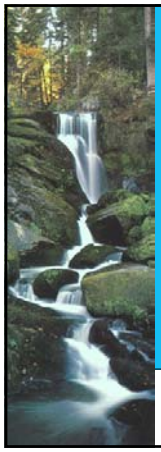


Practical Designs for Bioretention

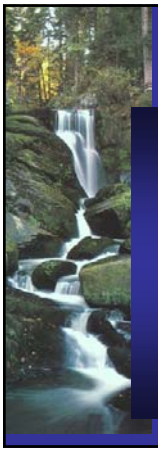
Curtis Hinman

chinman@wsu.edu

WSU Extension Pierce County Extension Faculty

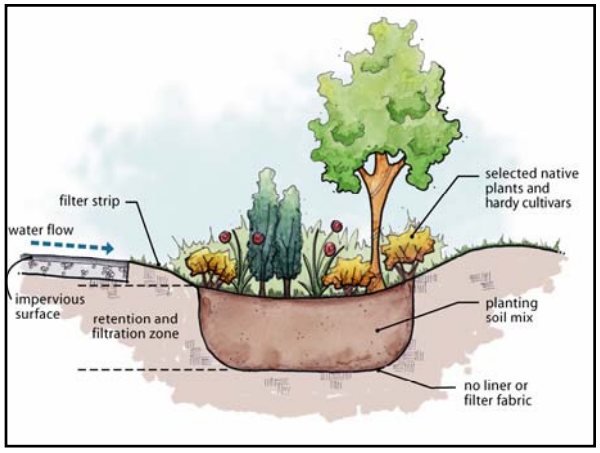
Puget Sound Water Quality Field Agent

WASHINGTON STATE UNIVERSITY
PIERCE COUNTY EXTENSION

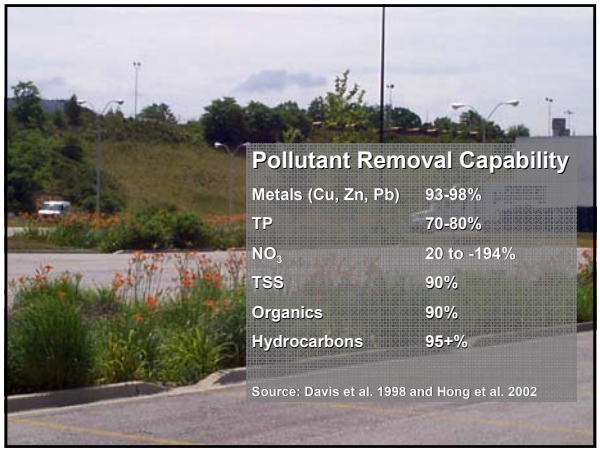


Basic Design Characteristics

- Shallow landscaped depressions that receive stormwater from small contributing areas
- Soil mixes and plants selected to more closely mimic native conditions
- Small scale, dispersed facilities integrated into the design as a landscape amenity



Buckman Heights 430 NE 16th Ave, Portland



Pollutant Removal Capability

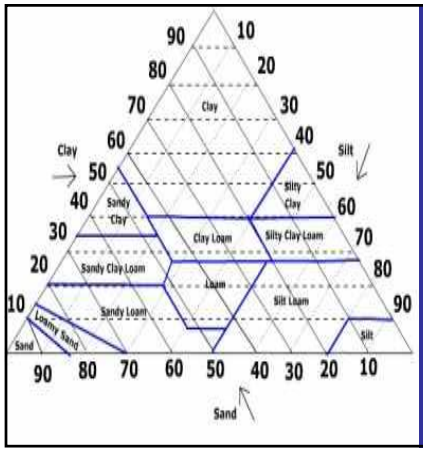
Metals (Cu, Zn, Pb)	93-98%
TP	70-80%
NO_3	20 to -194%
TSS	90%
Organics	90%
Hydrocarbons	95+%

Source: Davis et al. 1998 and Hong et al. 2002

Guidelines

Soil

- Loamy sand (USDA textural classification)
- 1.0 inch/hour minimum long-term hydraulic conductivity per ASTM D 2434, at 80% compaction per ASTM D 1557
- 10% minimum organic matter content per ASTM D 2974 (approx. 60-65% loamy sand and 35-40% compost)



Loamy sand

- Clay content at or below 10%
- Infiltration rates (with correction factor) at or above 1"/hr

Sandy loam

- Clay content can be 20%
- Infiltration rates (with correction factor) can be much less than 1"/hr

Guidelines

Soil

- pH between 5.5 and 7.0
- 18" minimum soil depth—24" minimum for improved nitrogen or phosphorus removal

