www.wvca.us/wvwrc/

Low Impact Development (LID)

LID Saves Money & Protects Your Community

Having a hard time thinking of ways to conserve and protect water in an urban setting? Here are a few low impact development (LID) techniques to get you started!

What is Low Impact Development (LID)?

One of four green roofs at WVU. The building structure had to be reinforced to handle the extra weight of soil and water.

Green Roofs can increase the life of a roof and provide energy savings for the building.

- LID includes a variety of practices that mimic or preserve natural drainage processes to manage stormwater. LID practices typically retain rain water and encourage it to soak into the ground rather than allowing it to run into ditches and storm drains where it would otherwise contribute to flooding and pollution problems (see www.epa.gov/nps/lid).

Why Should My Community Adopt LID?

LID Reduces Stormwater Runoff by Emphasizing Infiltration

Figure 1.

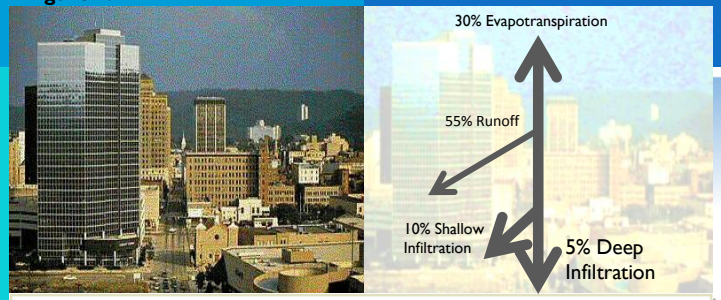


Figure 1. When roads, rooftops and parking lots cover much of the land, more than half of the rainfall runs off and flows directly into surface waters. In highly developed areas, such as in Charleston, WV (above left), only 15% of rain water has the opportunity to soak into the ground.

Figure 2.

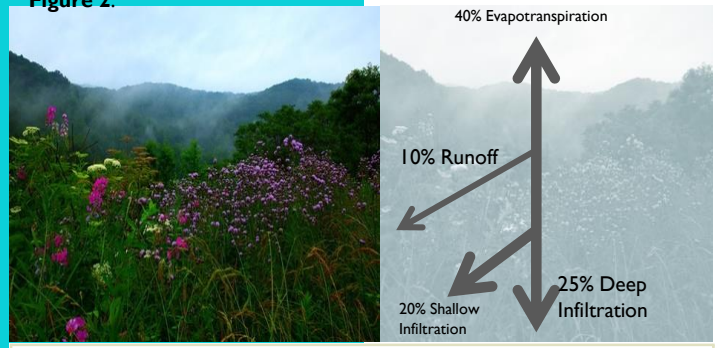


Figure 2. When vegetation and natural areas cover most of the land, very little water (only 10%) runs off into surface waters. Nearly half of the rainfall soaks into the soil. The remaining water evaporates or is released into the air by vegetation.

As a community grows, so does the amount of surface area covered by parking lots, roads and rooftops (Figure 1). Rainfall cannot soak through these hard surfaces; instead the rain water flows quickly across them - picking up pollutants along the way - and enters ditches or storm drains, which usually empty directly and without treatment into local waterways. Local streams in urban areas are overwhelmed by frequent urban flash flooding and stream habitats are smothered by sediments carried by excessive flows.

Contract this to an undeveloped watershed, where vegetation covered soil soaks up rainfall rather than allowing it to run off the land (Figure 2). Water is filtered as it moves through the earth until reaching the groundwater aquifer and then is released slowly by springs. An undeveloped watershed provides clean, safe water.

Fortunately, by adding LID solutions, communities can help their watersheds act more like undeveloped watersheds - despite the ever-expanding numbers of roads and rooftops. LID practices such as natural or man-made swales, depressions and vegetated areas capture and retain water onsite, allowing time for water to soak into the soil where it is naturally filtered.

LID Practices Fit Easily into New & Existing Landscapes

A landscaped curb extension calms traffic and captures and infiltrates street runoff.

Rainfall soaks through permeable pavement and into the ground below in this parking lot.

