Water Environment Research Foundation
Collaboration. Innovation. Results.

Highlights from WERF Stormwater Research and Future Opportunities

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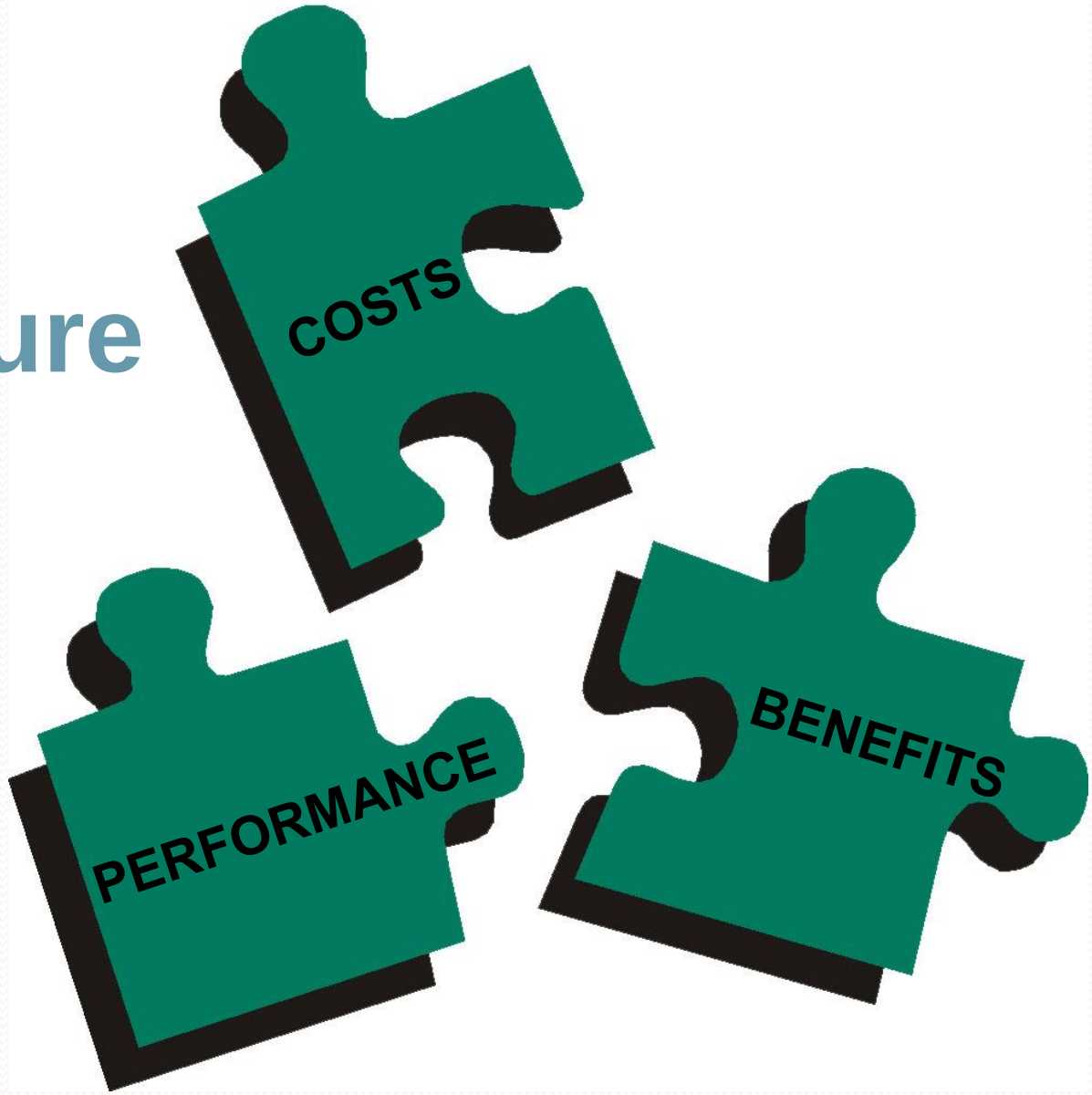
WEFTEC 2013
Stormwater Pavilion

BMPs & Green Infrastructure



"We still do not know one thousandth of one percent of what nature has revealed to us."

- Albert Einstein

What data is available on the performance of green infrastructure and BMPs?

