



Managing Wet Weather with Green Infrastructure



Core Group of the Partnership for Strategy Development

- American Rivers
- Association of State and Interstate Water Pollution Control Administrators
- Low Impact Development Center
- National Association of Clean Water Agencies
- Natural Resources Defense Council
- U.S. Environmental Protection Agency



Originating Documents

- Memo from EPA Assistant Administrator Ben Grumbles to EPA Regional Administrators, March 5, 2007, *Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Nonpoint Source and other Water Programs*
- *Green Infrastructure Statement of Intent*, signed by NRDC, NACWA, LID Center, ASIWPCA and EPA on April 19, 2007.



MANAGING
WET WEATHER WITH
GREEN INFRASTRUCTURE
ACTION STRATEGY
2008

Released
January 17, 2008

Strategy Categories

- Research
- Outreach & Communication
- Tools
- Clean Water Act Regulatory Support
- Economic Viability & Funding
- Demonstrations & Recognition
- Partnerships & Promotion

Green Infrastructure Website

www.epa.gov/npdes/greeninfrastructure



- General Information
- Key Resources
- Case Studies
- Guidance
- Partnership
- Contacts
- Statement of Support

Green Infrastructure Periodicals

- Relevant activities, events, conferences, publications, partner profiles
- Issued approximately every 2 months
- 6 to-date
- Distributed electronically and on the website



Managing Wet Weather with
Green Infrastructure
a periodic update on activities

Volume 2007, Issue 2

October 2007

EPA has begun compiling examples of enforcement actions in which green infrastructure activities are being implemented. Currently, summaries of five supplemental environmental notices (SEPs) have been posted on the website. Practices include: greenways, rain gardens, green roofs, bioretention. Contact: Gary Hudburgh, hudbu

Contacts
EPA Headquarters



A research forum is taking place in Washington D.C. at the Architectural Institute of America (AIA), to develop important research for organizations and funding research. The forum will discuss the use of green infrastructure (including green roofs, rain gardens, greenways, etc.) in the context of management practices. Contact: Jenny Molloy, molloy

On September 17, 2007 the Environmental Council passed resolution 07-10 supporting green infrastructure.

"ECOS hereby encourages the use of green infrastructure in the impacts of sewer overflows and as a tool to improve the environment, and

ECOS supports the objectives of the USEPA's (USEPA) Statement of Intent and endorses the Stakeholder Report for Green Infrastructure including the development of all components of green infrastructure; exploration of the use of green infrastructure in MSW Term Control Plans; development of memoranda for the use of green infrastructure in meeting requirements; and provision of technical assistance to reach to potential users of green infrastructure.

For more information on managing wet weather see the website at: www.epa.gov/npdes be added to an e-mail distribution list for future notices, send an e-mail request to molloy.jennifer@epa.gov.



Managing Wet Weather with
Green Infrastructure
a periodic update on activities

Volume 2008, Issue 3

July 2008

Milwaukee's Stormwater Park, a brownfield redevelopment project designed to handle runoff from 100 year storms in the Menomonee River Valley, was recently put to the test. In June the area experienced a 100 year event, and the park performed as it was designed to do. The large bioretention basins, normally full of native wildflowers, filled with stormwater. However, within a few days all of the water had infiltrated into the soils. Stormwater Park, designed to keep water out of the sewer system, features natural areas, open space, playing fields and a trail, and captures rain falling on the valley business park. The park was selected by the Sierra Club in 2006 as one of America's Best New Development Projects.

On June 13, 2008 EPA released a memo, *Clarification on which stormwater infiltration practices/technologies have the potential to be regulated as "Class V" wells by the Underground Injection Control Program*. There has been some confusion surrounding the applicability of the UIC requirements (under the Safe Drinking Water Act) for a variety of infiltration practices, including rain gardens, swales, planters, permeable pavements and other controls. The memo and accompanying guide clarify the intent of the Act, and also indicate which types of practices are generally considered Class V wells and which are not. In general, EPA does not consider typical green infrastructure or low impact development practices to qualify as Class V wells. However, EPA is committed to protection of groundwater and also provides clarification on which practices may qualify as Class V wells. The memo and guide are available at: http://www.epa.gov/npdes/pubs/memo_re_classv_wells.pdf

For more information on managing wet weather with green infrastructure see the website at: www.epa.gov/npdes/greeninfrastructure. To be added to an e-mail distribution list for future issues of this bulletin, or if you have items of interest to be considered for inclusion in future issues of this bulletin send an e-mail request to molloy.jennifer@epa.gov.

