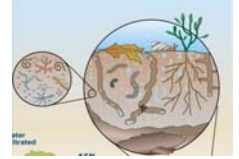# Bioretention Soils:
How much can we engineer soils?

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

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Performance Needs of the Soil

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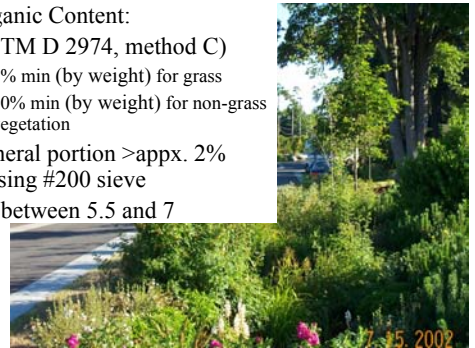- Provide water quality treatment

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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
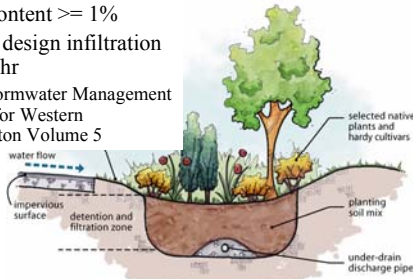
Support Vegetation

- 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?

Will it be Saturated?
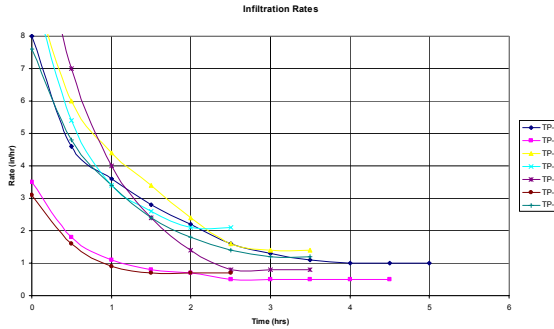
Will the soil be compacted?

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 RECOMNED USE FOR LARGE PROJECTS
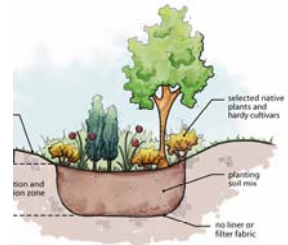
SEA Street #1

"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 "Bioretention Soil Mix 2"

Broadview Green Grid Testing

- Bioretention soil mix 2, supplied with modified Vegetable Garden blend from Cedar Grove. 6% passing #200 sieve.
- Densities between 73 pcf to 83 pcf
- 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.

Pinehurst NDS Bioretention Soil Mix 2 ???
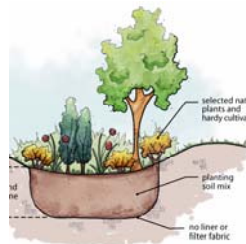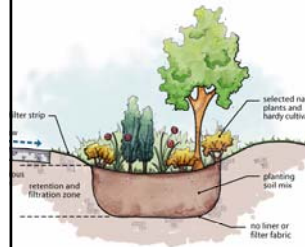
Modified Vegetable Garden blend from Cedar Grove, but same ratios as Broadview resulted in 11.9% passing #200 sieve! (hydraulic conductivity <1in/hr). Contractor will be removing and replacing soil.

10?/05 19th Avenue btwn NE 115th and NE 117th

Bioretention Soil Mix 3

- 55% -65% clean sand and 35-45% compost.
- Sieve Size   Percent Passing

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. 2in/hr at 80% compaction

Cascade Design 65% clean sand/ 35% compost
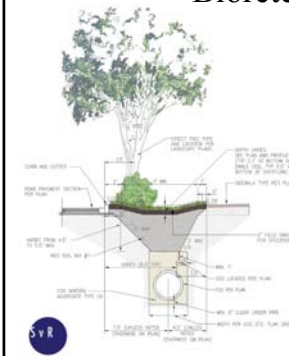

Bioretention Soil Mix 3

Pinehurst NDS 1/15/06
20th Avenue btwn NE 115th and NE 117th

?Considering using different soil spec on sideslopes?

Bioretention Soil Mixes – "Engineered Soil"

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

Sieve Size	Percent Passing
2-inch	100
¾-inch	70 - 100
¼-inch	50 - 80
US No. 40	15 - 40
US No. 200	**0 – 3**

- Design infiltration rate of 2 in/hr

High Point Neighborhood

High Point Neighborhood

High Point Neighborhood

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