INTERNATIONAL STORMWATER BMP DATABASE

www.bmpdatabase.org

WERF Water Environment Research Foundation

ASCE American Society of Civil Engineers

EWRI Environmental & Water Resources Institute of the American Society of Civil Engineers

EPA

U.S. Department of Transportation
Federal Highway Administration

APWA American Public Works Association — Your Comprehensive Public Works Resource

I-95 Plaza Bioretention Cell, Delaware DOT

Welcome! The International Stormwater Best Management Practices (BMP) Database project website features a database of over 530 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications. **New to the site?** Start Here

News

- National Stormwater Quality Database Has A New Home
- 2013 BMP Database Release
- 2012 BMP Performance Summaries

Related Databases & Research

- National Stormwater Quality Database
- Agricultural BMP Database
- Construction BMP Database
- Chesapeake Bay Research Portal

Urban Stormwater Research Reports

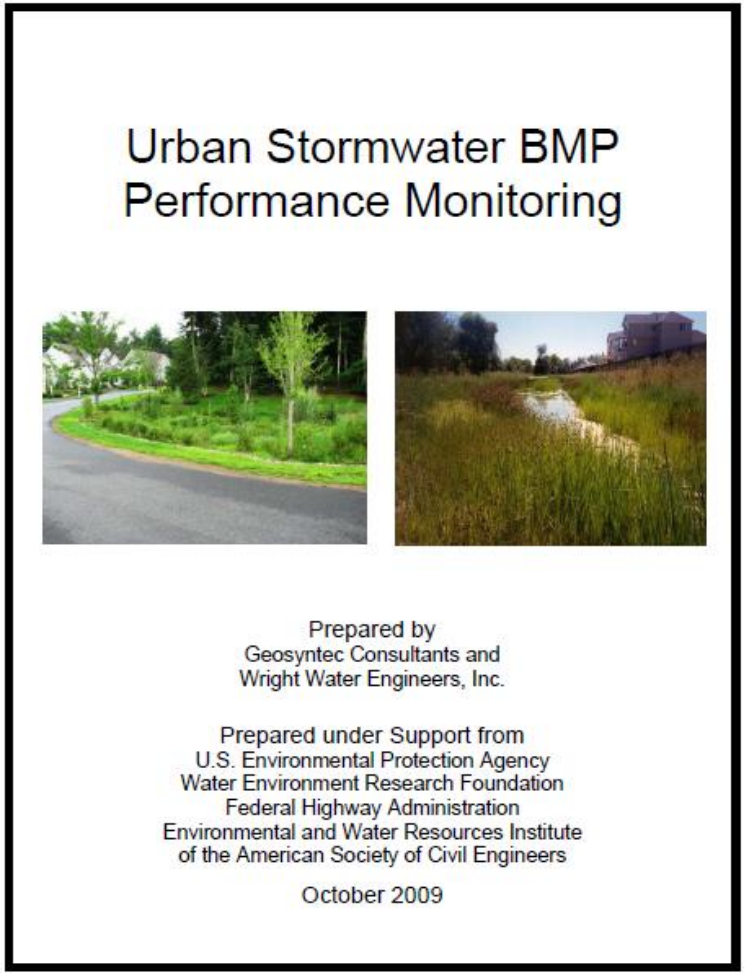
- 2012 BMP Performance Summaries
- 2012 Statistical Appendices
- 2012 Manufactured Device Performance Analysis Summary
- 2012 Volume Reduction in Bioretention
- 2012 Database Overview
- 2012 Chesapeake Bay BMP Performance Summary

Retrieve Urban Stormwater BMP Performance

- BMP Study Retrieval Tool
- BMP Map Tool
- BMP Category Reports
- Online Statistical Analysis Tool
- Download Access Database

BMP Database Overview

- BMP Database includes over 530 BMP monitoring studies, including significant GI/LID BMPs
- From 2008-2013, a key focus has been to better integrate green infrastructure through:
  - Monitoring Guidance (Updated)
  - New Data Entry Spreadsheets
  - Updated Analysis Results



BMP Summary

- Representative Green Infrastructure BMP Categories:
  - Bioretention
  - Biofilters
  - Green Roofs
  - Permeable Pavement
  - Rainwater Harvesting
  - Site-scale LID

