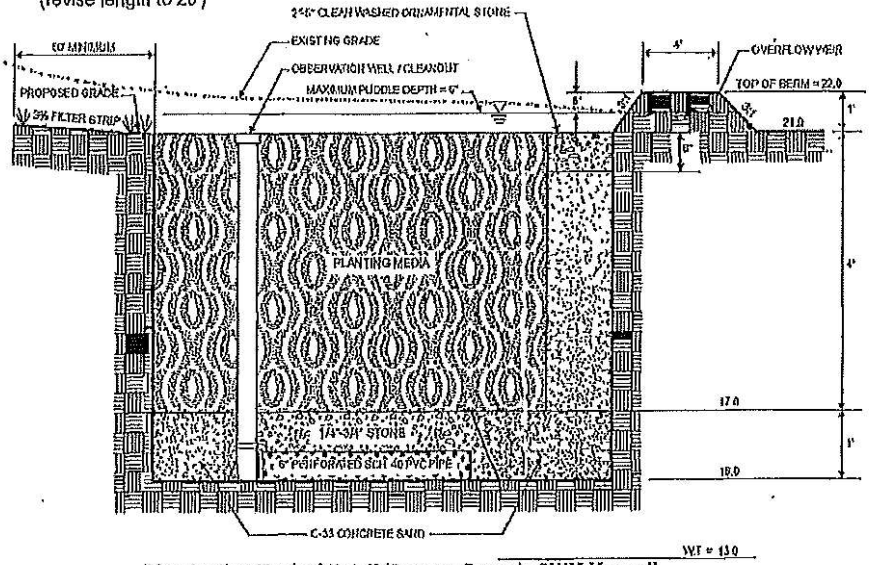
General Description

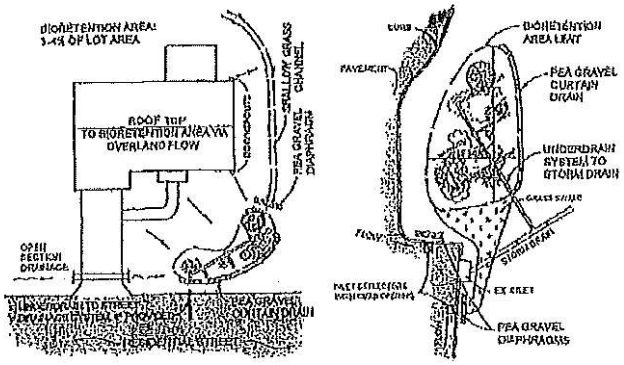
Bioretention areas (also referred to as *bioretention filters* or *rain gardens*) are structural stormwater controls that capture and temporarily store the water quality volume (WQ_v) using soils and vegetation in shallow basins or landscaped areas to remove pollutants from stormwater runoff.

Bioretention areas are engineered facilities in which runoff is conveyed as sheet flow to the "treatment area," which consists of a grass buffer strip, ponding area, organic or mulch layer, planting soil, and vegetation. An optional sand bed can also be included in the design to provide aeration and drainage of the planting soil. The filtered runoff is typically collected and returned to the conveyance system, though it can also be exfiltrated into the surrounding soil in areas where appropriate.

(revise length to 20')



Bioretention Typical Detail (Source: Georgia SWM Manual)



Application and Site Feasibility Criteria

Bioretention areas are suitable for single-family residential lots of 1 acre or less. Because of its ability to be incorporated in landscaped areas, the use of bioretention is extremely flexible.

The following criteria should be evaluated to ensure the suitability of a bioretention area for meeting stormwater management objectives on a site or development.

Physical Feasibility - Physical Constraints at Project Site

- Site Slope – No more than 6% slope
- Minimum Head – Elevation difference needed at a site from the inflow to the outflow: 5 feet
- Minimum Depth to Water Table – A separation distance of 2 feet recommended between the bottom of the bioretention facility and the elevation of the seasonally high water table.
- Soils – No restrictions; engineered media required.

Other Constraints / Considerations

- Aquifer Protection – Do not allow exfiltration of filtered hotspot runoff into groundwater

Planning and Design Criteria

The following criteria are to be considered minimum standards for the design of a bioretention facility for a single family residential lot. Consult with the local review authority to determine if there are any variations to these criteria or additional standards that must be followed.

A. LOCATION AND SITING

- Residential Bioretention areas should have a maximum contributing drainage area of 0.25 acres or less; multiple bioretention areas can be used.
- Bioretention systems are designed for intermittent flow and must be allowed to drain and reaerate between rainfall events. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.
- Bioretention area locations should be integrated into the site planning process, and aesthetic considerations should be taken into account in their siting and design. Elevations must be carefully worked out to ensure that the desired runoff flow enters the facility with no more than the maximum design depth.

