Coastal Stormwater Management: The Bioretention Option

Low Impact Case Studies at Hobcaw Barony
October 20, 2009

Forest Water Budget – Typical Scenario

TRANSPRIED WATER
EVAPORATED WATER
INFLTRATION
WATER UPTAKE
SURFACE RUNOFF?
GROUNDWATER
What is Bioretention?

- A “Low Impact Development” (LID) practice
- Developed in early 1990’s in Prince George’s County, MD
- Uses mixture of woody and herbaceous plants to remove pollutants from runoff
- Runoff is conveyed as sheet flow to the treatment area
- Consists of a grass buffer strip, ponding area, planting soil mix, mulch layer, and plants
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Presented by D. Hitchcock

How does bioretention work?

- **Vegetation on Surface**

- **EARTH FILL - Primarily Sand**

- **Runoff**

  Source: Dr. Bill Hunt, NCSU
  www.bae.ncsu.edu/stormwater

Filtering Practices – Bioretention

From the Low Impact Development Center

Presented by D. Hitchcock
Benefits of Bioretention

- Works with natural drainage and flow
- Incorporates landscape design
- Reduces peak flows and volumes
- Encourages infiltration
- Improves water quality with plants and microbes

Is Bioretention Right for the Site?

- Land use and phasing must warrant the practice
- Depth to water table should be > 3 ft
- Sediment loads should be managed
- Access for maintenance
- Water source for plant establishment and during drought conditions
Basic Design Criteria

• Should be designed to drain in 24-48 hours
• Required storage volume must accommodate 1-inch of runoff
• Typical soil mix should be 50-60% sand, 20-30% native soil, and 20-30% compost
• Mulch should be heavy material that won’t float away

What types of plants should we use for bioretention?

• Hearty species with a range of drought and wet condition tolerance, and possibly salt tolerant!!

• Options include small trees, shrubs, perennials, and grasses

• Consider native species…

• Plants that attract butterflies and hummingbirds

• A plant list is available – contact your local Extension office
Maintenance Requirements!!!

- No sediment loading or erosion – clogs soil mix
- Maintain plant growth by trimming and remove unwanted plants
- Clear debris from inlets and outlets
- Water plants if needed
- Replace mulch as needed
- Core aeration as an option
- Scrape top 1 inch of soil as needed to reduce clogging

Clemson’s Baruch Institute of Coastal Ecology and Forest Science
As part of LEED certification (pending), stormwater management included bioswales for rooftop runoff for research, education, and demonstration purposes.

Roof surface area = 8100 sq. ft.
Storage design for first inch of rainfall = 675 cu.ft.
Left swale = ~ 450 sq ft.
Right swale = ~ 600 sq ft.
Average depth = 1 ft. of storage
Total design storage = 1050 cu ft.
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BEFORE... …AFTER

Jan. 16, 2008 Sept. 25, 2009

Site preparation - Excavation
**Slope Stabilization**

- 75% sand, 25% compost
- Sand source: native soil plus dredged material from Hobcaw Barony
- Compost source: Georgetown County Landfill – biosolids and yard waste
- Mulch – Triple hammered hardwood

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**Bioretention Soil Media**

- 75% sand, 25% compost
- Sand source: native soil plus dredged material from Hobcaw Barony
- Compost source: Georgetown County Landfill – biosolids and yard waste
- Mulch – Triple hammered hardwood
Plant Selection

- **Trees:**
  Bald cypress (*Taxodium distichum*)

- **Shrubs:**
  Atlantic ninebark (*Physocarpus opulifolius*)
  Rusty blackhaw viburnum (*Viburnum rufidulum*)
  False indigo (*Amorpha fruticosa*)

- **Herbaceous:**
  Eastern red columbine (*Aquilegia canadensis*)
  Threadleaf coreopsis (*Coreopsis verticillata*)
  Swamp sunflower (*Helianthus angustifolius*)
  Joe-pye weed (*Eupatorium fistulosum*)
  Blazing star (*Liatris spicata*)
  Blue flag iris (*Iris virginica*)

- **Grasses:**
  Muhly grass (*Muhlenbergia capillaris*)
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**Water Balance for Bioretention**

- **EVAPOTRANSPIRATION**
- **PRECIPITATION**
- **COLLECTED INFLOW**
- **BANK RUNOFF INFLOW**
- **GROUNDWATER**
- **OUTFLOW**

**Monitoring**

- **Weather parameters:**
  - Rainfall
  - Barometric pressure
  - Temperature
  - Relative Humidity
  - Solar radiation
  - Potential evapotranspiration

- **Soil water parameters:**
  - Soil moisture
  - Water table depth

- **Surface water level**

- **Inflows**
  - Inflow ($Q_{in}$)
  - Infiltration ($I=0$)
  - Percolation ($P=0$)
  - Outflow ($Q_{out}$)
  - Evapotranspiration ($ET$)
  - Precipitation ($P$)
Water Table Response to Rainfall

A word on hydraulics...
Challenges

• Working in a tight spot with limited access

• Red-cockaded woodpecker habitat

• Contractor and subcontractor communications and understanding

• Slope stabilization

• Slowing drainage for longer storage?

• Shallow water table

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Georgetown County

Grand Strand Master Gardeners
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