BMP Category		Count
BR	Bioretention	31
BI	Biofilter - Grass Strip	45
BS	Biofilter-Grass Swale	41
CO	Composite	25
DB	Detention Basin	39
GR	Green Roof	17
IB	Infiltration Basin	2
LD	LID	2
MD	Manufactured Device	82
MF	Media Filter	38
MP	Maintenance Practice	28
OT	Other	6
PP	Porous Pavement	39
PT	Percolation Trench	13
RP	Retention Pond	75
WB	Wetland Basin	31
WC	Wetland Channel	19
Total BMPs		**533**
CX	Control/Ref. Sites	21

Quick Overview of 2012-13

- Performance Summaries Updates:
  - TSS, Nutrients, Metals, Bacteria, Volume Reduction
- New Detailed Analyses:
  - Bioretention Volume Reduction
  - Manufactured Device Unit Processes
- New On-line Tools:
  - Map Interface
  - Custom Statistical Queries


INTERNATIONAL STORMWATER BMP DATABASE
www.bmpdatabase.org

International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary Statistical Addendum:

TSS, Bacteria, Nutrients, and Metals

Prepared by
Geosyntec Consultants, Inc.
Wright Water Engineers, Inc.

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Water Environment Research Foundation
Federal Highway Administration
Environment and Water Resources Institute of the American Society of Civil Engineers

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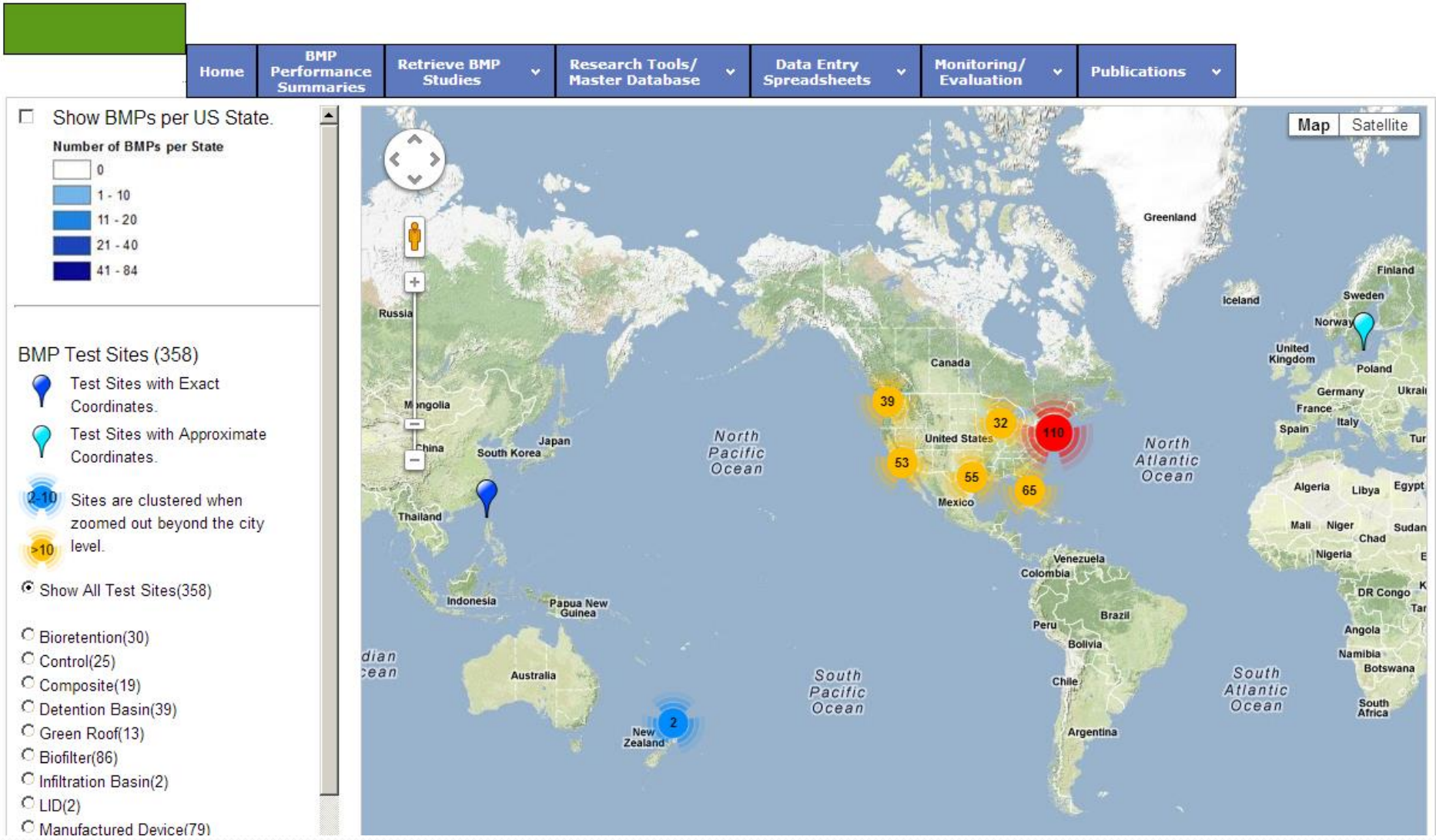
On-line Search Tool