Contacts	
EPA Headquarters	Jenny Molloy, OW/OWM
	Robert Gao, OW/OWM
	Gary Hudburgh, OCA
EPA Regions	
Stephanie Venezia, R1	
Dominique Leuckenhoff, R3	
Jim Gattina, R4	
Joan Kamauskas, R5	
Brent Larsen, R6	
Pradip Dalal, R7	
Elaine Lai, R8	
John Tinger, R9	
Krista Mendelman, R10	
Steering Committee Partners	
Nancy Stoner, NRDC	
Nathan Gardner-Andrews & Keith Jones, NACWA	
Chris Kloss & Neil Weinstein, LID Center	
Katherine Baer, American Rivers	
Linda Eichmiller, ASI/WPCA	

Partnership Statement of Support

- To-date 71 organizations have signed the *Statement of Support for Green Infrastructure*

Stakeholder Statement of Support for Green Infrastructure

Purpose

To bring together organizations that recognize the benefits of using green infrastructure in mitigating overflows from combined and separate sewers and reducing stormwater pollution and to encourage the use of green infrastructure by cities and wastewater treatment plants as a prominent component of their Combined and Separate Sewer Overflow (CSO & SSO) and municipal stormwater (MS4) programs.

Goals

Green infrastructure can be both a cost effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions. The undersigned organizations support:

- Use of green infrastructure by cities and utilities where it is an effective and feasible means of reducing stormwater pollution and sewer overflows;
- Development of models to quantify stormwater detention, retention, and filtration potential of green infrastructure to better identify opportunities to successfully use green infrastructure in CSO, SSO, MS4 and nonpoint source programs;
- Monitoring to verify the amount of CSO, SSO, and stormwater discharge reduction that cities obtain through using green infrastructure;
- Measurement of economic and environmental benefits realized from the use of green infrastructure in sewer systems and quantification of its life-cycle costs;
- Increased federal, state, and local funding for green infrastructure initiatives;
- Elimination of barriers to the incorporation of green infrastructure in stormwater and sewer system programs;
- Development and funding of a plan to identify research needs to further green infrastructure;
- Preparation of guidance documents to assist cities and wastewater treatment plants in developing green infrastructure initiatives in their CSO, SSO, and MS4 programs; and
- Development of model provisions to incorporate green infrastructure into CSO and MS4 permits; SSO capacity, management, operations, and maintenance plans; and consent decrees and other enforcement vehicles.

Research Forum

- Research forum to focus on filling green infrastructure research gaps held January 17 and 18, 2008 in D.C. at American Institute of Architects.
- 4 research areas identified: unit processes (performance of practices), watershed effects; economics; modeling.
- Benefits group (leadership: GRHC, CNT)
- Unit Processes group (leadership: EWRI)

Green Infrastructure Performance Information

- Updating Urban BMP Performance Tool to include performance study results for green infrastructure practices.
- Highlighting performance research on the website.