Communities can seamlessly incorporate LID practices into the public's everyday landscapes - adding both beauty and functionality. For example, in a traditional parking lot design, raised curbs typically completely surround vegetated traffic islands and all runoff is shunted into storm drains. By making minor modifications to the design, traffic islands can instead collect and infiltrate stormwater while maintaining the same look as a traditional traffic island. Similar opportunities exist everywhere you look, including:

- The vegetated strip often found between the sidewalk and the street can be modified to collect and treat stormwater.
- Permeable pavements, which look similar to traditional pavements, can be used in place of sidewalks and some roads.
- Porous pavers can provide a stable surface for parking and allow grass to grow and water to infiltrate.
- Public parks or green spaces can be designed to include grassed swales that slow and infiltrate stormwater.
- Impervious rooftops can be replaced with green roofs, reducing runoff and insulating the buildings beneath.

LID Techniques Can Be Applied at Any Development Stage

Street runoff collects in stormwater planters.

A rain barrel captures and stores roof runoff for later use.

- **In undeveloped areas, a holistic LID design can be incorporated in the early planning stages.** Typical new construction LID techniques include protecting open spaces and natural areas such as wetlands, installing bioretention areas (vegetated depressions) and reducing the amount of pavement.

- **In developed areas, communities can add LID practices to provide benefits and solve problems.** Typical post-development LID practices range from directing roof drainage to an attractive rain garden to completely retrofitting streets with features that capture and infiltrate rainwater.

Distinguishing LID from other Techniques that Address Community Growth Issues

A rain garden project at Dorcas Elementary School in the Potomac Valley Conservation District. The rain garden collects and treats runoff. A rain barrel captures and stores roof runoff for later use.

The U.S. Environmental Protection Agency (EPA) considers LID to be a management approach and set of practices that can reduce runoff and pollutant loadings by managing runoff as close to its source(s) as possible. LID includes overall site design approaches (holistic LID, or LID integrated management practices) and individual small-scale stormwater management practices (isolated LID practices) that promote the use of natural systems for infiltration, evapotranspiration and the harvesting and use of rainwater. Although both holistic LID and isolated LID practices can remove pollutants and reduce damaging stormwater flows (volume and velocity), holistic approaches maximize these benefits. Note that LID is not the same as "no (or zero) impact development" which may represent an unattainable ideal. For more information on LID, see www.epa.gov/nps/lid.

Communities' Efforts to Reduce the Impacts of Development are Expanding – How Does LID Fit?

Fourpole Creek Watershed Storm Drain Stenciling

Beech Fork Project Local Boy Scout Troop

LID is one of many strategies and techniques used to counteract the impact of development. Many of the strategies have things in common and a few of the terms have been used interchangeably, but each may have a different frame that sets it apart from the others. The following explanations are offered to help clarify concepts that can often arise when discussing these terms.

- **Green Infrastructure (GI)** has been used in different entities. GI has been used outside of stormwater context to describe the creation and networking of natural ecosystems and greenway corridors (e.g., forests and floodplains). This provides ecological services and benefits ranging from filtering air pollutants, reducing energy demands, mitigating urban heat islands, sequestering and storing carbon, enhancing aesthetics and property values, and preserving and creating natural habitat functions.
- **Green Stormwater Infrastructure or Wet Weather Green Infrastructure** emphasizes approaches that rely on natural or engineered-as-natural ecosystems to specifically control and manage stormwater runoff, often with the primary goal to reduce the occurrence and magnitude of combined sewer overflows (CSOs).
- **Sustainable Stormwater Management** provides stormwater drainage solutions that minimize both stormwater impacts from development and the need for ongoing or long-term maintenance.
- **Better Site Design** applies to an approach to new residential and commercial development that focuses on reducing pollutant loads, conserving natural areas, saving money and increasing property values. Key principles of this approach include reducing impervious cover, increasing the amount of natural lands set aside for conservation, and better integrating stormwater treatment systems on-site.
- **Conservation Design** seeks to protect the natural environment of an area by controlling growth and applying land use with an eye toward sustainability. Open space landscapes and vistas are intentionally preserved, along with high quality wildlife habitats and existing farmland and rural communities. In some regions, conservation design is used to explicitly protect the water quality. It is related to "preservation development," which is more narrowly focused on preserving farmland.
- **Smart Growth** refers to a range of development and conservation strategies intended to preserve and protect the natural environment while simultaneously making communities more attractive, economically stronger and more socially diverse.
- **New Urban** is closely related to Smart Growth and so many can be used interchangeably. It focuses on traditional neighborhood design, provides improved connectivity through traditional street grids, promotes a strong sense of place and local identity, and minimizes dependency on cars.
- **Light Imprint Design** is a term that grew out of the New Urbanist movement that seeks to integrate Low Impact Development with New Urbanism. It encourages sustainable, compact, mixed-use community development and walkable communities.