BMP Database Vision

International Stormwater BMP Database

Urban Stormwater BMPs

Partners:
WERF
ASCE-EWRI
FHWA
EPA
APWA
NFWF

Agricultural BMPs

Partners:
WERF
NCGA
MCGA

Currently under development.

Stormwater Quality

Partners:
University of Alabama
EPA

Planned for 2013.

Construction BMPs

Partners:
IECA

Potential Future.

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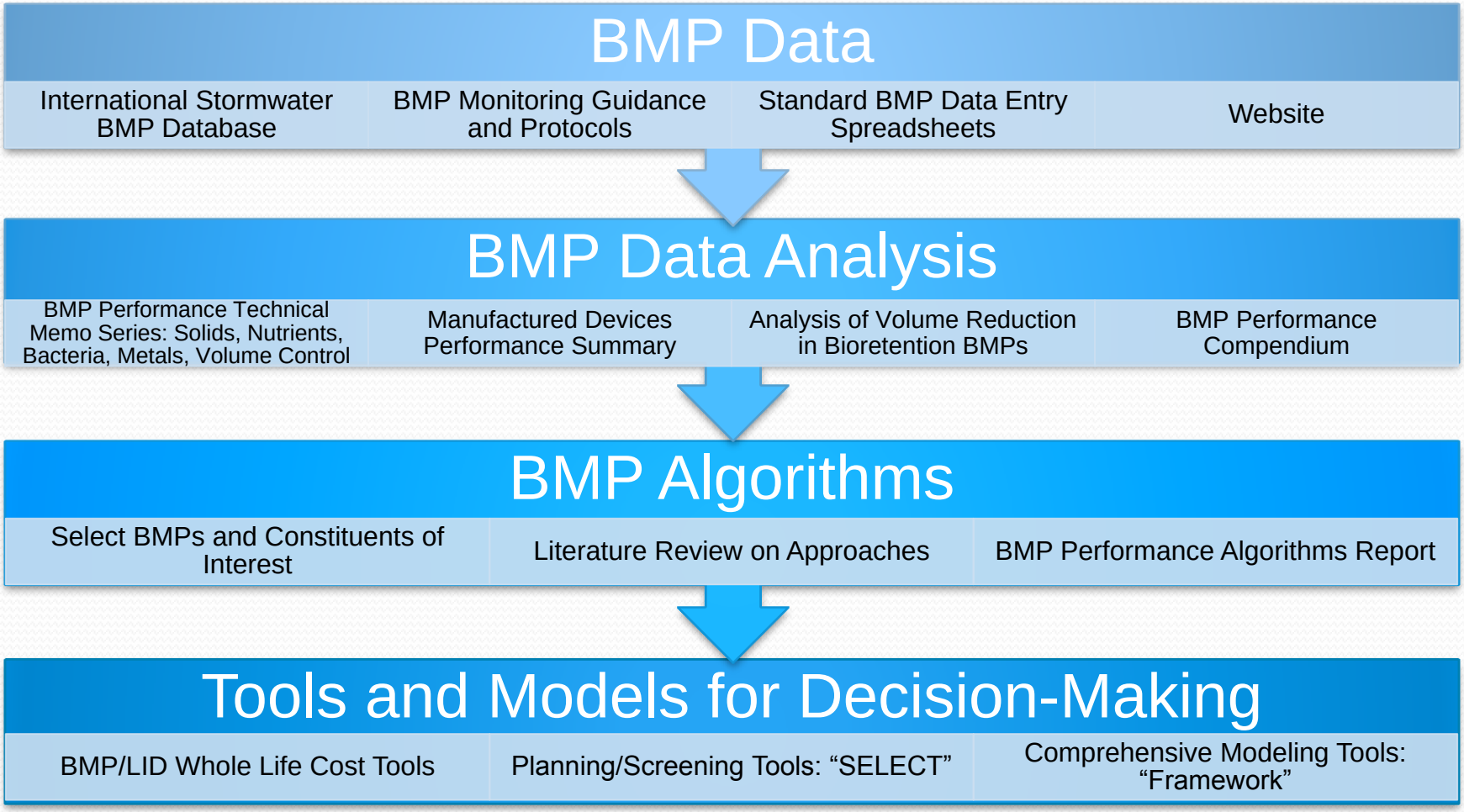
BMP Data
International Stormwater BMP Database
BMP Monitoring Guidance and Protocols
Standard BMP Data Entry Spreadsheets
Website
BMP Data Analysis
BMP Performance Technical Memo Series: Solids, Nutrients, Bacteria, Metals, Volume Control
Manufactured Devices Performance Summary
Analysis of Volume Reduction in Bioretention BMPs
BMP Performance Compendium
BMP Algorithms
Select BMPs and Constituents of Interest
Literature Review on Approaches
BMP Performance Algorithms Report
Tools and Models for Decision-Making
BMP/LID Whole Life Cost Tools
Planning/Screening Tools: "SELECT"
Comprehensive Modeling Tools: "Framework"

