EPA
United States Environmental Protection Agency and the EPA Region III states of Pennsylvania, Maryland, Delaware, District of Columbia, Virginia and West Virginia

Incorporating Environmentally Sensitive Development Into Municipal Stormwater Programs

EPA 833-F-07-011

January 2008

Executive Summary

This document is intended to assist local stormwater managers who wish to encourage or require low impact development practices to meet stormwater goals. Managing stormwater with low impact site design techniques can help jurisdictions meet National Pollutant Discharge Elimination System (NPDES) requirements, and the techniques offer construction cost savings as well as a variety of other benefits when compared to traditional stormwater management approaches.

Introduction

Consideration of the impacts of construction and land development on water resources is becoming increasingly important as more undeveloped land is being converted to impervious surfaces. The effects of urbanization on water resources are well known: degraded habitat, incised channels, impaired aquatic life, high pollutant loads, depleted groundwater, and higher incidence of flooding, among others. The mid-twentieth century approach to stormwater management was to dispose of stormwater as quickly as possible using engineered systems of curbs, gutters, pipes, and open channels, resulting in unexpected consequences for water quality. Since then, new approaches have evolved to mitigate impacts and reverse damage caused by existing development. These approaches, commonly referred to as Low Impact Development (LID), focus on emulating the functions of natural systems to reintegrate rainfall into the water cycle rather than disposing of it as a waste product.

LID is an environmentally sensitive approach to stormwater management that seeks to manage rainfall where it falls using decentralized, small-scale controls that are integrated into a site's landscape features. These include open space, rooftops, streetscapes, parking lots, sidewalks, and medians. The goal of this technique is to mimic a site's predevelopment hydrology by infiltrating, filtering, storing, evaporating, and detaining runoff close to its source (Low Impact Development Center, 2007).

Environmentally Sensitive Development (ESD) has many analogous terms, such as:

- Better site design
- Conservation design
- LID
- Smart Growth
- Green infrastructure
- Integrated site design
- Sustainable development

To incorporate LID at a neighborhood or watershed level to fully protect water resources, communities can consider employing a wide range of land use strategies including building a range of development densities, incorporating adequate open space, preserving critical ecological and buffer areas, and minimizing land disturbance.

An ecoroof in Arlington, Virginia

ESD offers a number of advantages over traditional, engineered stormwater drainage approaches, including:

- **Addresses stormwater at its source:** LID practices seek to manage rainfall where it falls, reducing or eliminating the need for regional detention ponds and flood controls.
- **More protective of streams and watersheds:** Because LID practices infiltrate rainfall and prevent runoff, they reduce pollutant loads as well as streambank erosion associated with peak flows.
- **Promotes groundwater recharge:** Many LID techniques infiltrate stormwater, recharging groundwater aquifers and providing baseflow to streams during dry weather. These infiltration practices also reduce stream temperature because surface runoff is warmer than groundwater.
- **Allows for more flexible site layouts:** The small-scale, dispersed nature of LID practices means that designers can include stormwater management in a variety of open spaces and landscaped areas—traditional stormwater management required large set-asides for ponds and wetlands that consumed valuable real estate.
- **Enhanced aesthetics and public access/use:** Well-designed, vegetated practices can provide a visual amenity, particularly when compared to hardened drainage infrastructure such as pipes, curbs, gutters, and concrete-lined channels. Some practices can double as park space, offering recreational amenities.
- **Cost savings:** A common myth is that LID costs more than traditional stormwater management, but case studies have shown the opposite to be true (see Table 1). Typically, cost savings arise from a reduction in the size and extent of pipes and other infrastructure needed to handle runoff. Savings can also arise from the ability to build additional units that would not have been feasible using traditional stormwater management approaches.