LID Provides Many Environmental & Economic Benefits

WVCA Harrisville City Park Stormwater / Erosion Project

The problem was stormwater erosion and flash flows due to impervious surfaces. The situation was stabilized using a turf reinforcement mat and articulated block.

- **Improved Water Quality.** Stormwater runoff can pick up pollutants such as oil, bacteria, sediments, metals, hydrocarbons and some nutrients from impervious surfaces and discharge these to surface waters. Using LID practices will reduce pollutant-laden stormwater reaching local waters. Better water quality increases property values and lowers government clean-up costs.

- **Reduced Number of Costly Flooding Events.** In communities that rely on ditches and drains to divert runoff to local waterways, flooding can occur when large volumes of stormwater enter surface waters very quickly. Holistically incorporating LID practices reduces the volume and speed of stormwater runoff and decreases costly flooding and property damage.

- **Restored Aquatic Habitat.** Rapidly moving stormwater erodes stream banks and scours stream channels, obliterating habitat for fish and other aquatic life. Using LID practices reduces the amount of stormwater reaching a surface water system and helps to maintain natural stream channel functions and habitat.

- **Improved Groundwater Recharge.** Runoff that is quickly shunted through ditches and drains into surface waters cannot soak into the ground. LID practices retain more rainfall on-site, allowing it to enter the ground and be filtered by soil as it seeps down to the water table.

- **Enhanced Neighborhood Beauty.** Traditional stormwater management infrastructure includes unsightly pipes, outfalls, concrete channels and fenced basins. Using LID broadly can increase property values and enhance communities by making them more beautiful, sustainable and wildlife friendly.

When implemented broadly, LID can also **mitigate the urban heat island effect** (by infiltrating water running off hot pavements and shading and minimizing impervious surfaces), **mitigate climate change** (by sequestering carbon in plants), **save energy** (from green roofs, tree shading, and reduced/avoided water treatment costs), **reduce air pollution** (reducing ground-level ozone), **increase property values** (by improving neighborhood aesthetics and connecting the built and natural environments), and **increase groundwater recharge,** potentially slowing or reversing land and well field subsidence.

LID Techniques Can Be Applied at Any Development Stage

Bioretention area

Wetland

- **In undeveloped areas, a holistic LID design can be incorporated in the early planning stages.** Typical new construction LID techniques include protecting open spaces and natural areas such as wetlands, installing bioretention areas (vegetated depressions) and reducing the amount of pavement or using porous pavement products.

- **In developed areas, communities can add LID practices to provide benefits and solve problems.** Typical post-development LID practices range from directing roof drainage to an attractive rain garden to completely retrofitting streets with features that capture and infiltrate rainwater.

Are LID Practices More Economical Thank Conventional Practices?

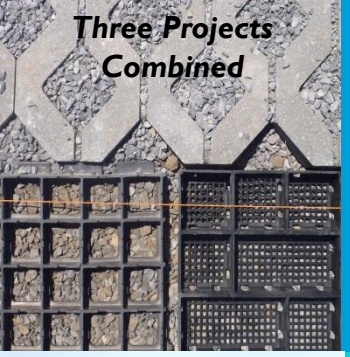
A vegetated swale in a residential subdivision.