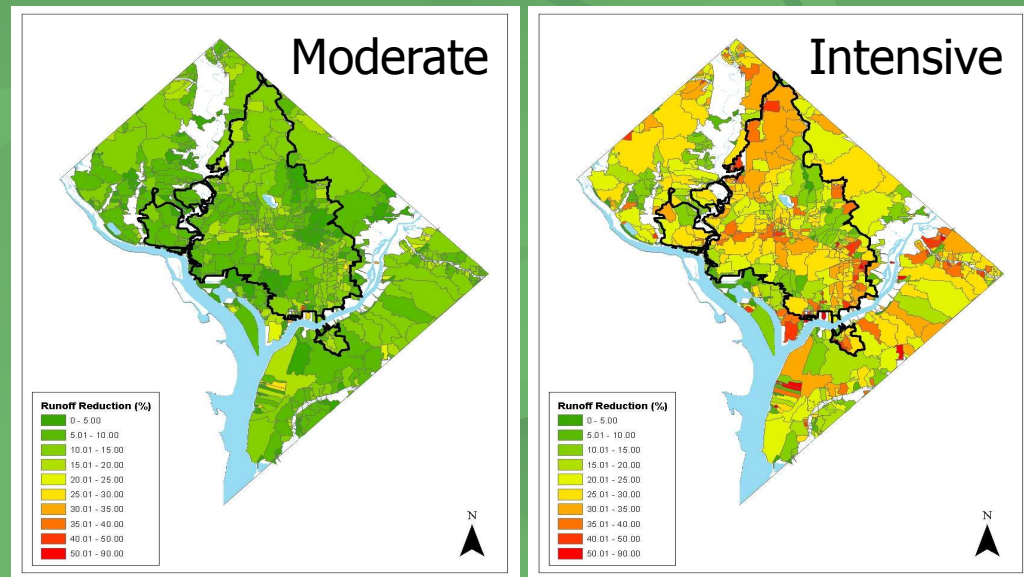
Obtained as unpublished data from University of New Hampshire, Cooperative Institute for Coastal and Estuarine Engineering	Vegetated Swale	Biofilter	53.95	17.84		-209%
City of Portland, OR - Bureau of Environmental Services. 1999. Russell Pond Bioswale: 2 component BMP - sedimentation forebay followed by a bioswale	Russell Pond Bioswale	Biofilter	17.24	17.93		75%

Stormwater Management Model (SWMM)

- Extending SWMM to allow it to handle more green infrastructure options in a more efficient manner, including to overcome the problem of scaling up controls applied at the individual lot level to larger land area units.
- Create simple user interface for green infrastructure portion of SWMMM.

Washington, D.C. Green Build-out Model

Estimates the effects of greening the city with green roofs, rain gardens, rights-of-way bioretention, permeable pavements, trees, rain barrels and cisterns on discharge reductions from both combined sewer systems and separate storm sewer systems.




Stormwater Management Calculator

- Modify current CNT calculator to make it more nationally applicable, estimate the amount of green infrastructure needed to achieve a runoff reduction goal, and provide 'green' vs 'conventional' costs.
- Modification of the runoff volume control to a user-specified goal of depth or predevelopment conditions.
- Addition of more controls, such as disconnected downspouts, amended soils, cisterns/rain barrels, reduced street widths, and elimination of curb and gutter.
- Complete early 2009.

Life Cycle Cost Tool

- Expanding WERF's 2005 spreadsheet cost tool to create a standardized format for collecting and reporting capital and O&M cost information for green infrastructure projects.
- Working with WERF and University of Utah on enhancement.
- Estimated completion early 2009.

Use of Green Infrastructure in NPDES Permits and Enforcement

 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 16 2007

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

MEMORANDUM

SUBJECT: Use of Green Infrastructure in NPDES Permits and Enforcement

TO: Water Division Directors, Regions 1 – 10
Regional Counsel/Enforcement Coordinators, Regions 1 - 10
State NPDES Directors

FROM: Linda Boomazian, Director *Linda Boomazian*
Water Permits Division (MG 4203M)
Mark Pollins, Director *Mark Pollins*
Water Enforcement Division (MC 2243A)

Administrator Stephen Johnson entered into an agreement on April 19, 2007, with State, environmental and wastewater utility groups to formalize the use of green infrastructure¹ approaches.² As part of the agreement, the Agency committed to develop "memoranda ... that would explain how regulatory and enforcement officials should evaluate and provide appropriate credit for the use of green infrastructure in meeting Clean Water Act requirements." One frequently encountered question is how green infrastructure practices fit into existing regulatory programs.

¹ Green Infrastructure uses natural or engineered systems – such as green roofs, rain gardens and permeable pavement – that mimic natural processes and direct stormwater to areas where it can be infiltrated, evapotranspired or re-used. Green infrastructure can provide many environmental benefits: stormwater control, air quality improvements, urban heat island mitigation, energy demand reductions, carbon sequestration, headwaters protection, etc.

² Green Infrastructure Statement of Intent,
http://www.epa.gov/npdes/pubs/gi_intentstatement.pdf.