Table 1. Cost Benefits of Low Impact Development Designs

Project Name and Location	Description	Cost Benefit
Poplar Street Apartments [1] Aberdeen, NC	◆ 270-unit apartment complex ◆ Most of the curb-and-gutter systems were eliminated ◆ Stormwater managed with a variety of LID BMPs	$175,000 in savings over conventional stormwater costs
Somerset [1] Prince George's County, MD	◆ Residential subdivision ◆ Most of the site was designed with swales and rain gardens ◆ Curbs and gutters were eliminated	Conventional: $2,456,843 LID Design: $1,671,461 Savings: $785,382 ◆ Able to develop 6 additional lots ◆ Decreased cost per lot by $4,000
Gap Creek [1] Sherwood, AR	◆ Residential subdivision ◆ Drainage areas preserved ◆ Greenbelts created for drainage area protection and recreation ◆ Streets designed to follow land contour	◆ $2.2 million in additional profit ◆ Lots sold for $3,000 more than competitors' lots ◆ Able to develop 17 additional lots ◆ Decreased cost per lot by $4,800
Kensington Estates [1] Pierce County, WA	◆ 103-lot residential development ◆ Decreased roadway width ◆ Porous paving ◆ Cul-de-sacs with vegetated depressions in the center	Estimated cost savings of 20% of conventional construction costs
Circle C Ranch [1] Austin, TX	◆ Residential subdivision ◆ Stormwater directed as sheet flow to a stream buffer ◆ Four bioretention areas	Conventional: $250,000 LID Design: $65,000 Savings: $185,000 Additional savings from reduced storm drain pipe size and trenching depth
Green Roof Density Bonus [2] Portland, OR	Portland offers a density bonus of 5,000 ft^2 for installation of a green roof on a commercial property	An estimated $225 million in additional economic development generated since inception
Laurel Springs [3] Jackson, WI	◆ Residential subdivision ◆ Developed using a clustered design Open space preserved ◆ Grading and paving reduced	Conventional: $3,200,081 Conservation: $2,570,555 Savings: $629,526

Sources: [1] U.S. Environmental Protection Agency, 2005; [2] Liptan, 2007; [3] Winer-Skonovd et al., 2006.

NPDES Requirements Addressed by LID

LID can be integrated into a municipal stormwater program at a variety of levels in addition to new development and redevelopment. The following are ways in which LID can help communities meet NPDES permit requirements.

- **Public Education and Outreach on Stormwater Impacts:** Municipalities and developers can post signs describing the functions and benefits of LID BMPs, including information about the impacts of urbanization on water resources.
- **Public Involvement and Participation:** Municipalities can encourage citizens and community groups to get involved in stormwater management by implementing rain gardens and other BMPs at their homes and businesses. Municipalities can sponsor workshops and demonstrations of environmentally friendly landscaping, including rainwater harvesting and reuse and selection of native plants. The State of West Virginia conducted several popular rain barrel workshops in partnership with a local municipality and are planning more by request from citizens.
- **Construction Site Stormwater Runoff:** Preservation of open space reduces the amount of area cleared and graded, decreasing costs for erosion and sediment control. Municipalities can include this practice as one of their required or recommended BMPs for developers and can incorporate this practice into capital improvement projects.
- **Post-Construction Stormwater Management in New Development and Redevelopment:** Most NPDES permits require post-construction stormwater management practices that reduce total suspended solids in stormwater by 80 percent. Permits also typically dictate performance standards for volume and peak discharge control to address channel

stabilization and flooding. LID practices have been shown to remove pollutants beyond the 80 percent standard and are highly effective at maintaining or restoring a site's hydrology to protect stream channels.

- **Pollution Prevention/Good Housekeeping for Municipal Operations:** The use of native plants in landscaping reduces the need for municipal crews to irrigate or use pesticides, herbicides or fertilizers. Municipalities can incorporate selection of native plants into its landscaping guidelines and can train its maintenance crews to use integrated pest management.

State Requirements feature "Green Technology" and "Environmental Site Design"

The State of Delaware requires that "Green Technology BMPs" be considered first for water quality protection for development projects. Other practices can be considered only after these "Green" BMPs have been eliminated for engineering or hardship reasons as approved by the plan reviewer. See www.swc.dnrec.delaware.gov/SedimentStormwater.htm for more information.