- In many cases, the answer is yes. LID typically includes a variety of low-cost elements such as bioswales that retain rain water and encourages it to soak into the ground rather than allowing it to run off into storm drains where it would otherwise contribute to flooding and pollution problems. LID projects typically include smaller overall development footprints, reduce the amount of runoff generated and increase the amount of natural areas on a site, thereby reducing costs when compared to traditional stormwater management and flood control.

Example Economic Benefits of LID Elements

Rain garden have been installed in both Hampshire and Berkeley County DOH Facilities. WVCA partnered with Romney FFA and Hedgesville High FFA for planting and design. Interpretive signage has been placed at the sites.

- Adding roadside bioswales, making roads narrower and designing smaller or porous parking lots with on-site runoff retention **saves money by reducing the amount of pavement, curbs and gutters needed.**
- Installing green roofs, disconnecting roof downspouts from impervious surfaces (driveways or streets), and incorporating bioretention areas to capture on-site runoff **saves money by eliminating the need for costly runoff detention basins and pipe delivery systems.**
- Designing more compact residential lots **saves money by reducing site grading and building preparation costs, and can increase the number of lots available for sale.**
- Preserving natural features in the neighborhood **can increase the value and sale price of residential lots.**
- Using existing trees and vegetation **saves money by reducing landscaping costs and decreasing stormwater volume.**



Sleepy Creek 319 Incremental Project-"Urban Stormwater"

Volunteers from the Sleepy Creek Watershed Association, Eastern Panhandle Conservation District and Mountain View Solar & Wind completed the installation of a porous paving parking lot as a demonstration site in the U.S. 522 Business Park.

This project is an innovative technique to control stormwater runoff and slow pollution into tributaries of Sleepy Creek.

Because the stormwater that runs off paved or impermeable surfaces picks up dirt and debris as well as pesticides, fertilizers, oil, antifreeze and other contaminants, it can be a major cause of pollution in streams and waterways.

When rain falls on these surfaces, it is not filtered through plants, gravel and soil and results in excess runoff which cannot be absorbed into the ground. The excess travels into lakes and streams and eventually into the Chesapeake Bay.

The 319 Grant provided $20,000 for the porous or permeable paving of a 5,000 sq. ft. parking lot. The project team partnered with Mountain View Solar and installed 3,267 feet of "Turf Cell," an open cell concrete block type material weighing up to 60 lbs. each. After installation, the block was filled with small stone, which was compacted in the cell openings.

Another 1,000 sq. ft. overflow lot was covered with "Geo Block 2," a recycled plastic open grid which is interlocked and filled with 70% stone and 30% soil. The grid has open cells in which grass can grow.

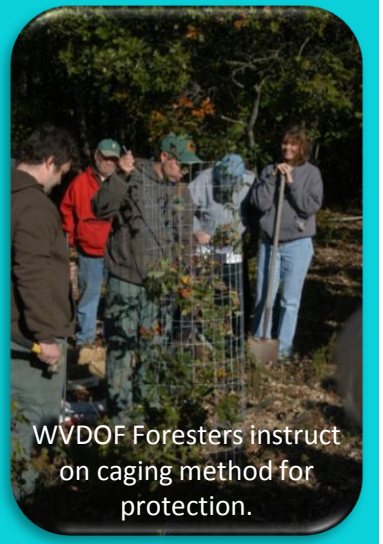
The third portion of the demo site was a 1,000 sq. ft. parking area using "Geo Pave" units which hold stone in place through a herringbone cell pattern with a mesh bottom.

All of the permeable materials allow precipitation to percolate through areas that would traditionally be impervious.

The demonstration areas will have signs identifying the products used in the project to aid builders and homeowners who may wish to install porous paving.

LID Provides Added Value for Communities

Project CommuniTree funded the stormwater planting in the "common area".



WVDOF Foresters instruct on caging method for protection.