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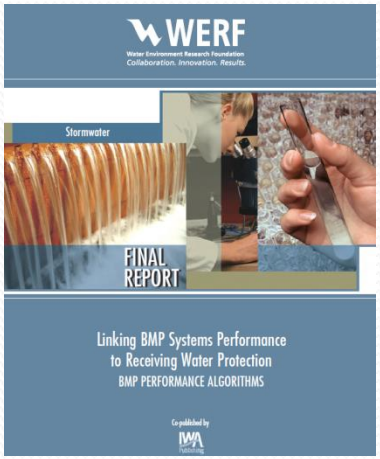
New WERF Modeling Tools



- BMP Performance Algorithms Report
  - Includes new approaches for modeling LID
- SELECT Tool
  - Simple spreadsheet based planning tool to evaluate alternative BMP scenarios
  - www.werf.org/select

- Framework v1.0– *Coming Dec 2013*
  - Comprehensive modeling tool to link BMP performance to receiving water impacts

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How can I estimate the costs of GI and BMPs?

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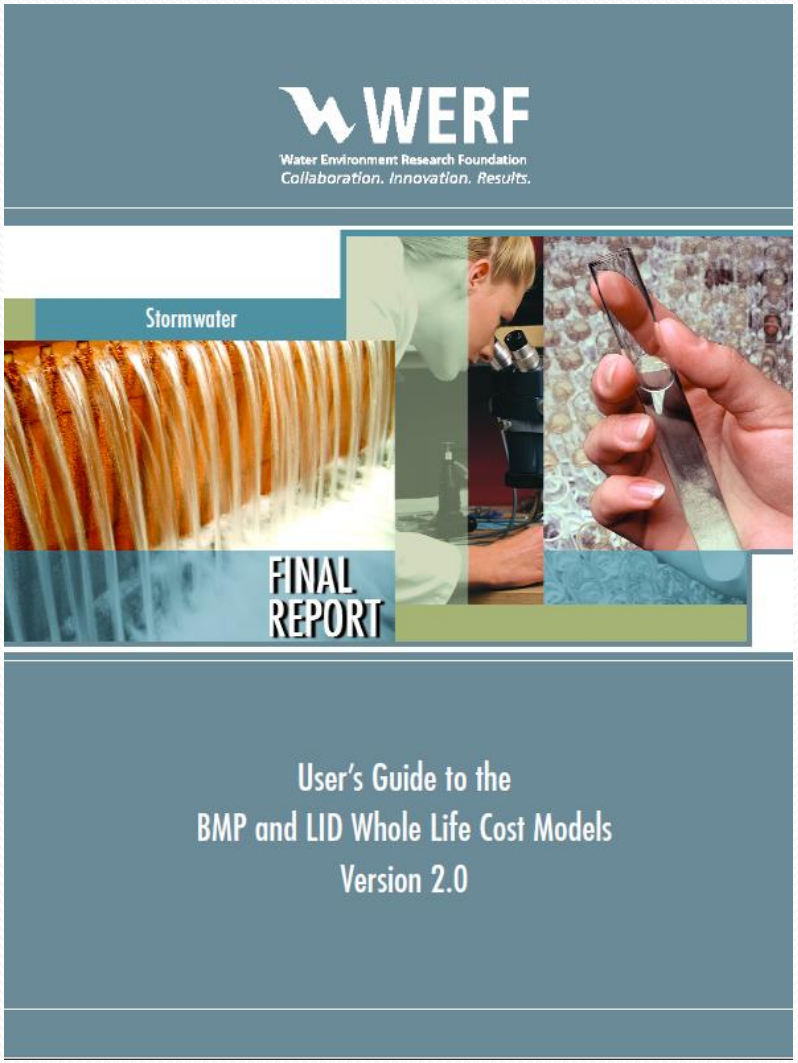
BMP and LID Whole Life Cost Tools