The State of Maryland passed the Stormwater Management Act of 2007 (http://mlis.state.md.us/2007RS/billfile/SB0784.htm), which requires the implementation of environmental site design for new development and redevelopment projects. Under the new legislation, local jurisdictions are tasked with reviewing and modifying existing codes and ordinances that would impede environmental site design. Also, developers are tasked with demonstrating that environmental site design is implemented to the maximum extent practicable at their site. Traditional stormwater controls are only allowed where absolutely necessary. The legislation also includes a groundwater recharge standard (100 percent of the predevelopment volume) and references Maryland's Model Stormwater Management Ordinance, which can be downloaded at www.mde.state.md.us/assets/document/sedimentstormwater/model_ordinance.pdf.

Types of LID BMPs

LID is a flexible technique that can be applied to nearly any site, including both infill/redevelopment sites and new development. Neighborhood or regional level techniques such as compact development and open space preservation further mitigate the impacts of development. When used in combination with site techniques, these regional-level techniques can reduce runoff and associated pollutants across a watershed.

- **Disconnected impervious surfaces:** Runoff from rooftops, sidewalks, driveways, and roads can be directed to landscaped areas or porous pavement to promote infiltration and reduce stormwater volumes.
- **Preservation of open space/natural features:** Areas of a development site that will not contain buildings or other infrastructure can be protected from clearing, grading, and other construction-related impacts, reducing the amount of disturbed land and maintaining mature vegetation.
- **Bioretention:** Also known as rain gardens, biofilters, bioswales, and bioinfiltration practices, these are landscaped depressions that collect runoff and manage it through infiltration, evapotranspiration, and biological uptake of nutrients and other pollutants.
- **Flow-through planters and tree boxes:** Planters and tree boxes enhance streetscapes and courtyards with attractive vegetation and shade and also provide pervious areas for rainfall interception and stormwater infiltration.
- **Porous pavement:** A variety of paving surfaces have been developed that contain pore spaces that store and infiltrate runoff. Pavement types include porous concrete, porous asphalt, and interlocking pavers.
- **Water harvesting (rain barrels, cisterns):** Rainfall from rooftops can be collected via downspouts and stored for reuse. Rain barrels are typically used to store water for landscaping, and cisterns, which offer more storage volume, can store water for toilet flushing, landscape irrigation, or other gray water applications.
- **Ecoroofs:** Also known as green roofs, ecoroofs consist of a layer of soil and plants installed on a roof surface. Ecoroofs provide stormwater retention, reducing stormwater volumes and promoting evaporation and transpiration. Ecoroofs have been shown to have energy-saving benefits and help to reduce the heat-island effect in urban areas.
- **Low-input landscaping:** Choosing native plants that are easy to maintain and adapted to local climate and soil conditions decreases or eliminates the need for watering, fertilizers, and pesticides.

Steps for Permittees

Municipalities

Update development standards and pass ordinances with LID incentives

- Evaluate transportation design specifications, plumbing codes, landscaping requirements, and other standards that might prohibit the use of LID practices. Identify language that may be incompatible with LID and work with other municipal departments to discuss the changes and identify alternatives. It is important to address the other departments' concerns about safety, cost, etc. to ensure their buy-in.
- Depending on how new requirements are codified in your community, develop new code language, propose changes to the zoning or development ordinance, or develop a separate stormwater ordinance that outline the new standards. The town of Warsaw, Virginia, and Stafford County, Virginia, incorporated LID into their ordinances, the text of which can be viewed at the Publications page of the Friends of the Rappahannock website (www.riverfriends.org).
- Identify possible incentives that can be offered to encourage LID implementation. Incentives can be in the form of density bonuses, reduced size of required drainage infrastructure, discounted utility fees, and tax credits.

- Provide guidance for implementing the new standards. Develop a standards manual or adopt your state manual if it meets your needs. Wherever possible to conserve resources, adapt existing resources to local situations. Prince George's County, Maryland, developed two design manuals with technical specifications for LID practices: *Low-Impact Development Design Strategies: An Integrated Design Approach* and *Low-Impact Development Hydrologic Analysis*, both of which are available on EPA's website at www.epa.gov/owow/nps/lid.
- Implement demonstration projects and monitor them for effectiveness and suitability of design. Municipalities should take the initiative to experiment with BMP designs and identify those that work well in local conditions. Demonstration projects show developers and citizens the potential associated with attractive stormwater BMPs and instill confidence in their performance.
- Evaluate constraints (areas of high groundwater, poorly drained soils, etc.) and inform the development community about where the new BMP requirements apply and where site constraints prohibit LID implementation.

