

# Low Impact Development

## Promoting water quality through an integrated design approach

### Introduction

Low impact development (LID) is an innovative planning and engineering approach that emphasizes the conservation of natural resource function and on-site features. The approach combines hydrologically functioning site design with pollution prevention measures to reduce the impacts of land development on natural hydrology and water quality. Pre-development hydrologic conditions are maintained or replicated through the implementation of small scale, site-specific design and engineering techniques (typically known as integrated management practices, or IMPs), which allow the retention, detention, infiltration, filtering, storage and evaporation of stormwater runoff close to the source. These LID applications effectively increase water quality and reduce runoff quantity, preserving the integrity of rivers, streams and wetlands.

LID techniques are integrated into preexisting sites or into site plans during development and redevelopment. The design applications are intended to treat, store, and infiltrate on-site stormwater. Scale differentiates LID from traditional best management practices (BMP) for stormwater management. BMPs typically use large off-site facilities to collect stormwater from a larger surrounding area.

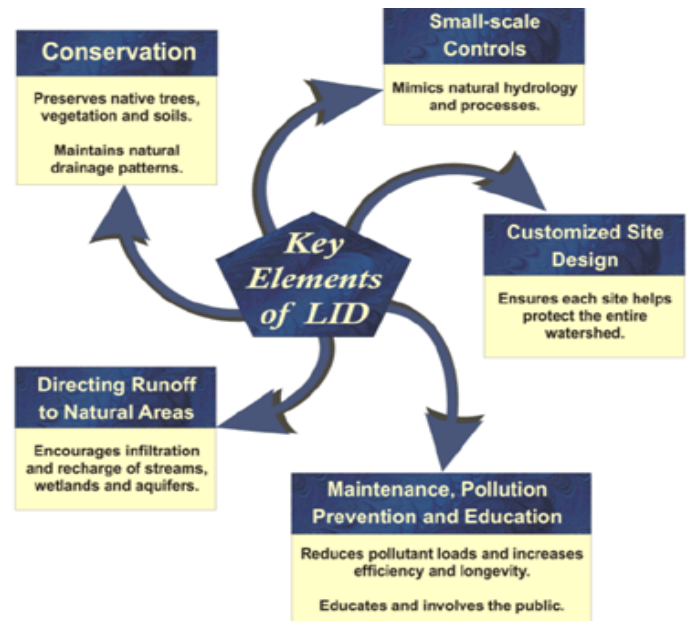
### History

The concept of low impact development was originally introduced in Prince George's County, Maryland in 1990. Government officials determined that traditional stormwater best management practices were not cost-effective and failed to meet specific water quality goals set forth by the county. The LID approach has received support from the United States Environmental Protection Agency (EPA) as a way to promote the goals and objectives stated by the Clean Water Act.

### Goals of Low Impact Development

The primary goal of low impact development is to ensure the maximum protection of the ecological integrity of receiving waters by maintaining the watershed's hydrology. In addition, LID seeks to:

- Provide an improved technology for environmental protection of receiving waters



- Provide economic incentives that encourage environmentally sensitive development.
- Develop the full potential of environmentally sensitive site planning and design.
- Help build communities based on environmental stewardship.
- Reduce construction and maintenance costs of the stormwater infrastructure.
- Introduce new concepts, technologies and objectives for stormwater management such as micromanagement and multi-functional landscape features; mimic or replicate hydrologic functions; and maintain the ecological/biological integrity of receiving streams.
- Encourage flexibility in regulations that allow for innovative engineering and site planning to promote “smart growth” principles.

### General Benefits of LID

There are many benefits to using a low impact

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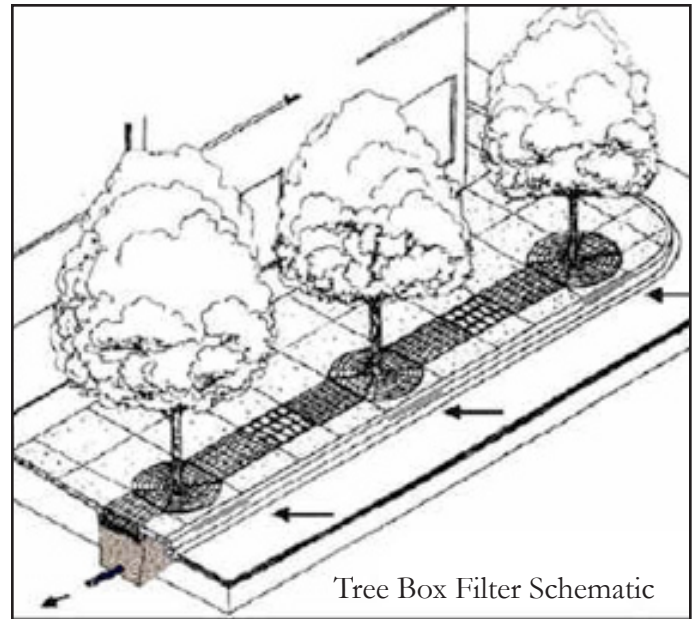
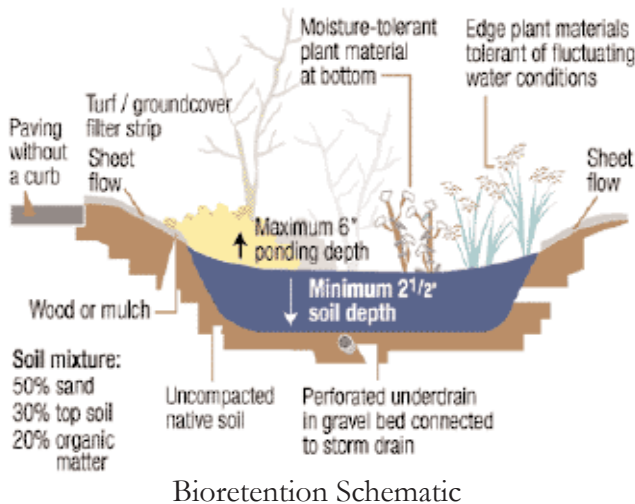
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development strategy. While specifics vary by site, habitat protection is one result stemming from integrating management practices and environmentally sensitive site design. Reduced impervious surface results in less stormwater runoff, particularly volumes and rates. LID promotes groundwater recharge through infiltration, and has numerous water quality benefits.