Internet Address (URL) • <http://www.epa.gov>
Recycled/Recyclable • Printed with Vegetable Oil Based Inks on Recycled Paper (Minimum 50% Postconsumer content)

- Memo issued August 16, 2007
- Jointly issued by WPD and WED
- Clarifies that green infrastructure controls can be implemented within current regulatory framework

Underground Injection Control Clarification



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN 13 2008

OFFICE OF
WATER

MEMORANDUM

SUBJECT: Clarification on which stormwater infiltration practices/technologies have the potential to be regulated as "Class V" wells by the Underground Injection Control Program

TO: Water Division Directors, Regions 1-10

FROM: Linda Borman, Director

Water Permits Division (MC 4203M)

Steve Hearn, Director

Drinking Water Protection Division (MC 4606M)

Over the past several years stormwater infiltration has become an increasingly effective tool in the management of stormwater runoff. Although primary stormwater management responsibilities within EPA fall under the Clean Water Act (CWA), the infiltration of stormwater is, in some cases, regulated under the Safe Drinking Water Act (SDWA) with the goal of protecting underground sources of drinking water (USDWs). Surface and ground water protection requires effective integration between the overlapping programs. This memorandum is a step forward in that effort and is meant to provide clarification on stormwater implementation and green infrastructure, in particular under the CWA, which is consistent with the requirements of the SDWA's Underground Injection Control (UIC) Program.

In April 2007, EPA entered into a collaborative partnership with four national groups (the Association of State and Interstate Water Pollution Control Administrators,

- Memo & guide issued June 13, 2008 by WPD & DWPD
- Clarifies which infiltration practices are generally considered class V wells
- Notes procedures for complying with UIC requirements
- Typically most green infrastructure practices are not class V wells



	Infiltration Practice Technology	Description	Is this Practice/Technology Generally Considered a Class V Well?
A	Rain Gardens & Bioretention Areas	Rain gardens and bioretention areas are landscaping features designed to provide on-site infiltration and treatment of stormwater runoff using soils and vegetation. They are commonly located within small pockets of residential and where surface runoff is directed into shallow, landscaped depressions or in landscaped areas around buildings, or in more urbanized settings, to parking lot islands and green street applications.	No.
B	Vegetated Swales	Swales (e.g., grassed channels, dry swales, wet swales, or bioswales) are vegetated, open-channel management practices designed specifically to treat and attenuate stormwater runoff. As stormwater runoff flows along these channels, vegetation slows the water to allow sedimentation, filtering through a subsoil matrix, and/or infiltration into the underlying soils.	No.
C	Pocket Wetlands & Stormwater Wetlands	Pocket/Stormwater wetlands are structural practices similar to wet ponds that incorporate wetland plants into the design. As stormwater runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake. Several design variations of the stormwater wetland exist, each design differing in the relative amount of shallow and deep water, and dry storage above the wetland.	No.
D	Vegetated Landscaping	Self-Explanatory.	No.
E	Vegetated Buffers	Vegetated buffers are areas of natural, or established vegetation maintained to protect the water quality of underlying areas. Buffer zones slow stormwater runoff, provide an area where runoff can infiltrate the soil, contribute to ground water recharge, and filter sediment. Slowing runoff also helps to prevent soil and stream bank erosion.	No.

MS4 Permit Language

- Working collaboratively with certain states and regions that have specifically requested assistance.
- Proposed performance based standards that promote infiltration, reuse and evapotranspiration.
- Includes incentives for smart growth practices, e.g., redevelopment, mixed use.
- Includes assessment work that will provide foundation for additional provisions in the next round.

West Virginia Proposed Small MS4 Permit

- Proposed July 2008
- Technical meetings with public and MS4
- WVDEP responding to comments
- Probably finalized in early 2009



State of West Virginia
Department of Environmental Protection
Division of Water and Waste Management
601 57th Street, SE
Charleston, WV 25304-2345

General
National Pollution Discharge Elimination System
Water Pollution Control Permit

Permit No.: WV0116025	Issue Date:
Subject: Stormwater Discharges From small Municipal Separate Storm Sewer Systems	Effective Date:
	Expiration Date:
	Supersedes: WV/NPDES General Water Pollution Control Permit No. WV0116025, issued March 7, 2003

To Whom It May Concern:

This is to certify that operators of small municipal separate storm sewer systems (MS4s) located in the State of West Virginia who have satisfied the registration requirements and agreeing to be regulated under the terms and conditions of this general permit are hereby granted coverage under the General WV/NPDES Water Pollution Control Permit to discharge stormwater into waters of the State.