Bringing Developers Up to Speed on New Requirements

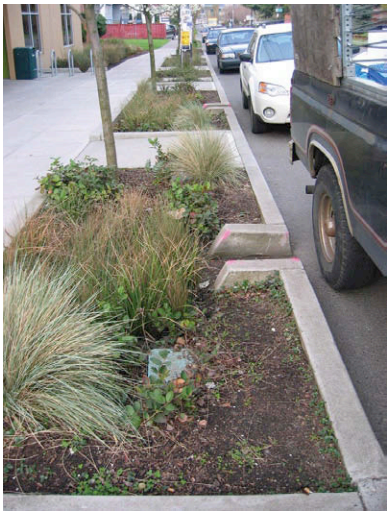
The City of Philadelphia implemented a new stormwater ordinance with performance-based requirements that allow developers more flexibility in meeting stormwater, combined sewer overflow abatement, and flood control standards. To aid engineers and developers in adapting to the new policies, the City does not charge for plan reviews. They have brought in on-site contractors in addition to regular staff to review and suggest revisions to submissions. As time has passed they have seen a substantial drop in resubmissions.

Require LID for capital improvement projects

A municipality can set a good example, show confidence in the use of new technology, and demonstrate success with pilot projects in the public right-of-way. Municipalities have jurisdiction over development activities in the right-of-way and on public lands, which allows greater design flexibility and more reliable maintenance using municipal crews. LID projects adapt well to linear applications (streetscapes, courtyards, medians, etc.) and small-scale open spaces. Work with facilities management and landscaping crews because maintenance of vegetated LID practices sometimes requires special handling, such as hand-weeding and prohibiting heavy equipment and pesticide use. Also, consider adopting Leadership in Energy and Environmental Design (LEED) Green Building Rating System standards for all municipal building and development projects (see "Expanded Stormwater Guidelines for the LEED Green Building Rating System" sidebar for more information).

Educate developers and maintenance crews

Allow time and dedicate staff resources for bringing design engineers and landscape architects up to speed on new requirements. Provide checklists to help ensure compliance with new procedures. Develop locally based coefficients where appropriate in order to streamline sizing calculations and include example calculations to ensure consistency and transparency in project submittals. Hold periodic training sessions on LID applications, and request that plan reviewers provide specific comments when submitted designs do not meet standards.



Curb cuts allow water from the street to flow into bioretention areas

Establish a maintenance tracking system

Determine whether property owners or the municipality will be responsible for maintenance. If property owners will be responsible, there are a number of ways in which the municipality can assure maintenance:

- Require maintenance agreements, which are recorded with the property deed, for new and existing BMPs.
- Require a performance bond for new BMPs.
- Perform spot inspections to identify maintenance problems and check maintenance records.
- Require that property owners submit maintenance records or other evidence that maintenance was performed as prescribed.

Municipalities should consider a balance between compliance assistance and enforcement mechanisms to ensure that property owners uphold their maintenance responsibilities.

Maintain a database or geographic information system (GIS) of locations of all LID BMPs. This database is needed for maintenance assurance and can also be used for other efforts, such as watershed modeling, stormwater master planning, and inspection programs. Publicly owned BMPs should be tracked for maintenance purposes as well as for asset inventories required under Governmental Accounting Standards Board (GASB) Statement No. 34 (www.gasb.org).

Quantify the benefits of LID

Present case studies showing the water quality and community benefits of LID, whether modeled or measured. Good examples and reliable data will help to make a case for changes in development standards by describing potential cost savings and other amenities offered by LID. This information can be part of a larger effort to educate municipal decision makers, such as city councils, the mayor, commissioners, etc., about the benefits of LID and to dispel any myths and misconceptions surrounding "green" infrastructure. These studies can also be used to gain buy-in from state permitting authorities and to quantify stormwater management benefits in terms of volume reductions and pollutant removal. One tool that can be used to estimate the benefits of LID and conservation practices is the Center for Neighborhood

Technology's (2007) Green Values Stormwater Calculator (http://greenvalues.cnt.org/calculator), which allows users to input site development characteristics and green practices and returns financial and hydrologic outcomes for different scenarios.

