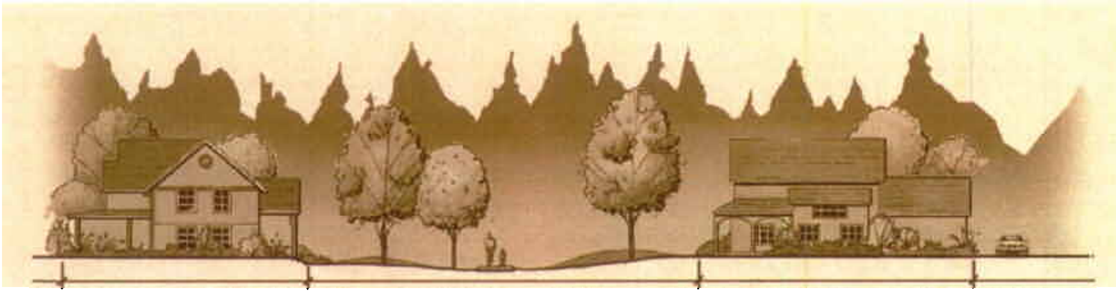
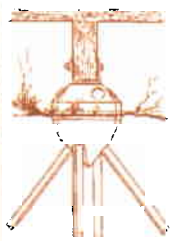


LOW IMPACT DEVELOPMENT

TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND



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Puget Sound Action Team • Washington State University Pierce County Extension

53

6 Integrated Management Practices

IN THIS CHAPTER...

Specifications for:

- *Bioretention areas*
- *Amending construction site soils*
- *Permeable paving*
- *Vegetated roofs*
- *Minimal excavation foundations*
- *Roof rainwater collection systems*

Integrated management practices (IMPs) are the tools used in a low impact development (LID) project for water quality treatment and flow control. The term IMP is used instead of best management practice or BMP (used in a conventional development) because the controls are integrated throughout the project and provide a landscape amenity in the LID design.

6.1 Bioretention Areas

The bioretention concept originated in Prince George's County, Maryland in the early 1990s and is a principal tool for applying the LID design approach. The term bioretention was created to describe an integrated stormwater management practice that uses the chemical, biological, and physical properties of plants, microbes, and soils to remove, or retain, pollutants from stormwater runoff. Numerous designs have evolved from the original application; however, there are fundamental design characteristics that define bioretention across various settings.

Bioretention areas (also known as rain gardens) are:

- Shallow landscaped depressions with a designed soil mix and plants adapted to the local climate and soil moisture conditions that receive stormwater from a small contributing area.
- Facilities designed to more closely mimic natural conditions, where healthy soil structure and vegetation promote the infiltration, storage, and slow release of stormwater flows.
- Small-scale, dispersed facilities that are integrated into the site as a landscape amenity.
- An IMP designed as part of a larger LID approach. Bioretention can be used as a stand-alone practice on an individual lot, for example; however, best performance is achieved when integrated with other LID practices.

Bioretention is an integrated stormwater management practice that uses the chemical, biological, and physical properties of plants, microbes, and soils to remove, or retain, pollutants from stormwater.

The term bioretention is used to describe various designs using soil and plant complexes to manage stormwater. The following terminology is used in this manual:

- Bioretention cells: Shallow depressions with a designed planting soil mix and a variety of plant material, including trees, shrubs, grasses, and/or other herbaceous plants. Bioretention cells may or may not have an under-drain and are not designed as a conveyance system.

57

- Bioretention swales: Incorporate the same design features as bioretention cells; however, bioretention swales are designed as part of a conveyance system and have relatively gentle side slopes and flow depths that are generally less than 12 inches.
- Bio*detention:* A design that uses vegetative barriers arranged in hedgerows across a slope to disperse, infiltrate, and treat stormwater (see sloped biodetention description in this chapter).

The following section outlines various applications and general design guidelines, as well as specifications, for individual bioretention components. Design examples are also included in Appendix 2 to provide designers with a pool of concepts and specifications useful for developing bioretention facilities specific to local needs. This section draws information from numerous sources; however, many of the specifications and guidelines are from extensive work and experience developed in Prince George's County, Maryland and the city of Seattle.

6.1.1 Applications

While the original concept of bioretention focused on stormwater pollutant removal, the practice is also used for water quantity control. Where the surrounding native soils have adequate infiltration rates, bioretention can be used as a retention facility. Under-drain systems can be installed and the facility used to filter pollutants and detain flows that exceed infiltration capacity of the surrounding soil. However, designs utilizing under-drains provide less flow control benefits.

Rain gardens are a landscape amenity and a stormwater control practice that can be applied in various settings, including:

- Individual lots for rooftop, driveway, and other on-lot impervious surface infiltration.
- Shared facilities located in common areas for individual lots.
- Areas within loop roads or cul-de-sacs.
- Landscaped parking lot islands.
- Within right-of-ways along roads (linear bioretention swales and cells).
- Common landscaped areas in apartment complexes or other multifamily housing designs.