### Examples of LID Design Applications

**Bioretention** is designed to manage stormwater by mimicking pre-development hydrologic conditions in a concentrated area. Bioretention has the ability to manage and clean stormwater at or near the source. Often, bioretention cells are placed in the path of sheet flow from pavements, such as at the edge of a parking lot. A bioretention cell is made up of a mix of porous soil, sand, topsoil, and compost. Cells are typically located in a shallow swale-like depression in the earth. The area above and around the cell is planted with low shrubs and grasses that thrive in wet soil. Larger trees and bushes are often planted at the periphery of the bioretention site. The cell absorbs stormwater runoff, filtering and slowing it. Bioretention also helps to recharge groundwater in and around the site.

Bioretention cells are noteworthy for their ability to remove heavy metals from water. They typically reduce copper, zinc, and lead by 90% or more. The quantity and



temperature of stormwater runoff are both lower with the use of bioretention cells on site.

**Tree box filters** are essentially small-scale bioretention cells, as on a sidewalk. The bioretention soil (see Bioretention Schematic for soil mixture content) is placed in a container beneath a tree box. Stormwater runoff flows into a curb cut in the tree box where it filters through the bioretention soils. The filtered water flows through a pipe or sheet flows into an adjacent natural area.

**Green roofs** are designed to replicate the pre-development stormwater function of the site to the maximum extent possible. Typically, a green roof consists of a layer of vegetation and soil on the very top, which covers filter and drainage membranes, waterproof and root repellent layers, insulation, and structural support. These layers serve to prevent water damage and leakage while soaking up as much rainwater as possible. There are many economic and environmental benefits to installing green roofs, including maximizing the time between roof replacements, reducing exterior noise inside the building, lowering heating and cooling costs, improving water quality, reducing stormwater runoff,

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and providing an aesthetically pleasing public space where roof access is possible.

Rooftop gardens decrease stormwater runoff between 15 and 90% below a standard impervious roof, depending on the depth, size, and soil composition of the green roof. A 2.5-inch deep sedum and grass layer retains about 67% of water that falls on the roof.

**Permeable pavers** are an alternative to concrete or asphalt in light-duty or residential settings, such as driveways, sidewalks, and parking areas. Pavers interlock or create a lattice grid over grassy areas and are typically inset into layers of sand and gravel to allow water to filter through to the underlying soils. This reduces runoff and improves groundwater recharge and water quality.

Studies have shown that permeable pavers reduce runoff water temperature by 4 to 7 degrees Celsius when compared with traditional asphalt pavement. There are also reductions in heavy metals and suspended solids.

### LID in Virginia

Many counties and cities in Virginia have integrated low impact development standards into their codes. Stafford County, Virginia, offers a good example. They

amended their code to permit low impact development. Additionally, the county made exceptions in the curb and gutter requirements to accommodate water flowing into LID structures such as bioretention and tree box filters. Bioretention vegetated swales are permitted in lieu of curb and gutters along streets for the purposes of stormwater treatment and movement. Bioretention sites also count towards minimum landscaping requirements for parking lots, effectively addressing two development requirements at the same time.

### References and Resources

Low Impact Development Center, Inc.  
<http://www.lowimpactdevelopment.org/>

“Low-Impact Development Design Strategies”  
 Prince George’s County, Maryland; Department of Environmental Resources, June 1999

Center for Watershed Protection  
[http://www.cwp.org/better\\_site\\_design.htm](http://www.cwp.org/better_site_design.htm)

Montgomery County, MD Bioretention Case Study  
[http://www.montgomerycountymd.gov/content/dep/restoration/sligo\\_lid.pdf](http://www.montgomerycountymd.gov/content/dep/restoration/sligo_lid.pdf)

Bioretention Resources  
[www.bioretention.com](http://www.bioretention.com)

Green Roofs Resources  
[www.greenroofs.org](http://www.greenroofs.org)

LID Design Applications  
[www.lid-stormwater.net](http://www.lid-stormwater.net)

Friends of the Rappahannock  
[www.riverfriends.org](http://www.riverfriends.org)



Residential Green Roof

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