Modeling Tangible Benefits of Stormwater Retrofits: The Green Build-Out Model

The Casey Trees Foundation (Deutsch et al., 2007) used the Green Build-Out Model to estimate how the addition of just two BMPs, tree cover and ecoroofs affected stormwater runoff volumes in Washington, DC. Researchers modeled two scenarios: a "green build-out" scenario, in which trees and green roofs were placed wherever possible, and a "lowend" scenario where trees and green roofs were placed wherever practical. Using a continuous wet weather simulation based on an average year with a 1-year, 6-hour design storm, the two scenarios showed the following reductions in stormwater entering the sewer system and discharges to Washington's streams and rivers. A follow up analysis is being conducted that adds several of the most commonly used LID practices and is expected to show a significant increase in flow reduction higher than figures listed below.

Result	Low-End Scenario	High-End Scenario
Stormwater prevented from entering the sewer system	310 million gallons	1.2 billion gallons
Reduction in discharges	282 million gallons	1 billion gallons

Other key findings: green roofs were found to offer more storage than trees per unit area, trees are more beneficial when they overhang impervious areas, and larger tree boxes provide greater benefits by reducing imperviousness and allowing more tree growth.

Grant credit for LID and conservation measures

Communities can offer incentives to developers to preserve open space, protect or plant trees, and implement LID site design techniques by offering stormwater credits. The goal of the credits is to reduce the required capacity (and therefore the cost) of stormwater treatment practices using non-structural site design and conservation measures. Credits can also be used to reduce the stormwater utility rate or user fee, if applicable. A number of municipalities across the nation offer some form of stormwater credit, and some states have developed guidance to encourage municipalities to adopt a credit system. For example, the State of Minnesota (2006) describes six types of credits that local jurisdictions can adopt:

- Natural area conservation
- Site reforestation or prairie restoration
- Drainage to stream, wetland or shoreline buffers
- Surface impervious cover disconnection
- Rooftop disconnection
- Grass channels

Minnesota also identifies four factors necessary for successful establishment of a credit system:

- Interest in and experience with LID techniques
- A review process in which stormwater management is discussed prior to initial site layout
- Communication between plan reviewers and design consultants
- Field verification of BMP efficacy by both parties

To establish a stormwater credit system, local jurisdictions should choose which credits to offer based on local feasibility factors, encourage designers to evaluate credit applicability early in the design process, have plan reviewers ensure that credits are applied properly, and inspect sites after construction to ensure that stormwater features are in place and functioning as intended.

Developers

Review new requirements and standards

Obtain and review new BMP standards and requirements from the municipal planning department, including technical design manuals, sample review checklists, and other educational materials. Send design staff to any training workshops offered by the municipality or any other organization that offers this kind of training (e.g., the Center for Watershed Protection).

Get early buy-in for stormwater BMP plans

During the conceptual design stage, meet with a representative from the municipal planning department to discuss ways in which LID can be incorporated into the site to avoid multiple design iterations. Identify areas that are especially well-suited to LID BMPs, such as areas with well-drained soils, stands of mature trees and other mature vegetation, and natural depressions or low-lying areas of the site. Attempt to site buildings, roads, and other infrastructure around these features if possible. Arendt (1996) describes in detail a methodology for evaluating a development site to maximize open space, reduce impervious surfaces, and optimize stormwater management. Delaware's (1997) *Conservation Design for Stormwater Management* (www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/New/Delaware_CD_Manual.pdf) provides additional guidance on designing low-impact site layouts, including case studies comparing the impacts of different designs.

Space for BMPs is more limited in infill developments, though many options are still available, such as the use of flow-through planters in courtyards and along sidewalks, ecoroofs, and narrow swales along the site's perimeter. Porous pavers can be substituted for traditional pavement, and cisterns can be used to store roof runoff for reuse.