Besides reducing the capital and other actual costs, using LID practices provides numerous additional economic benefits, some of which are difficult to quantify, including:

- Improved aesthetics for communities
- Expanded recreational opportunities
- Increased property values due to the desirability of the lots and their proximity to open space
- Increased marketing potential and faster sales for residential and commercial properties
- Reduced stream channel damage and pollutant loadings in downstream waters
- Reduced drinking water treatment costs
- Reduced costs associated with combined sewer outflows, where applicable

LID offers flexibility for developing and re-developing properties. A wide range of LID technology choices are available to match the needs of individual sites and desires of the parties developing or buying the property.

LID Practices Add Natural Beauty

Installation of the Moorefield Elementary School Outdoor learning center and butterfly garden. The entire school participated in the installation of the learning center through a grant from the Potomac Valley Conservation District.

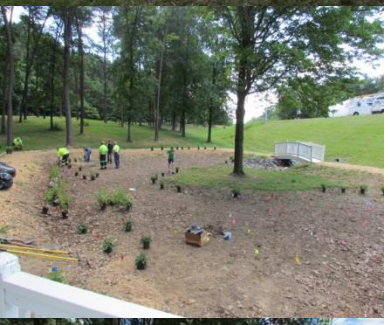
LID practices, which emphasize using natural vegetation to control stormwater, add value and beauty to public and private spaces. LID practices such as bioswales, rain gardens and street trees intercept stormwater, providing water quality benefits and saving money by reducing the need for stormwater conveyance and treatment infrastructure.

LID practices also generate numerous aesthetic and social benefits, including:

- Adding park-like elements to yards and neighborhoods
- Increasing habitat for bees, birds and butterflies
- Calming street traffic and improving public safety
- Offering recreational opportunities and pedestrian access

Many LID practices include traditional landscaping techniques that use mulch, plants and grass. With LID, the landscape serves the double purpose of adding beauty and capturing and filtering stormwater.

Stormwater Management Takes Center Stage in the Panhandle



The West Virginia Welcome and Rest Center (*travelling south into West Virginia from Maryland on Interstate 81 and crossing the majestic Potomac*); take the exit and check out the newest addition to the facilities' stormwater management plan which is assisting in allowing outdoor enthusiasts to continue enjoying the river. West Virginia Division of Highways (WVDOH) recently completed the installation and planting of a 3,560 square foot rain garden that is handling a portion of the stormwater runoff from the impervious surface of the parking area and sidewalks.

The project began with the idea of developing an area of the property that has been typically inaccessible and hard to mow and maintain into a project that would serve as a usable demonstration site. WVDOH contacted the West Virginia Conservation Agency and the Eastern Panhandle Conservation District for technical assistance. USDA Natural Resources Conservation Service offered to assist with the soils investigation. The conservation partners were able to assess the site and determined that it would be perfect for a demonstration bio retention project. The structure was excavated and filled with suitable soil amendments and left to settle over the winter of 2011. A walking trail was installed around the garden including two bridges.

The Eastern Panhandle Conservation District provided a planting design and informational signage at the site. The signs direct people down to the rain garden area from the Welcome Center and also explain how the garden functions in filtering pollutants. During the month of June, employees from the West Virginia Conservation Agency and WV Division of Highways planted over 174 perennial plants within the garden. The planting is designed to showcase blooming flowers and plants for all seasons. Routine maintenance will be coordinated with local Berkeley county school programs. Brochures on the intention and design of rain gardens are being made available within the Welcome Center.

If you are passing through the Panhandle, take the time to check out how attitudes are changing as West Virginia takes steps to protect water quality. For more information on this project, please call Carla Hardy at 304.538.751.

LID Practices Fit Easily into New and Existing Landscapes

Communities can seamlessly incorporate LID practices into the public's everyday landscapes - adding both beauty and functionality. For example, in a traditional parking lot design, raised curbs typically completely surround vegetated traffic islands and all runoff is shunted into storm drains. By making minor modifications to the design, traffic islands can instead collect and infiltrate stormwater while maintaining the same look as a traditional traffic island. Similar opportunities exist everywhere you look, including:

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- Impervious rooftops can be replaced with green roofs, reducing runoff and insulating the buildings beneath.

