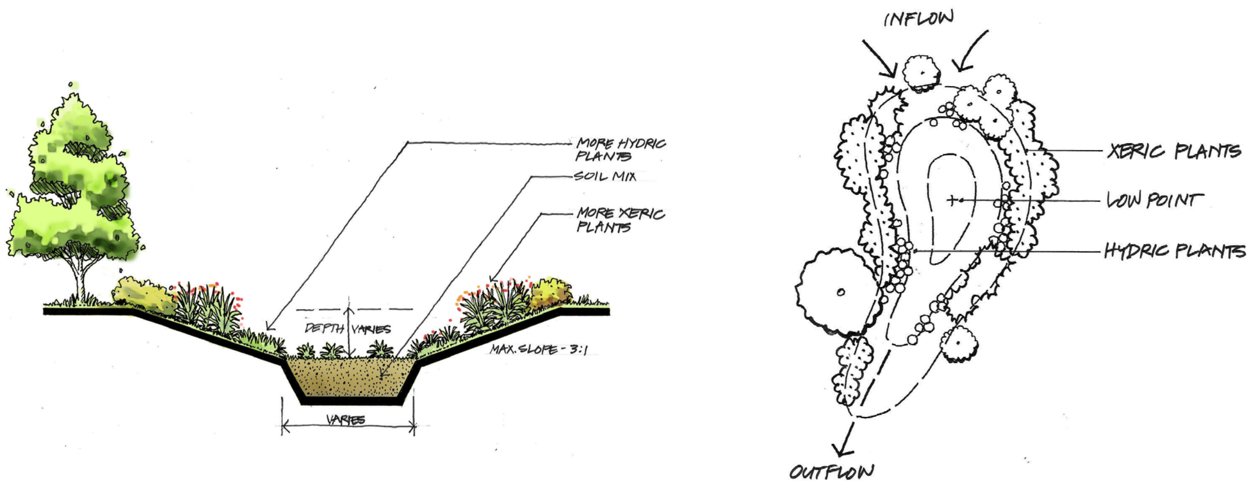
UF UNIVERSITY of FLORIDA
IFAS Extension

Bioretention Basins/Rain Gardens



Depiction of typical bioretention area design illustrating shallow slopes, well drained soil profile and location of plant material along hydrologic gradient. Basins with large catchments should include an over drain or provide a spillway in case of high flow event, and underdrains can be used in areas with low conductivity soils.

Definition:

A bioretention area or rain garden is a shallow planted depression designed to retain or detain stormwater before it is infiltrated or discharged downstream. While the terms "rain garden" and "bioretention basin" may be used interchangeably, they can be considered along a continuum of size, where the term "rain garden" is typically used to describe a planted depression on an individual homeowner's lot, where the lot comprises the extent of the catchment area. Bioretention basins serve the same purpose but that more technical term typically describes larger projects in community common areas as well as non-residential applications.

Applications

- Residential yards (most common in smaller, urban sites)
- Commercial developments
- Parking lot islands
- Roadways (off-line cells adjacent to roadways accessed by curb cut)

Objectives:

Bioretention basins/rain gardens retain, filter, and treat stormwater runoff using a shallow depression of conditioned soil topped with a layer of mulch or high carbon soil layer and vegetation tolerant of short-term flooding. Depending on the design, they can provide retention or detention of runoff water and will trap and remove suspended solids and filter or absorb pollutants to soils and plant material.

Overview:

Bioretention basins can be installed at various scales, for example, integrated with traffic calming measures in suburban parks and in retarding basins. In larger applications, it is considered good practice to have pretreatment measures (e.g. vegetated strips and swales) upstream of the basin to capture sediment and reduce the maintenance frequency of a bioretention basin.

The size of the rain garden or bioretention area will determine the volume of runoff that can be stored or reduced, as well as the treatment benefits. Where the volume of runoff exceeds that of the bioretention area, additional stormwater devices will be required in the treatment train to handle the design storm.

Benefits

- Pollutant removal through infiltration and plant absorption
- Reduction of water runoff from site
- Reduced irrigation for planting beds
- Increased biodiversity in the landscape with wildlife and aesthetic values

Water Protection Benefits:

Bioretention basins use vegetation in retention areas to reduce nutrient export through plant uptake, filtering and sorption. The vegetation also improves soil infiltration.

Water conservation implications – Biorention basins are designed to capture and retain stormwater in recessed gardens that typically do not need irrigation beyond plant establishment.

Stormwater implications – Infiltration processes and adsorption to plant roots remove pollutants from the flow stream. This is a key practice in the LID suite for improving stormwater quality. This also reduces the quantity of water flowing off-site into the larger municipal stormwater system.

Design Considerations:

This is an infiltration dependent practice affected by soil type and groundwater table. Where soils are well drained and groundwater tables are well below the surface, an under drain is not required. Where soils have low conductivity, underdrains can be used to reduce ponding time and increase treated volume. There is no specific slope requirement for bioretention, although size of the basin will typically decrease or become narrower and follow the elevation contour as slopes increase above 5%.