www.werf.org/bmpcost

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Whole Life Cost Summary (example)

Curbed Bioretention

M	User entered 'MEDIUM' maintenance level in Sheet 1.

Site Name: Webinar Demp
Site Location: National
Date: May, 2009

Cost Summary

CAPITAL COSTS	Included in WLC Calculation: Model	User	Chosen option	Total Cost
Total Facility Base Cost	$39,300		$ 39,300	$ 39,300
Total Associated Capital Costs (e.g., Engineering, Land, etc.)	$21,113		$ 21,113	$ 21,113
Capital Costs				$60,413

REGULAR MAINTENANCE ACTIVITIES	Months Between Events	Cost per Event	Total Cost per Year	Included in WLC Calculation: Model	User	Chosen option
Inspection, Reporting & Information Management	24	$100	$50	$ 50.00		$ 50.00
Vegetation Management with Trash & Minor Debris Removal	6	$200	$400	$ 400.00		$ 400.00
Pick up fruit and prune tree	12	$100	100	$ 100.00		$ 100.00
add additional activities if necessary	0	$0	0	$ -		$ -
Annual Totals, Regular Maintenance Activities				$550		$550

CORRECTIVE AND INFREQUENT MAINTENANCE ACTIVITIES (Unplanned and/or >3yrs. betw. events)	Years between Events	Cost per Event	Total Cost per Year	Included in WLC: Model	User	Chosen option
Till Soil	4	$400	$100	$ 100.00		$ 100.00
Unclog Drain	2	$0	$0	$ -		$ -
Replace Mulch	2	$2,075	$1,038	$ 1,037.50		$ 1,037.50
add additional activities if necessary	0	$0	$0	$ -		$ -
add additional activities if necessary	0	$0	$0	$ -		$ -
Corrective and Infrequebt MaintenanceActivities (Unplanned and/or >3yrs. betw. events)				$1,138		$1,138
Maintenance Costs as a percent of Capital Cost:						3%

Note: Annual maintenance costs should be expected to be between 5% and 10% of total capitol Costs (Kang, et al (2008)).

1.Design & Maintenance Options | 2.Capital Costs | 3.Maintenance Costs | 4.Cost Summary | 5.Whole Life Costs | 6.Present Value Graph | 7.De

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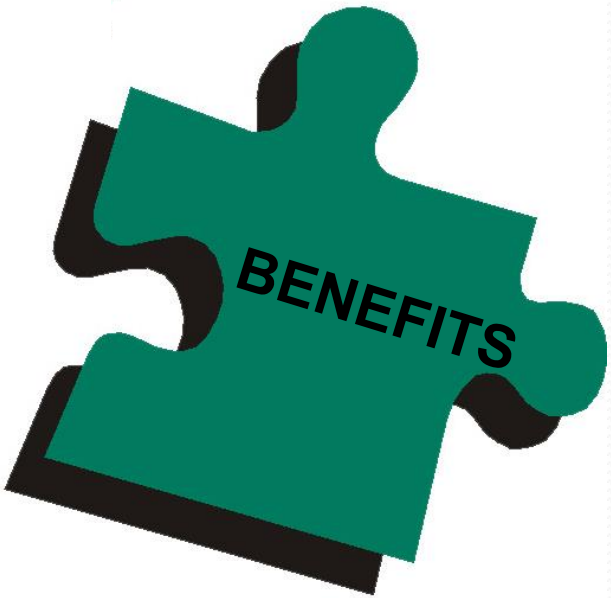
How do you quantify and account for the multiple benefits of GI?