Greenbrier Valley CD
Meadow River Youth Park
Stormwater Project

The Meadow River Watershed Association obtained ownership of an eight acre park located north in Rainelle, WV along the Meadow River. Since obtaining ownership of the park, the association has had multiple stormwater issues to deal with. Efforts have been taken to address the major runoff from adjacent properties. Additional efforts were needed to address runoff from the parking lot areas, roofed pavilions, and U.S. route 60. This project developed a rain garden / constructed wetland to handle the additional runoff. The rain garden is located between the parking lot area and a developing walking trail / playground area. Educational kiosks are located around the facility and walking trail allowing it to be used as an outdoor classroom. The association and the WVCA worked cooperatively with the USDA NRCS Alderson Plant Materials Center to assure that only locally native vegetation was used for the project. The area will serve educational purposes to assist with educating the public about the nearby Meadow River wetland area.

Communities Are Easily Managing LID Practices

WVCA Harrisville City Park Stormwater / Erosion Project
The problem was stormwater erosion and flash flows due to impervious surfaces. The situation was stabilized using a turf reinforcement mat and articulated blocks.

- Communities contemplating “green” LID approaches may be concerned that maintenance costs will grow as a result of switching from traditional “grey” stormwater practices. While this may be true in some cases, in general LID practices have lower long-term lifecycles costs, perform better, and provide additional benefits such as improved aesthetics and enhanced property values. Communities that install traditional “grey” stormwater infrastructure (curbs, pipes, tanks, etc.) typically look only at the initial capital costs of installing the practices and do not evaluate the performance of the systems or fully account for operation and maintenance costs such as pond dredging and water quality inlet pumping and residuals disposal. In contrast, LID practices typically require a lower initial investment and more ongoing maintenance - especially in the early years as vegetation becomes established in bioretention areas. Once established, LID practices can often be maintained in the same manner as other landscaping elements that require mowing, weeding and debris removal. Note that permeable pavements require frequent vacuum sweeping to maintain water quality benefits, but can still result in cost savings by avoiding the land space and costs needed to build ponds, etc.

LID Can Be More Cost-Effective Over Time

Mill Creek of the South Branch
WVCA 319 project
Contracted, designed and installed low cost stormwater control demonstration on a poultry and livestock farm within the Bay Drainage watershed to manage the contaminated stormwater leaving the poultry production area. The landowner was agreeable to installing two channel drains on his sloping farm lane to capture the solids leaving the area and redirect the contaminated water into a check basin and then through a grassy buffer. Nine hundred feet of exclusion fencing was also installed on the farm to compliment this project. This demo will be used to education poultry producers on the low cost options available to control stormwater.

When deciding whether to adopt LID practices on a wide scale, communities should consider life cycle costs and performance of traditional stormwater control practices versus LID. Grey infrastructure is typically designed to reduce flooding risk, but often does not adequately protect water quality and habitat. Incorporation LID practices provides many supplemental benefits, some of which are difficult to quantify, including improved aesthetics and community livability, expanded recreational opportunities, increased property values and a cleaner environment. Adding LID practices can also reduce the amount of grey infrastructure needed to manage flooding and combined sewer overflows and avoid expensive capacity expansions. Various models and tools are available to help communities anticipate costs associated with various types of LID practices. Tools include:

- **Best Management Practices and LID Whole Life Cost Models -** www.werf.org/bmpcost
  To estimate life cycle costs for stormwater management, the Water Environment Research Foundation and EPA developed a set of spreadsheet tools to help users identify and combine capital costs and ongoing maintenance costs for stormwater best management practices (BMPs) and LID.

- **BMP-REALCOST -** www.udfcd.org/downloads/software/BMP-REALCOST_v1.0.zip
  This spreadsheet-based tool, developed by the Urban Drainage and Flood Control District in Denver, Colorado, analyzes the life cycle costs of BMPs for planning purposes. The tool incorporates the costs of construction, engineering, administration, land, maintenance and replacement of selected BMPs, including LID. The download includes a manual that describes its purpose and proper application.