Mulch

- Compost best for bottom of facility
- Shredded or chipped hardwood or softwood floats—good for perimeter
- Dense groundcover beneficial—may need access to maintain mulch if pollutant hotspot

Guidelines

Ponding depth and drawdown

- 12 inch maximum ponding depth
- 24 hour maximum surface pool drawdown
- Soils must dry out periodically to retain hydraulic capacity, maintain infiltration rates, as well as soil oxygen levels for adequate pollutant removal capability and healthy biota

Guidelines

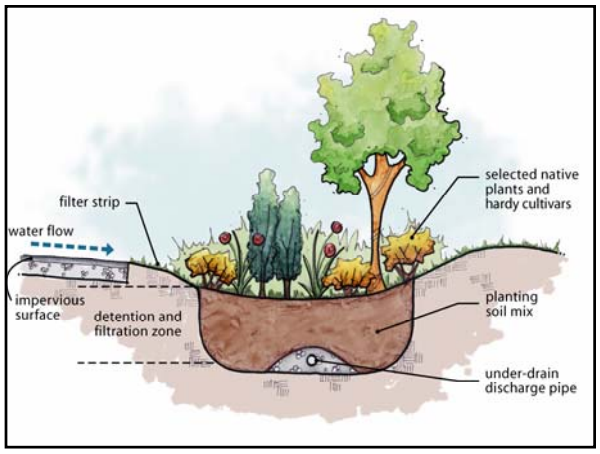
Flow entrances

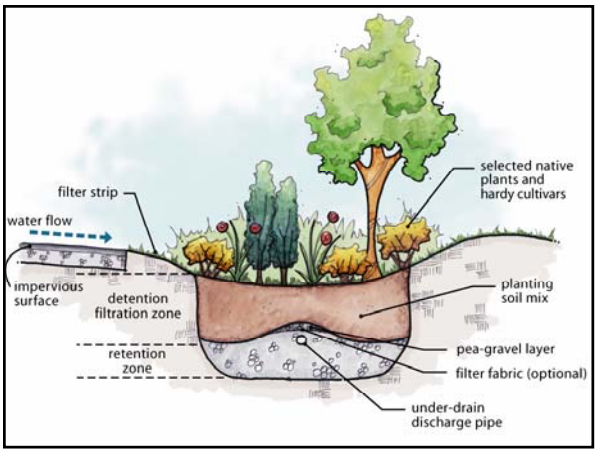
- Dispersed low velocity flow through landscaped area or filter strip preferred
- Concentrated flow entrances should have flow dissipation and erosion protection material (e.g. rock pads)
- Settling or pre-treatment areas and catch basins

Under-drains

Use when

- Near sensitive infrastructure that may flood
- Filtering flows from pollution hotspots (impermeable liner required)
- Soil infiltration rates are not adequate to meet maximum pool and system dewater rates.
- Improved nitrogen removal desired





Guidelines

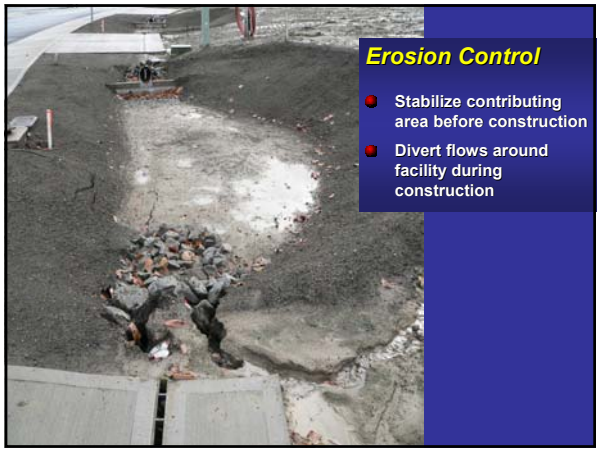
Construction

- Soil compaction in facility can lead to failure
- Avoid excavation during wet or saturated conditions
- Operate machinery adjacent to facility — do not allow heavy equipment with deep lugged tires in facility — rip soil in bottom of cell with light weight equipment if compacted
- Vertical sidewalls below grade ok if surrounding soil stable—sidewalls above grade 3H:1V max

Guidelines

Construction

- Place soil in 12” lifts
- Allow to settle naturally, boot pack or wet each lift until just saturated—sediment control necessary for any under-drain or surface overflow discharge if watering to settle



Bioretention Flow Credits

- Represent as a pond with consistent infiltration rate
- Pond equals above ground and soil storage
- Facilities with under-drains: only storage below under-drain considered
- Determine infiltration rate
- Use the lower of:
  1. the estimated long-term rate for the planting soil mix; or
  2. the initial (short-term) rate of the underlying soil