All operators of regulated small municipal separate storm sewer systems are required to apply for and obtain coverage in accordance with this permit, unless waived in accordance with CFR § 122.32(a).

This permit is subject to the following terms and conditions:

The information submitted on and with the site registration application form will hereby be known as the stormwater management program (SWMP). The information submitted on and with the site registration application, also known as the SWMP will hereby be made terms and conditions of the permit with like effect as if all such information were set forth herein, and other conditions set forth in Parts I, II, III, IV, Appendices A through D and the SWMP approval letter.

1

Green Infrastructure Permitting & Enforcement Guide

- For NPDES permit writers and enforcement staff.
- Information on how to include and/or review green infrastructure components in permits and enforcement documents for stormwater, SSOs, CSOs
- Has been through one round of external reviews (EPA regions, states, NACWA, NRDC), and is in revision process.

Enforcement-related Case Studies

- First set of 5 case studies have been compiled and posted on the website.
- Case studies in this set are all supplemental environmental projects (SEPs).

Green Infrastructure in Enforcement Actions

When an organization or individual has failed to comply with federal environmental laws, the agency may initiate an enforcement action against them. Enforcement actions are taken in order to compel the individual or company to return to compliance and to deter others from committing similar violations in the future.

As part of a settlement agreement for an enforcement action, an alleged violator may voluntarily agree to undertake a Supplementary Environmental Project, or SEP, in exchange for mitigation of the penalty to be paid. SEPs are projects that are designed to protect and improve the environment and public health beyond that achieved by standard compliance with applicable laws. These projects offer a unique opportunity to further our nation's goals of ensuring clean air and water, safe food, better waste management, and the public's right to know about environmental issues. SEPs have existed since the early 1980s, and since that time their inclusion in EPA's settlement agreements has become more commonplace.

More information on SEPs can be found at: <http://cfpub.epa.gov/compliance/resources/policies/civil/seps>

In wet weather enforcement actions, a growing number of SEPs have involved the use of green infrastructure techniques to mitigate environmental damage. To date, green infrastructure SEPs has been used in settlements with:

- [The Board of Water and Sewer Commissioners of the City of Mobile, Alabama](#)
- [The Board of County Commissioners of Hamilton, Ohio and the City of Cincinnati](#)
- [The District of Columbia Water and Sewer Authority and the District of Columbia](#)
- [The Washington Suburban Sanitary Commission](#)
- [Sanitation District No. 1 of Northern Kentucky](#)

Reducing Stormwater Costs through LID Strategies and Practices



Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices



- Released December 2007
- 17 case study comparisons of traditional vs green infrastructure development costs.

Municipal Workshops

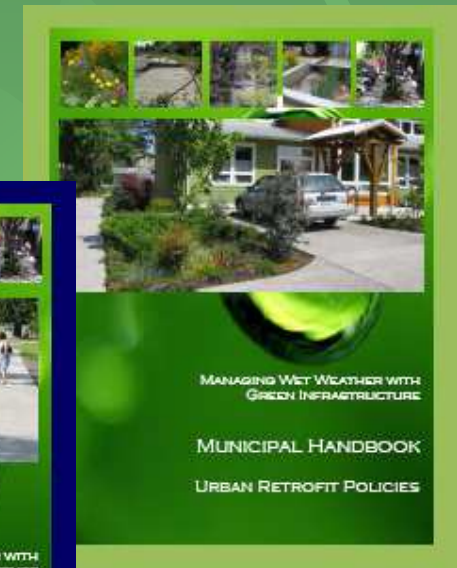
- Chicago, September; Louisville, November
- Planned and/or tentatively discussed for 2009: New York, Virginia, DC, Texas, Missouri, Pennsylvania, Alabama, West Virginia . . .
- Covers topics identified by municipalities as challenging: modeling, designs, O&M, codes & ordinances, financing, incentives . . .