- **Green Values Calculator -** http://greenvalues.cnt.org/national/calculator.php
  Developed by the Center for Neighborhood Technology, this online tool guides users through a process to determine the performance, costs and benefits of LID/green infrastructure practices as compared to conventional stormwater management practices.

Visualizing LID in Your Community

Several publications are available to help you visualize how LID can add natural beauty and stormwater control to your community:

- www.epa.gov/greeninfrastructure
- www.epa.gov/nps/lid/#multimedia
- www.nrdc.org/smartGrowth/visions
- www.werf.org/liveablecommunities/index.htm

Education can improve maintenance of LID practices. For access to the most recent information on LID maintenance available, check www.epa.gov/nps/lid and www.epa.gov/greeninfrastructure.

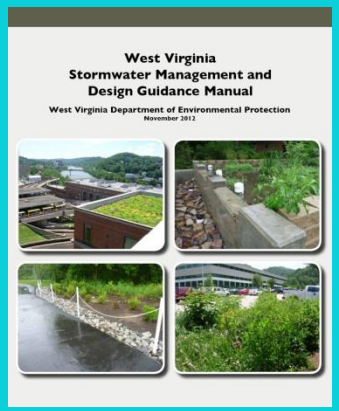
Education Is The Key

Guyan CD Stormwater Workshop Attendees checking the soil percolation to determine if the site is suitable for a rain garden.

Potomac Valley CD
Two-Day Stormwater /
Sediment & Erosion Workshop

Over 90 inspectors, engineers and private contractors were educated through on-site demos on the newest applications in stormwater management.

Stormwater Management and Design Manual



http://www.dep.wv.gov/WWE/Programs/stormwater/MS4/Pages/StormwaterManagementDesignandGuidanceManual.aspx

West Virginia Department of Environmental Protection recently released the Stormwater Management and Design Guidance Manual. You can download the entire manual from this website. This manual provides design and guidance on designing and implementing stormwater management practices that will manage rainfall on site in accordance with West Virginia's small Municipal Separate Storm Sewer System (MS4) general permit.

This manual contains stormwater management practices that utilize the Runoff Reduction Method, which is a method that utilizes infiltration, harvesting and evapotranspiration of rainfall on site. For more information about the runoff reduction method, visit: http://www.dep.wv.gov/WWE/Programs/stormwater/MS4/Pages/StormwaterManagementDesignandGuidanceManual.aspx

Watershed Resource Center Session #47

WVCA Watershed
Resource Center
1900 Kanawha
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For More Information on Stormwater Management and Soil Interpretation, Attend the WVWRC Workshop.

March 21st - 9:00 a.m. - 10:00 a.m.
Session #47 / Parlor D

Stormwater Management Manual & Soil Interpretations for Stormwater Infiltration Systems

Sponsored by: CAWV and WVCA Watershed Resource Center.
Presented by: Sherry Wilkins, WVDEP and Rob Pate, Resource Soil Scientist, USDA-NRCS.
Sherry Wilkins, WVDEP will speak on the Stormwater Management Manual and how MS4's can utilize the tools WVDEP has made available. Rob Pate, USDA-NRCS will present "Soil Interpretations for Stormwater Infiltration Systems". We will discuss the Web Soil Survey and Soil Data Mart, where you can find soil interpretations for stormwater infiltration systems. We will go over where and how you can access this public information, and how you can download this information to your own GIS system.

Information: Watershed Resource Center phone 304-558-0382 or e-mail wrc@wvca.us

RESOURCES:

EPA

- *Source: Information contained in this PowerPoint is taken from LID Barrier Busters Fact Sheet Series - United States Environmental Protection Agency *Office of Wetlands, Oceans, and Watersheds * 1200 Pennsylvania Avenue, NW, Washington, CD 20460 - EPA 841-N-12-003A * March 2012*
  http://water.epa.gov/polwaste/green/bbfs.cfm
- Earth Gauge is a program of the National Environmental Education Foundation.
  http://www.earthgauge.net