Figure 6.1.1 Bioretention area in center of apartment building courtyard, Portland, Oregon.
Photo by Curtis Hinman

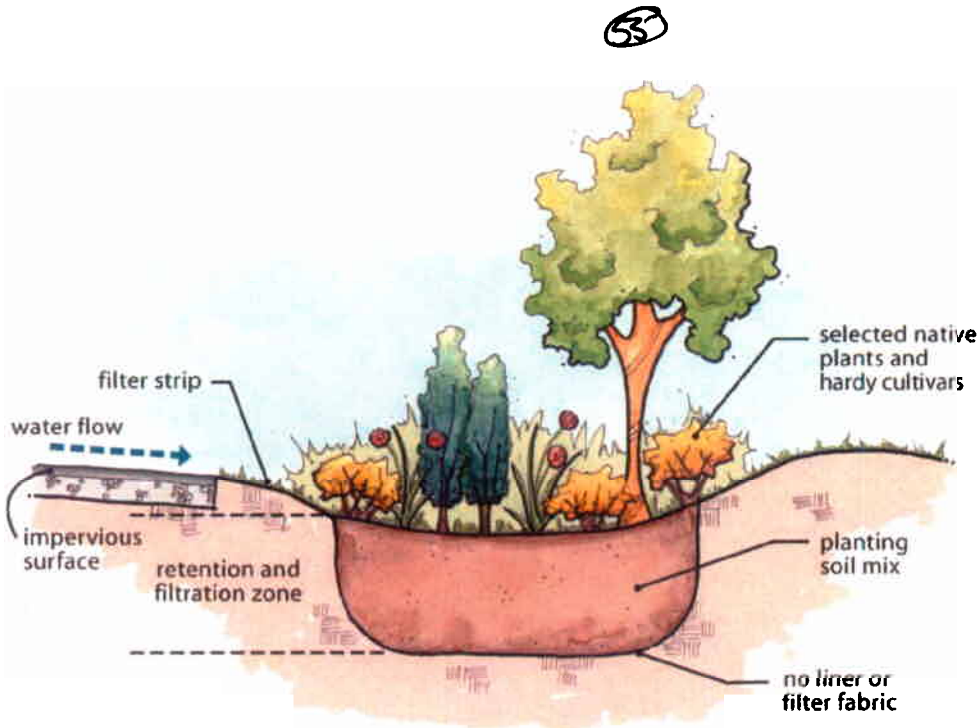

Figure 6.1.2 Cross-section of a basic bioretention cell with no under-drain.

Graphic by AHBL Engineering

6.1.2 Design

Bioretention systems are placed in a variety of residential and commercial settings, and are a visible and accessible component of the site. Design objectives and site context are, therefore, important factors for successful application.

The central design considerations include:

- *Soils:* The soils underlying and surrounding bioretention facilities are a principal design element for determining infiltration capacity, sizing, and rain garden type. The planting soil placed in the cell or swale is highly permeable and high in organic matter (e.g., loamy sand, USDA soil texture classification, mixed thoroughly with compost amendment) and a surface mulch layer. See Section 6.1.2.3: Bioretention Components for details.
- *Site topography:* For slopes greater than 10 percent, sloped biodetention and weep garden designs can be used. See Section 6.1.2.1: Types of bioretention areas.
- *Depth-to-water table:*
  - o A minimum separation of 1 foot from the seasonal high water mark to the bottom of the bioretention area is recommended where the contributing area of the bioretention has less than 5,000 square feet of pollution-generating impervious surface; and less than 10,000 square feet of impervious surface; and less than ¾ acres of lawn. Recommended separation distances for bioretention areas with small contributing areas are less than the new Department of Ecology (Ecology) recommendation of 3 feet for two reasons: (1) bioretention soil mixes provide effective pollutant capture; and (2) hydrologic loading and potential for groundwater mounding is reduced when managing flows from small contributing areas.
  - o A minimum separation of 3 feet from the seasonal high water mark to the bottom of the bioretention area is recommended where the contributing

56

area of the bioretention area is equal to or exceeds any of the following limitations: 5,000 square feet of pollution-generating impervious surface; or 10,000 square feet of impervious surface; or ¾ acres of lawn and landscape. See Bioretention Areas in Chapter 7 for flow modeling guidance.

- *Expected pollutant loading:* See sections 6.1.2.3: Bioretention components and 6.1.4: Performance for recommended designs by pollutant type.
- *Site growing characteristics and plant selection:* Appropriate plants should be selected for sun exposure, soil moisture, and adjacent plant communities. Invasive species control may also be necessary.
- *Transportation safety:* The design configuration and selected plant types should provide adequate sight distances, clear spaces, and appropriate setbacks for roadway applications.
- *Visual buffering:* Bioretention facilities can be used to buffer structures from roads, enhance privacy among residences, and for an aesthetic site feature.
- *Ponding depth and surface water draw-down:* Flow control needs, as well as location in the development, will determine draw-down timing. For example, front yards and entrances to residential or commercial developments may require rapid surface dewatering for aesthetics. See Section 6.1.2.3: Bioretention components for details.
- *Impacts of surrounding activities:* Human activity influences the location of the facility in the development. For example, locate bioretention areas away from traveled areas on individual lots to prevent soil compaction and damage to vegetation, and provide barriers to restrict vehicle access in roadside applications.
- *Setbacks:* Local jurisdiction guidelines should be consulted for appropriate bioretention area setbacks from wellheads, on-site sewage systems, basements, foundations, and utilities.

6.1.2.1 Types of bioretention areas

Numerous designs have evolved from the original bioretention concept as designers have adopted the practice to different physical settings. Types of bioretention designs include:

- Bioretention cells integrated into gardens on individual lots.

Figure 6.1.3 Bioretention cell integrated into landscaping.
Photo by Larry Coffman