SOIL TESTING

Soil Testing

Soil Testing – Why?

- Required input parameter for stormwater calculations
- For the design of stormwater BMPs

Soil Testing – What?

- Hydrologic Soil Group (HSG)
- Seasonal High Water Table (SHWT)
- Soil permeability for determining suitable BMPs
- Soil series for groundwater recharge (annual recharge spreadsheet)
- Not only infiltration BMPs need soil test
Soil Testing

Soil Testing – How?

• NRCS Web Soil Survey

• NJ BMP Manual Chapter 12

Soil Testing for HSG

Methods to Identify HSGs:
1. NRCS Web Soil Survey
2. Default Method
3. HSG Testing Method
**Default Method for Identifying HSG**

- NJDEP BMP Manual Chapter 12:
  - 1b: Default Hydrologic Soil Groups:

  **In coastal plain:**
  - Pre-developed: HSG A
  - Post-developed: HSG D

  **Outside coastal plain:**
  - Pre-developed: HSG B
  - Post-developed: HSG D


**Soil Testing for Determining HSG**

**Ch. 12 Subsection 1c: HSG Testing Procedures**

- Soil testing can be used to determine HSG
- HSG depends on:
  - Saturated hydraulic conductivity (Ksat)
  - Depth to impermeable layer
  - Depth to seasonal high water table

**Safety First!**

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 NJ DEP Division of Water Quality, Online Stormwater Management Design Review Course
Soil Testing for Determining HSG

**HSG Testing Procedures (cont’d.)**

- Number of required soil tests depends on size of soil mapping unit:

<table>
<thead>
<tr>
<th>Soil Mapping Unit Size (Acres)</th>
<th># of Soil Profile Pits</th>
<th># of Soil Borings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X &lt; 0.5$</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>$0.5 \leq X \leq 2$</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>$X &gt; 2$</td>
<td>$1 + (1$ per each add’l 2 Acres)</td>
<td>$4 + [2$ per each add’l 2 Acres]</td>
</tr>
</tbody>
</table>

Soil Testing for Determining HSG

**HSG Testing Procedures (cont’d.)**

Example: Soil Profile Pits and Soil Boring Locations

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**Soil Testing for Determining HSG**

**HSG Testing Procedures (cont’d.)**

- Required profile pit and boring depths:
  - To Seasonal High Water Table, or
  - Deeper of either six (6) feet below existing grade or four (4) feet below proposed grade

For more information, refer to BMP Manual Chapter 12, Subsection 2b (“Soil Log Requirements”)
Soil Testing for Determining HSG


Soil Testing for Determining HSG

Soil Testing Depth

Source: NRCS

HSG Testing Procedures (cont’d.)

Soil Testing Depth
Soil Testing for Infiltration BMPs

Number and Location

• For infiltration BMPs
  o Minimum of two soil profile pits within the infiltration area of any proposed BMP and
  o One additional profile pit for every additional 10,000 sf

Soil Testing for Infiltration BMPs

Number and Location (cont’d.)

• For sites with multiple BMPs each less than 500 sf
  o One profile pit for each soil mapping unit per site, plus
  o One soil boring at each BMP
• Drywells
  o One soil boring per lot (single family home)
Soil Testing for Infiltration BMPs

Soil Tests for Linear Infiltration BMPs
- Minimum infiltration area length to width ratio of 4:1
- Max. infiltration area of bottom width 25 feet or less and top width 40 feet or less

<table>
<thead>
<tr>
<th>Area (linear feet per soil mapping unit)</th>
<th>Soil Boring</th>
<th>Soil Pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Each additional 500</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Every 2,000</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Soil Testing for Infiltration BMPs

Figure 12-4: Soil Exploration Locations for Linear Infiltration BMPs

Test Pit and Boring Depth Requirements
The greater of:
- Minimum of 8 feet below lowest elevation of basin bottom or
- 2 times the maximum water depth of design storm
Soil Testing for Infiltration BMPs

Test Boring and Pit Depth Requirements

Soil Testing for Infiltration BMPs

Soil Hydraulic Conductivity Tests - **No** Soil Replacement

Collected from *most hydraulically restrictive* soil layer below BMP and above SHWT or bedrock:

To the greater of:
- 8 feet below lowest point of basin or
- 2 times the maximum water depth

Soil Testing for Infiltration BMPs

Soil Hydraulic Conductivity Tests - **Soil Replacement**

Collected from *most hydraulically restrictive* soil layer **below** the depth of soil replacement and above SHWT or bedrock:

To the greater of:
- 8 feet below lowest point of basin or
- 2 times the maximum water depth
Soil Testing for Seasonal High Water Table

NJAC 7:9A-5.8 Criteria for recognition of zones of saturation
- Observation of soil mottling
  - Any season of the year
- Direct observation of SHWT
  - January – April

Soil Hydraulic Conductivity Testing

Soil Tests
- One soil test at each soil profile pit and soil boring location
- Soil permeability tests must be performed on most hydraulically restrictive layer
- Soil explorations extend to 8 ft below basin bottom or twice max potential water depth, whichever is greater

Soil Testing for Determining Soil Hydraulic Conductivity

Acceptable hydraulic conductivity tests:
- Tube Permeameter Test
- Percolation Test
- Cased borehole infiltration test
- Basin flooding test (for bedrock)
- Other constant head permeability tests that utilize in-situ conditions
Soil Testing Criteria

Soil hydraulic conductivity tests must be performed on the most hydraulically restrictive layer.

### Soil Testing Criteria

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Hydraulic Conductivity</th>
<th>Field Class</th>
<th>Field Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay loam</td>
<td>0.03</td>
<td>Poor</td>
<td>1.94 m/hr</td>
</tr>
<tr>
<td>Clay</td>
<td>0.02</td>
<td>Very Poor</td>
<td>3.77 m/hr</td>
</tr>
<tr>
<td>Loamy</td>
<td>0.08</td>
<td>Poor</td>
<td>1.94 m/hr</td>
</tr>
<tr>
<td>Loamy sands</td>
<td>0.05</td>
<td>Very Poor</td>
<td>3.77 m/hr</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>0.10</td>
<td>Poor</td>
<td>1.94 m/hr</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>0.10</td>
<td>Very Poor</td>
<td>3.77 m/hr</td>
</tr>
<tr>
<td>Loamy sands</td>
<td>0.05</td>
<td>Poor</td>
<td>1.94 m/hr</td>
</tr>
<tr>
<td>Loamy sands</td>
<td>0.05</td>
<td>Very Poor</td>
<td>3.77 m/hr</td>
</tr>
</tbody>
</table>

Source: NRCS

### Hydraulic Conductivity Testing

**Percolation Test**

The field measured hydraulic conductivity value shall be calculated as follows:

$$K = \frac{a}{t \times d} \text{ in/hr}$$

Where:
- $a$ = infiltration rate in inches per hour
- $t$ = time in minutes
- $d$ = depth in inches

**Table 12-9:** Values for Corresponding Test Hole Diameters

<table>
<thead>
<tr>
<th>D (in)</th>
<th>4</th>
<th>8</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>20.00</td>
<td>44.00</td>
<td>25.71</td>
<td>37.27</td>
<td>26.70</td>
</tr>
</tbody>
</table>

### Soil Testing

What should be submitted?

- Soil survey information
- Soil test logs
- Hydraulic conductivity testing procedures and results
- Seasonal High Water Table
- Date of performing soil testing
- Relevant calculations and/or conclusions
**Soil Testing**

Chapter 12 Construction and Post-Construction

**Construction**
- Pre-construction meeting
- Minimize compaction
- Testing each layer where hydraulic conductivity is critical before adding a new layer

**Post-Construction**
- Tests in most hydraulically restrictive horizon
  - Between the bottom of as-built BMP and SHWT
  - Confirm drain time of ≤ 72 hours

**References**


**More Information:**

Bureau of Nonpoint Pollution Control
Division of Water Quality
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PO Box 420, Mail Code 401-2B
Trenton, NJ 08625-420
Tel: 609-633-7021
www.njstormwater.org

Brian Salvo
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QUIZ 2

https://www.njstormwater.org/smdrc_training.html

NJDEP Division of Water Quality
SWMDR Training Module 2
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