Ongoing Project

21st Century Water Asset Accounting

Objective:

To help utilities account for the cost-savings provided by green infrastructure and watershed protection in a format that parallels current infrastructure valuation techniques

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Future Opportunities and Directions

Future Opportunities

New Targeted Collaborative Research Project Opportunities

- Protocol and Guidance for Using Stream Restoration as a BMP, $150K
- Evaluation of Green Infrastructure Systems Project, $200-400K

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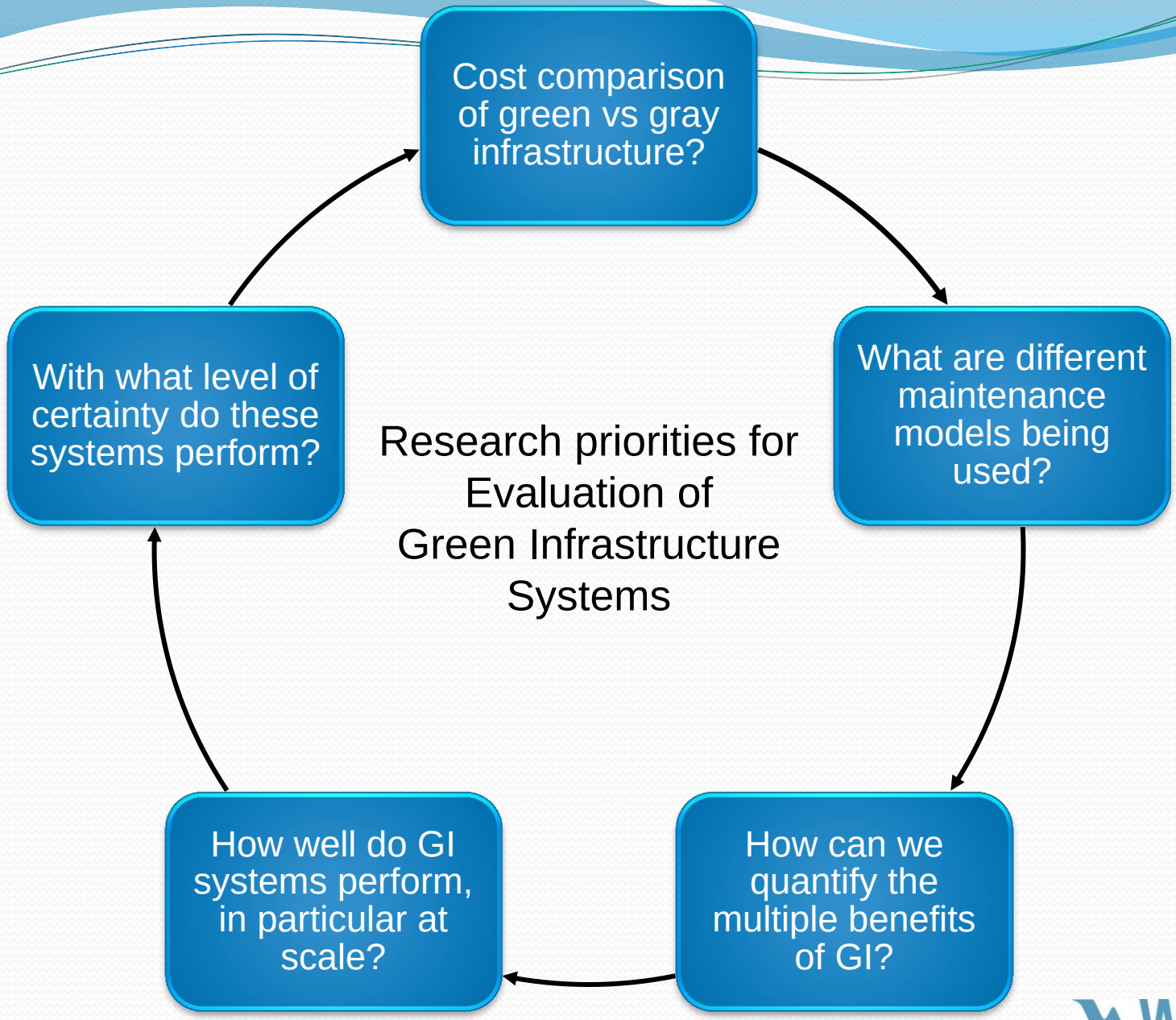
Cost comparison of green vs gray infrastructure?
What are different maintenance models being used?
How can we quantify the multiple benefits of GI?
How well do GI systems perform, in particular at scale?
With what level of certainty do these systems perform?
Research priorities for Evaluation of Green Infrastructure Systems

