Bioretention Soils: How much can we engineer soils?

Tracy Tackett, P.E.  tracy.tackett@seattle.gov
Low Impact Development Program Manager
Seattle Public Utilities

Performance Needs of the Soil

- Provide desired infiltration rate
- Support vegetation and soil biota
- Provide water quality treatment

Provide Water Quality Treatment

- Cation Exchange Capacity >= 5 meq/100 gm dry soil
- Organic Content >= 1%
- Maximum design infiltration rate 2.4 in/hr
  - DOE, Stormwater Management Manual for Western Washington Volume 5

Support Vegetation

- Organic Content:
  (ASTM D 2974, method C)
  - 5% min (by weight) for grass
  - 10% min (by weight) for non-grass vegetation
- Mineral portion > appx. 2% passing #200 sieve
- pH between 5.5 and 7

Organic Content of Compost does have variability!

47-59%, AVG 52%

Provide desired infiltration Rate

- What is the design infiltration rate?
- How can you tell if you have achieved that design rate?
Bioretention Soil Mixes – lets try for regional consistency

- Testing methods
  - Hydraulic conductivity per ASTM D 2434
  - Compaction per ASTM D 1557
- <10% passing # 200 sieve, suggest max of 7.5%
- 100% passing 1-inch sieve

Bioretention Soil Mixes – “Bioretention Soil Mix 1”

- Design infiltration rate of ???
- LID manual p. 181
- Native amended with compost
- DO NOT RECOMMEND USE FOR LARGE PROJECTS

SEA Street #1

“Bioretention Soil Mix 2”

- Design infiltration rate of 1 in/hr at 80% compaction
- LID manual p 182, modified.
- US No. 200 2 – 7.5
- approx. 60-65%
  Loamy sand (USDA textural classification)
  and 35-40% compost
**Broadview Green Grid Testing**

- Bioretention soil mix 2, supplied with modified Vegetable Garden blend from Cedar Grove. 6% passing #200 sieve.
- Densities between 73pcf to 83pcf
- Appx. 70 to 83 percent compaction per ASTM D1557
- Dry: 48-54% porosity
- At 15% moisture content: There is apprx. 0.3 feet of water storage available for every 1 foot of soil.

**Bioretention Soil Mix 2 ???**

Modified Vegetable Garden blend from Cedar Grove, but same ratios as Broadview resulted in 11.9% passing #200 sieve! (hydraulic conductivity <1in/hr). Contractor will be removing and replacing soil.

**Bioretention Soil Mix 3**

- 55% -65% clean sand and 35-45% compost.
- Sieve Size Percent Passing
  - 1/4-inch 100
  - US No. 6 54-95
  - US No. 8 45-92
  - US No. 50 9-35
  - US No. 200 2-7.5
- Design infiltration rate of 1.5 in/hr at 85% compaction, 2 in/hr at 80% compaction
Considering using different soil spec on sideslopes?

Bioretention Soil Mixes – “Engineered Soil”

- 65%-70% gravelly sand and 30-35% compost.
- LID manual p. 181

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-inch</td>
<td>100</td>
</tr>
<tr>
<td>¾-inch</td>
<td>70 - 100</td>
</tr>
<tr>
<td>½-inch</td>
<td>50 - 80</td>
</tr>
<tr>
<td>US No. 40</td>
<td>15 - 40</td>
</tr>
<tr>
<td>US No. 200</td>
<td>0 – 3</td>
</tr>
</tbody>
</table>

- Design infiltration rate of 2 in/hr

More Project Information:
http://www.ci.seattle.wa.us/util/naturalsystems/