Design for long-term maintenance

Developers should design BMPs with maintenance in mind. Native plants should be selected wherever possible to reduce chemical inputs and eliminate the need for watering. Limited

access areas or those that require special maintenance can be set off from the surrounding landscape using low walls with cuts to allow stormwater to enter, a row of stones, or other physical or visual barriers. Access should be provided for periodic maintenance that might require heavy equipment.

Developers should include detailed guidance on BMP maintenance with the property deed, including prescribed maintenance activities, inspection schedules and checklists, plant lists, and guidance on how to recognize problems or malfunctions. The maintenance information should distinguish between inspections and maintenance activities that require special expertise versus those that can be performed by homeowners or laborers.

Phase construction activities and practice site fingerprinting

When planning construction activities, developers should identify ways to minimize the amount of earth disturbed at any one time. This can be accomplished by phasing construction activities so that only a portion of the site is cleared and graded at one time. The remainder of the site can be left undisturbed to reduce erosion. Also, developers should make every effort to disturb as little of the site as possible. This practice, called "site fingerprinting," involves clearing only the areas of a site that will contain buildings or infrastructure, leaving open spaces in a natural condition and preserving existing vegetation.

Revise corporate policies to promote LID

Developers can choose to implement LID and other environmentally friendly business practices across the board by adopting a corporate policy to require site analyses for all development projects that identify opportunities for "greening" developments. Because consumers are becoming more aware of the impacts of development on the environment, developers who regularly incorporate environmentally sensitive features into their projects can market their properties as "environmentally friendly" to appeal to this increased level of awareness.

Expanded Stormwater Guidelines for the LEED Green Building Rating System

The U.S. Green Building Council developed The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ as a nationally accepted benchmark for the design, construction, and operation of high performance green buildings. The LEED rating system includes "points" or credits for onsite stormwater management, including construction site pollution prevention, protecting/restoring habitat, maximizing open space, controlling stormwater quantity and quality, and using water-efficient landscaping. The Council has recently developed a Neighborhood Development Rating System that integrates the principles of smart growth, urbanism, and green building into a national standard for neighborhood design. This rating system provides greater specificity related to water quality enhancement, offering up to 5 points for a comprehensive stormwater management plan that infiltrates, re-uses, or evapotranspirates runoff from impervious surfaces. Infill development has less stringent requirements than new development. See www.usgbc.org for more information about the LEED rating system.

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Additional Resources

Manuals and Reports

Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows

www.nrdc.org/water/pollution/rooftops/rooftops.pdf (PDF, 3.0 MB, 54 pages)
Provides policy guidance for decision makers and includes nine case studies of cities that employed green techniques successfully.

The Practice of Low Impact Development (LID)

www.huduser.org/Publications/PDF/practLowImpctDevel.pdf (PDF, 3.31 MB, 131 pages)
Provides a brief introduction LID and discusses conventional and alternative techniques and technologies that developers can integrate into their existing land development practices. Focuses on technologies that affect both the cost impacts and environmental issues associated with land development.

Conservation Design for Stormwater Management
www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/New/Delaware_CD_Manual.pdf (PDF, 9.7 MB, 228 pages)
Provides guidance for incorporating conservation into site designs, including six case studies comparing conservation designs to traditional designs.

Delaware Green Technology BMPs
www.swc.dnrec.delaware.gov/SedimentStormwater.htm
Delaware's Sediment and Stormwater Program website contains links to Delaware's resources for green technology, including a Green Technology Best Practices Brochure and Standards & Specifications for Green Technology BMPs.

Growing Greener: Conservation by Design
www.natlands.org/uploads/document_33200515638.pdf (PDF, 1.63 BM, 20 pages)
A statewide community planning initiative designed to help communities use the development regulation process to their advantage to protect interconnected networks of greenways and permanent open space. The booklet can be downloaded in PDF format at.

Better Site Design: A Handbook for Changing Development Rules in Your Community
www.cwp.org/pubs_download.htm (available for purchase)
Outlines 22 guidelines for better developments and provides a detailed rationale for each principle. Also examines current practices in local communities, details the economic and environmental benefits of better site designs, and presents case studies from across the country.