B. GENERAL DESIGN

- The Standardized bioretention area for a single residential lot consists of:
  (1) Grass filter strip (lawn areas) between the contributing drainage area and the ponding area should where possible be a minimum of 20' in length.
  (2) Ponding area containing vegetation with a planting soil bed,
  (3) Organic/mulch layer must be four (4') in depth,
  (4) Gravel and perforated pipe underdrain system to collect runoff that has filtered through the soil layers (bioretention areas can optionally be designed to infiltrate into the soil).
- A bioretention area design will also include some of the following:
  - Optional sand filter layer to spread flow, filter runoff, and aid in aeration and drainage of the planting soil.
  - Stone diaphragm at the beginning of the grass filter strip to reduce runoff velocities and spread flow into the grass filter.

C. PHYSICAL SPECIFICATIONS / GEOMETRY

- The planting soil filter bed is sized using a Darcy's Law equation with a filter bed drain time of 48 hours and a coefficient of permeability (k) of 0.5 ft/day.
- The ponding depth of the bioretention areas is 6 inches.
- The planting soil bed must be at least 4 feet in depth. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25%. The soil must have an infiltration rate of at least 0.5 inches per hour and a pH between 5.5 and 6.5. In addition, the planting soil should have a 1.5 to 3% organic content and a maximum 500 ppm concentration of soluble salts.
- Water should be directed as sheet flow over lawn area to the bioretention area.
- The mulch layer should consist of 2 to 4 inches of commercially available fine shredded hardwood mulch or shredded hardwood chips.
- The sand bed should be 12 to 18 inches thick. Sand should be clean and have less than 15% silt or clay content.
- Pea gravel for the diaphragm and curtain, where used, should be ASTM D 448 size No. 6 (⅛" to ¼").
- The underdrain collection system is equipped with a 6-inch perforated PVC pipe (AASHTO M 252) in an 8-inch gravel layer. The pipe should have 3/8-inch perforations, spaced at 6-inch centers, with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center and a minimum grade of 0.5% must be maintained. A permeable filter fabric is placed between the gravel layer and the planting soil bed.

D. PRETREATMENT

- Adequate pretreatment is provided when all of the following are provided: (a) water flows over grass filter strip (lawn area) prior to entering the bioretention area.

E. OUTLET STRUCTURES

- Outlet pipe is to be provided from the underdrain system to the facility discharge. Due to the slow rate of filtration, outlet protection is generally unnecessary.

F. EMERGENCY SPILLWAY

- An overflow structure and nonerosive overflow channel must be provided to safely pass flows from the bioretention area that exceed the storage capacity to a stabilized downstream area or watercourse. If the system is located off-line, the overflow should be set above the shallow ponding limit.

G. MAINTENANCE ACCESS

- Adequate access must be provided for all bioretention facilities for inspection, maintenance, and landscaping upkeep, including appropriate equipment and vehicles.

H. SAFETY FEATURES

- Bioretention areas generally do not require any special safety features. Fencing of bioretention facilities is not generally desirable.

I. LANDSCAPING

- Landscaping is critical to the performance and function of bioretention areas.
- A dense and vigorous vegetative cover should be established over the contributing pervious drainage areas before runoff can be accepted into the facility.

- After the trees and shrubs are established, the ground cover and mulch should be established.

- Choose plants based on factors such as whether native or not, resistance to drought and inundation, cost aesthetics, maintenance, etc. Planting recommendations for bioretention facilities are as follows:
  - Native plant species should be specified over non-native species.
  - Vegetation should be selected based on a specified zone of hydric tolerance.
  - A selection of trees with an understory of shrubs and herbaceous materials should be provided.
  - Selection of plant species shall comply with Appendix B of the PA BMP Manual or DCNR Native Plantings list.

The following are some native plants suitable for rain gardens for the Northeast Region. They are also attractive to butterflies, birds, and other wildlife. Be sure to choose species appropriate for the degree of sun or shade on the site.

Wildflowers, Ferns, Grasses, and Sedges:

- *Asclepias incarnata*, Swamp milkweed
- *Chelone glabra*, White turtlehead
- *Eupatorium maculatum*, Joe-pye weed
- *Lobelia cardinalis*, Cardinal flower
- *Lobelia syphilitica*, Blue lobelia
- *Monarda didyma*, Oswego tea
- *Vernonia noveboracensis*, Common ironweed
- *Athyrium filix-femina*, Lady fern
- *Osmunda regalis*, Royal fern
- *Osmunda cinnamomea*, Cinnamon fern
- *Carex pendula*, Drooping sedge
- *Carex stipata*, Tussock sedge

Trees and Shrubs:

- *Amelanchier laevis*, Shadbush
- *Asimina triloba*, Pawpaw
- *Betula nigra*, River birch
- *Cephalanthus occidentalis*, Buttonbush
- *Clethra alnifolia*, Sweet pepperbush
- *Cornus amomum*, Silky dogwood
- *Fothergilla gardenii*, Dwarf fothergilla
- *Ilex verticillata*, Winterberry holly
- *Lindera benzoin*, Spicebush
- *Liquidambar styraciflua*, Sweet gum
- *Sambucus canadensis*, American elderberry
- *Viburnum dentatum*, Arrowwood

All vegetative materials used in BMPs shall have a one year warranty for replacement of vegetation that dies, exhibits disease or illness, or branches that begin to wither or fall off at no extra cost.