be responsible for any interpretations, assumptions, projections, or interpolations made by contractors or other users of this log.

Water pressure measurements and subsequent interpreted water levels shown on this log should be used with discretion since they represent dynamic conditions. Dynamic pore water pressure measurements may deviate substantially from hydrostatic conditions, especially in cohesive soils. In cohesive soils, water pressures often take extended periods of time to reach equilibrium and thus reflect their true field level. Water levels can be expected to vary both seasonally and yearly. The absence of notations on this log regarding water does not necessarily mean that this boring was dry or that the contractor will not encounter subsurface water during the course of construction.

CPT Terminology

CPT.............Cone Penetration Test
CPTU.........Cone Penetration Test with Pore Pressure measurements
SCPTU.......Cone Penetration Test with Pore Pressure and Seismic measurements

(Note: This test is not related to the Dynamic Cone Penetrometer DCP)

TIP RESISTANCE
The resistance at the cone corrected for water pressure. Data is from cone with 60 degree apex angle and a 10 cm² end area.

SLEEVE FRICTION RESISTANCE
The resistance along the sleeve of the penetrometer.

FRiction Ratio

Ratio of sleeve friction over corrected tip resistance.

V. Shear Wave Velocity
A measure of the speed at which a seismic wave travels through soil/rock.

PORE WATER MEASUREMENTS
Pore water measurements reported on CPT Log are representative of water pressures measured at the U2 location, just behind the cone tip, prior to the sleeve, as shown in the figure below. These measurements are considered to be dynamic water pressures due to the local disturbance caused by the cone tip. Dynamic water pressure decay and Static water pressure measurements are reported on a Pore Water Pressure Dissipation Graph.

Robertson CPT 1990

Soil Behavior type based on pore pressure

SBT SOIL BEHAVIOR TYPE
Soil Classification methods for the Cone Penetration Test are based on correlation charts developed from observations of CPT data and conventional borings. Please note that these classification charts are meant to provide a guide to Soil Behavior Type and should not be used to infer a soil classification based on grain size distribution.

The numbers corresponding to different regions on the charts represent the following soil behavior types:

1. Sensitive, Fine Grained
2. Organic Soils - Peats
3. Clays - Clay to Silty Clay
4. Silt Mixtures - Clayey Silt to Silty Clay
5. Sand Mixtures - Silty Sand to Sandy Silt
6. Sands - Clean Sand to Silty Sand
7. Gravelly Sand to Sand
8. Very Stiff Sand to Clayey Sand
9. Very Stiff, Fine Grained

Note that engineering judgment, and comparison with conventional borings is especially important in the proper interpretation of CPT data in certain geomaterials.

The following charts are used to provide a Soil Behavior Type for the CPT Data.

Robertson CPT 1990
Soil Behavior type based on friction ratio