Conservation Design for Subdivisions: A Practical Guide for Creating Open Space Networks
www.amazon.com/Conservation-Design-Subdivisions-Practical-Creating/dp/1559634898
A plain-language, illustrated guide for designing open space subdivisions (available for purchase).

Low-Impact Development Design Strategies: An Integrated Design Approach
www.epa.gov/owow/nps/lid/lidnatl.pdf (PDF, 9MB, 150 pages)
This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA.

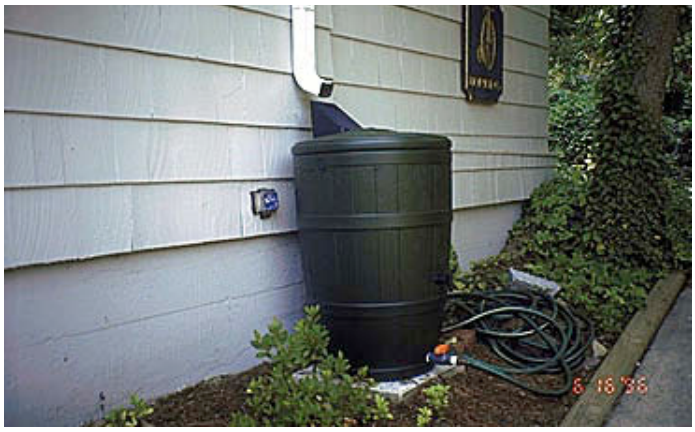
Low-Impact Development Hydrologic Analysis
www.epa.gov/owow/nps/lid/lid_hydr.pdf (PDF, 2MB, 45 pages)
This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA. The design charts from the appendices of this document are not available in PDF format.

Websites

EPA LID Website
www.epa.gov/owow/nps/lid
A compilation of a number of resources, with links to Web sites, a literature review, fact sheets, and technical guidance.

Low Impact Development Center Website
www.lowimpactdevelopment.org
A nonprofit organization whose goal is to promote water resource and environmental protection through proper site design techniques that replicate preexisting hydrologic site conditions. Their website contains a variety of technical resources and case studies exemplifying LID techniques.

Center for Watershed Protection Website
www.cwp.org
A nonprofit organization that provides technical tools for protecting water resources to local governments, activists, and watershed organizations. The Center has developed a number of excellent publications pertaining to site design and watershed protection.



Rain barrels are appropriate for residential settings.

Green Values Stormwater Toolbox
http://greenvalues.cnt.org
This site by the Center for Neighborhood Technology contains an overview and definition of green infrastructure practices and hosts the "Green Values Stormwater Calculator" that allows users to select "green interventions" and enter site characteristics, returning hydrologic and financial outcomes for each scenario. It also includes a pocket guide called Water: From Trouble to Treasure, A Pocket Guide to Green Solutions.

Ordinances

Maryland Model Stormwater Management Ordinance
www.mde.state.md.us/assets/document/sedimentstormwater/model_ordinance.pdf (PDF, 2.1MB, 28 pages)

Stafford County, Virginia, Low Impact Development Subdivision Ordinance Amendments
www.riverfriends.org/LinkClick.aspx?fileticket=qm80RtwjwG0%3d&tabid=86&mid=425 (PDF, 137KB, 6 pages)

Stafford County, Virginia, Low Impact Development Stormwater Code Amendments
www.riverfriends.org/LinkClick.aspx?fileticket=tcM6iE7Ko3I%3d&tabid=86&mid=425 (PDF, 226 KB, 32 pages)

Warsaw, Virginia, Low Impact Development Ordinance Amendments
www.riverfriends.org/LinkClick.aspx?fileticket=VlaUwo%2fvYtQ%3d&tabid=86&mid=425 (PDF, 104 KB, 3 pages)

Permits

Ventura, California, MS4 Permit
www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/venturaMs4.html

Contacts

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- West Virginia—Sherry Wilkins
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NOTE: This document is not law or regulation; it provides recommendations and explanations that MS4s may consider in determining how to comply with requirements of the CWA and NPDES permit requirements.