Determination of ponding depth should consider inflow characteristics (inflow rate, total volume, etc.), soil infiltration rate, and total ponding volume available. The ponding depth should not be greater than 12 inches, with 6-8 inch depths preferred. The duration of ponding after a storm should also not exceed 24 hours to reduce the likelihood of mosquito breeding or safety hazards.

A bioretention area/rain garden is used to encourage infiltration, so place it in an area where infiltration is good, not where water normally pools. It should be at least 10 ft. from any building, to avoid moisture around the building's foundation. Don't place a rain garden over a septic system. Consider how it can be integrated into existing and future landscaping. When adding plant material, do not place woody plants in the inflow path. Use native plants to improve the site's biodiversity.

Operations and Maintenance:

When rain gardens are installed on individual lots, it is important to implement educational programming to homeowners on proper maintenance. It is also important that the storage capacity of the rain garden/bioretention area be maintained through regular maintenance of vegetation and removal of debris that may compromise any structures during a high flow event. Regular visual inspection of the basin, looking for signs of erosion, excessive sediment deposits or dead and diseased vegetation, should be conducted. Mulch in the bioretention area should also be monitored for bare spots and should be replaced every 2-3 years. Plant selection is critical to aid operation, and other considerations may include gravel or stone to limit volunteer growth that can reduce storage area.

Design Keys

- *The design of a bioretention area/rain garden is a balance of stormwater function with biological functions. That means there must be consideration of:*
- *Basin design (soil type, drainage, groundwater table, slope, outfall device)*
- *Location in the treatment train*
- *Plant material selection and placement*
- *On-going management*

HOA or Regulatory Considerations:

There is presently no regulatory "presumption of compliance" granted to rain gardens or bioretention basins in stormwater permits. Although not significantly different than a conventional dry retention basin except for size, spatial distribution and landscape integration of this practice requires them to be submitted as an "alternative" management practice during the permitting process. Water management districts are also cautious about giving credit toward volume storage for any structure installed on a homeowner's property without sufficient guarantee that the structure will be adequately maintained in the long-term.

Credits in Green Building Certification Programs:

- FGBC-Home Standard (S-15 onsite designated retention areas)
- Florida Yards & Neighborhoods (stormwater runoff: swales, terraces and/or rain gardens created to catch and filter stormwater)
- LEED for Homes (SS 4.3 management of runoff from roof)
- LEED for Neighborhood Development Pilot (GCT Credit 9: Stormwater Management)
- NAHB Model Green Home Building Guidelines (1.3.5 Manage storm water using low-impact development when possible)

Relative Costs:

While this practice may create additional site work costs as compared to conventional practices, it can be offset by reduced infrastructure such as stormwater pipes, storm drains and stormwater ponds. Costs per acre of development range from $5,000 to $10,000 for larger areas and costs per square foot range from $3 to $15. In some cases it has been found that bioretention can yield a 50% savings over conventional systems for overall site drainage. In most cases the area would have been landscaped, so the cost of installing and maintaining a bioretention area should be compared to the cost of otherwise landscaping the area.

References and Resources:

Bannerman, R. and E. Considine. 2003. *Rain Gardens, A How-To Manual for Homeowners*. University of Wisconsin. http://clean-water.uwex.edu/pubs/pdf/home.rgmanual.pdf

Bioretention Basins Factsheet (Lake Superior Streams.Org) http://www.lakesuperiorstreams.org/stormwater/toolkit/bioretention.html

Bioretention (Rain Gardens) Fact Sheet (EPA) http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=72

Clar, M., A.P. Davis, W.F. Hunt, and R.G.Traver, 2007. Bioretention Technology: An Overview of Current Practice and Future Needs, Paper presented at the 2nd National Low Impact Development (LID) Conference, sponsored by North Carolina State University, Wilmington, NC.

Engineering Technologies Associates and Biohabitats. 1993. *Design Manual for Use of Bioretention in Stormwater Management*. Prepared for Prince George's County Government, Watershed Protection Branch, Landover, MD.

LID BMP Fact Sheet – Bioretention Basins (Fairfax County) http://www.lowimpactdevelopment.org/ffxcty/1-1_bioretentionbasin_draft.pdf

Winogradoff, Derek A. 2002. *Bioretention Manual*. Programs & Planning Division,

Department of Environmental Resources, Prince George's County, Maryland. http://www.princegeorgescountymd.gov/Government/AgencyIndex/DER/ESG/Bioretention/bioretention.asp

Credits

Authors:

Mark Clark
Soil and Water Science Department

Glenn Acomb
Landscape Architecture Departmen

Fact Sheet Illustrations:

Glenn Acomb
Landscape Architecture Department

Wei Ren
Landscape Architecture Department

Fact Sheet Illustration Assistance:

Brian Niemann
Florida Yards & Neighborhoods

Layout:

Barbara Haldeman
Program for Resource Efficient Communities

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