Municipal Handbook

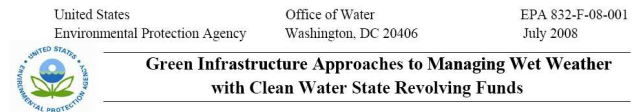
The Municipal Handbook is a series of guidance documents to help local officials implement green infrastructure in their communities. Modules will be released as completed, including:

- Municipal Policies to Promote Rainwater Harvesting
- Green Streets and Right-of-Way Design
- Funding Options
- Urban Retrofit Policies
- Operation & Maintenance
- Municipal Incentives



Clean Water State Revolving Fund

- Fact sheet released July 2008 promoting and explaining the use of CWSRF for green infrastructure projects



This factsheet identifies several ways in which states, communities, and individuals can use the Clean Water State Revolving Fund (CWSRF) to finance green infrastructure projects. A general overview of green infrastructure and the CWSRF program are provided, as well as case studies highlighting specific projects from across the country.

What is green infrastructure?

"Green infrastructure" is a relatively new and flexible term that has been used in a variety of contexts. For the purposes of this factsheet, the term "green infrastructure" refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire (the return of water to the atmosphere either through evaporation or transpiration), or reuse stormwater. Examples of green infrastructure approaches currently in use include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, permeable pavements, riparian buffers, and floodplains. Green infrastructure also includes decentralized harvesting approaches, such as the use of cisterns to capture water for flushing toilets or subsequent outdoor irrigation. These approaches reduce the amount of runoff discharging to surface waters and keep rainwater out of our sewer systems so it does not contribute to sewer overflows.

What are additional benefits of green infrastructure?

In addition to reducing the overall volume of stormwater runoff and the frequency of sewer overflows, green infrastructure can help communities enjoy a number of additional environmental and economic benefits, including:

- Cleaner Water
- Enhanced Water Supplies

- Cleaner Air
- Reduced Urban Temperatures
- Climate Change Benefits
- Increased Energy Efficiency
- Source Water Protection
- Community Benefits
- Cost Savings



Vegetated swales capture and infiltrate runoff along this "green street" in Portland, Oregon.

These benefits make green stormwater development an attractive option for towns and cities looking to upgrade their infrastructure systems. Nevertheless, many local governments lack the financial resources needed to implement green infrastructure projects in their communities. This is where the CWSRF can help.

What is the Clean Water State Revolving Fund?

The CWSRF is a powerful financing program that provides loan assistance for wastewater treatment, stormwater management, nonpoint source abatement and estuary protection projects. Today,

Read more about the benefits of green infrastructure at: www.epa.gov/npdes/greeninfrastructure

Large Retail Initiative

- ‘Big Box’ initiative to promote incorporation of green infrastructure practices as standard design elements.
- To date, interest expressed by Kohl’s, Costco, and Whole Foods.
- Working on site designs for large retail operations



Green Capitals

- Green right-of-way retrofits at/near state capitol buildings for high profile, visible, demonstration projects
- Offering design and mentoring services
- Vermont in 2009



Nashville TN state capitol grounds

Energy Independence and Security Act of 2007

“Sec. 438. Storm Water Runoff Requirements for Federal Development Projects. The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the **predevelopment hydrology** of the property with regard to the **temperature, rate, volume, and duration of flow.**”

Design to Control a Specified Volume

% Average Annual Rainfall Approach

	<u>90%</u>	<u>95%</u>	<u>99%</u>
Washington DC	1.2"	1.7"	2.4"
Atlanta GA	1.6"	2.1"	3.4"
Seattle WA	1.3"	1.6"	1.7"
Salt Lake City UT	0.6"	0.8"	1.2"

Analyses of 95% Volumes

Location	95% 24-hr Rainfall (in)	% Impv
Charleston, WV	2.05	73%
Denver, CO	1.96	55%
Cincinnati, OH	2.38	51%
Portland, OR	1.75	95%
Phoenix, AZ	1.54	47%
Boston, MA	2.76	69%
Atlanta, GA	2.97	70%



Atlanta, Georgia Military Base

		Sandy	Loam
Area (acres)	Green Roof	0	2.36
	Porous Pavement	0	1.80
	Bio-retention	2.26	3.12
Proportion*	Green Roof	0.0%	60.0%
	Porous Pavement	0.0%	16.7%
	Bio-retention	36.1%	50.0%





Managing Wet Weather with Green Infrastructure

