Bioretention and Bioinfiltration Facilities

Description

Bioretention and bioinfiltration facilities are shallow, landscaped depressions that contain a layer of prepared soil, a mulch layer, and vegetation. These facilities provide filtering of storm water runoff by temporarily ponding water during storms. Bioretention facilities have underdrain systems, while bioinfiltration facilities allow runoff to infiltrate into existing site soils (infiltration rates greater than 0.5 inches per hour).

The standard bioretention and bioinfiltration designs sometimes incorporate trees, but mainly as a landscaping "afterthought." The concept design presented here not only incorporates trees and shrubs, but has also been modified to improve growing conditions and decrease potential engineering conflicts (Figure 26). Planting trees and shrubs in bioretention and bioinfiltration facilities may increase nutrient uptake and evapotranspiration.

Bioretention and bioinfiltration facilities are typically small (footprints are generally 5% of the impervious area they receive drainage from, drainage areas are less than 2 acres) and can be used in many applications. Where space is available, a forested or multi-zone filter strip may be used as pretreatment for bioretention and bioinfiltration facilities.

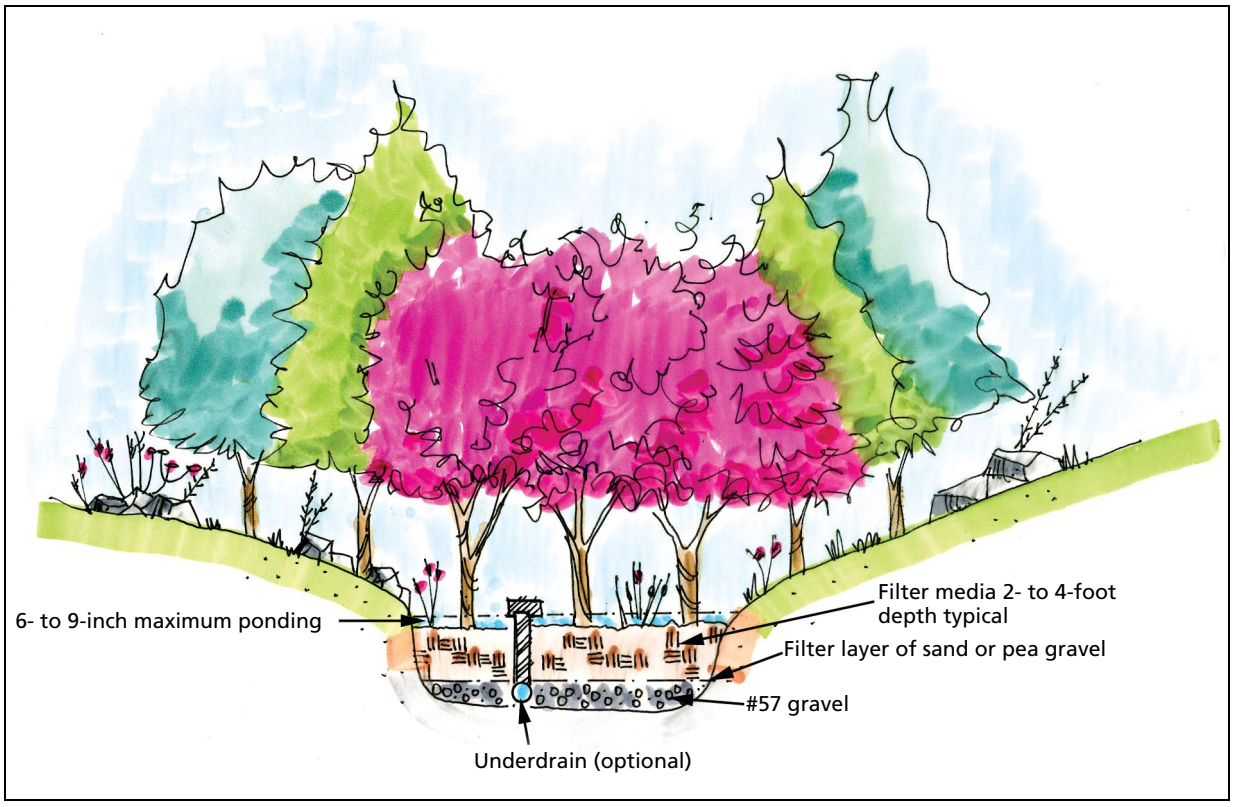

Figure 1. Bioretention and bioinfiltration facilities remove pollutants from storm water runoff using a filter medium.

Design Modifications

- ☐ Filter fabric should not be used between the filter media and the gravel jacket around the underdrain, as it creates an undesirable soil/water interface. A filter layer of sand or pea gravel may be used in lieu of filter fabric in this area to prevent the migration of fines into the gravel layer below. Ferguson (1994) provides a formula for determining the composition of this sand layer, and Prince George's County (2001) provides guidance on use of a pea gravel layer. Filter fabric may not be necessary along the sides of the excavated area unless there is concern about lateral movement of water into the adjacent soil (e.g., in applications where lateral seepage may cause upheaval of adjacent pavement).
- ☐ Use #57 (i.e., 1 ½-inch diameter) gravel instead of #2 around underdrain to provide some filtering. The underdrain may be suspended within #57 gravel to provide enhanced recharge and infiltration by increasing the stone reservoir.
- ☐ Allow for 6-9 inches of ponding during storm events.

Species Selection

Species selection is key in bioretention designs since it is more efficient than trying to change the site characteristics. Select a minimum of three hardy, native tree species that are adapted to soil and site conditions.
Other desirable species characteristics may include the following:

- ☐ Tolerant of inundation
- ☐ Tolerant of drought
- ☐ Wide spreading canopy
- ☐ Tolerant of salt

General Planting Guidance

- ☐ Have a landscape architect create a planting plan for the facility.
- ☐ Do not plant trees directly over the underdrain as a precautionary measure.
- ☐ Excavate the center only to a depth of 4 feet and backfill with filter media (infiltration rate of at least 0.5 feet per day). Use existing soil on side slopes (minimum 4:1 slopes). Use a filter medium with a lower sand ratio, or plant large trees only on side slopes to reduce potential for upheaval.
- ☐ Overplant with bare root seedlings for fast establishment and to account for mortality. Alternatively, plant larger stock when a dedicated water source is available using desired spacing intervals (35-50 feet for large and very large trees) and random spacing, or use a mix of seedlings and larger stock.
- ☐ Provide adequate soil volume for trees: in general, 2 cubic feet of useable soil for every square foot of mature canopy (Urban, 1999). Assume some shared rooting space between trees.

Maintenance	☐	Use tree shelters to protect seedlings where deer predation is a concern.
	☐	Use mulch to retain moisture.
Topics for Future Research	☐	Quantify increased pollutant removal due to trees in facility.

Further Resources

Center for Watershed Protection. 1996. Design of stormwater filtering systems. Ellicott City, MD.

Ferguson, B. K. 1994. Stormwater infiltration. Boca Raton, FL: CRC Press, Inc.

Prince George's County. 2001. Bioretention manual. Upper Marlboro, MD: Department of Environmental Resources Program and Planning Division.

Urban, J. 1999. Room to grow. Treelink 11: 1-4.

This fact sheet was excerpted from:

Cappiella, Karen; Schueler, Tom; Wright, Tiffany. 2006. Urban Watershed Forestry Manual. Part 2: Conserving and Planting Trees at Development Sites. NA-TP-01-06, Newtown Square, PA: p 35-37. USDA Forest Service, Northeastern Area State and Private Forestry.

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