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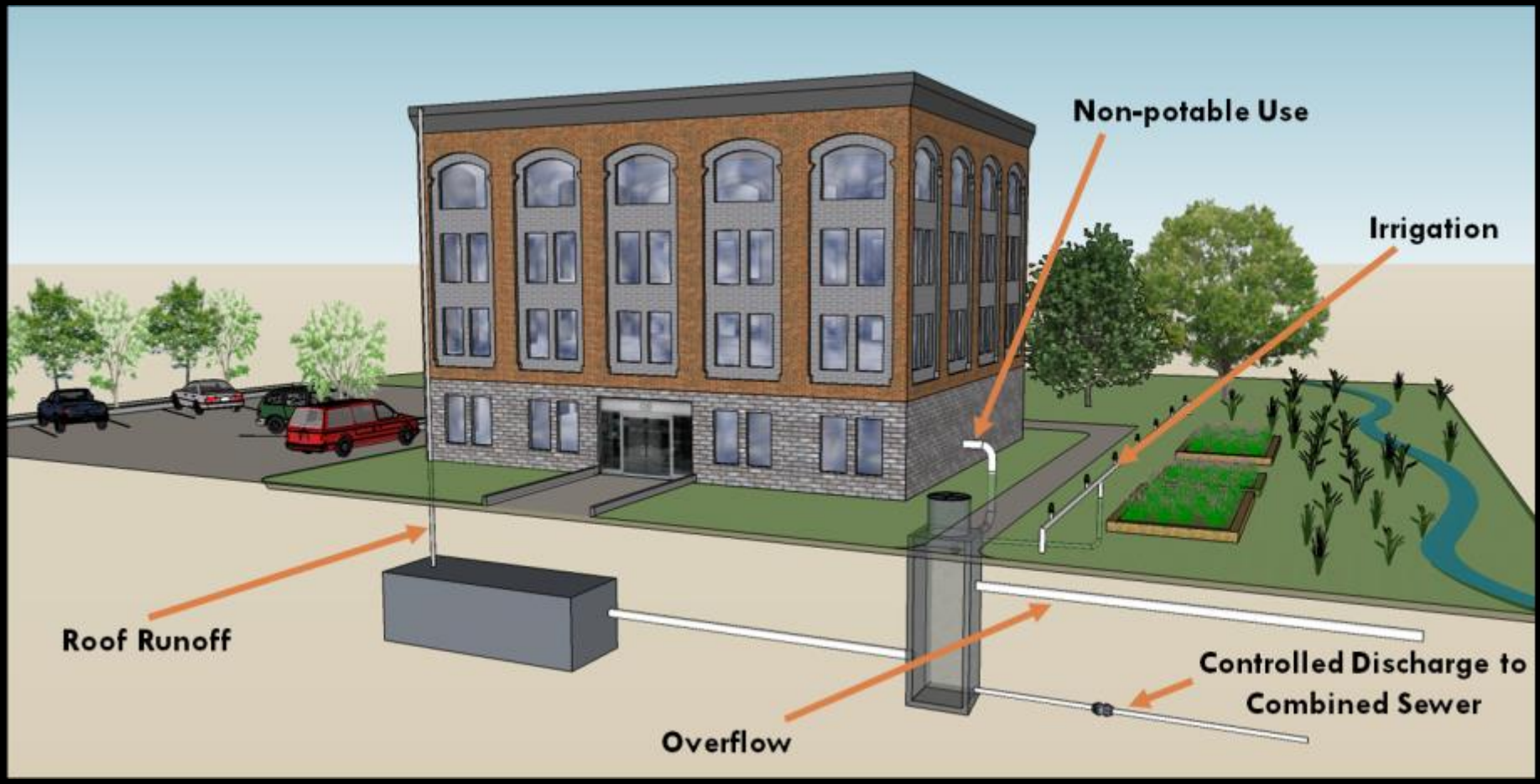
Future Opportunities

Pilot Site
Opportunities

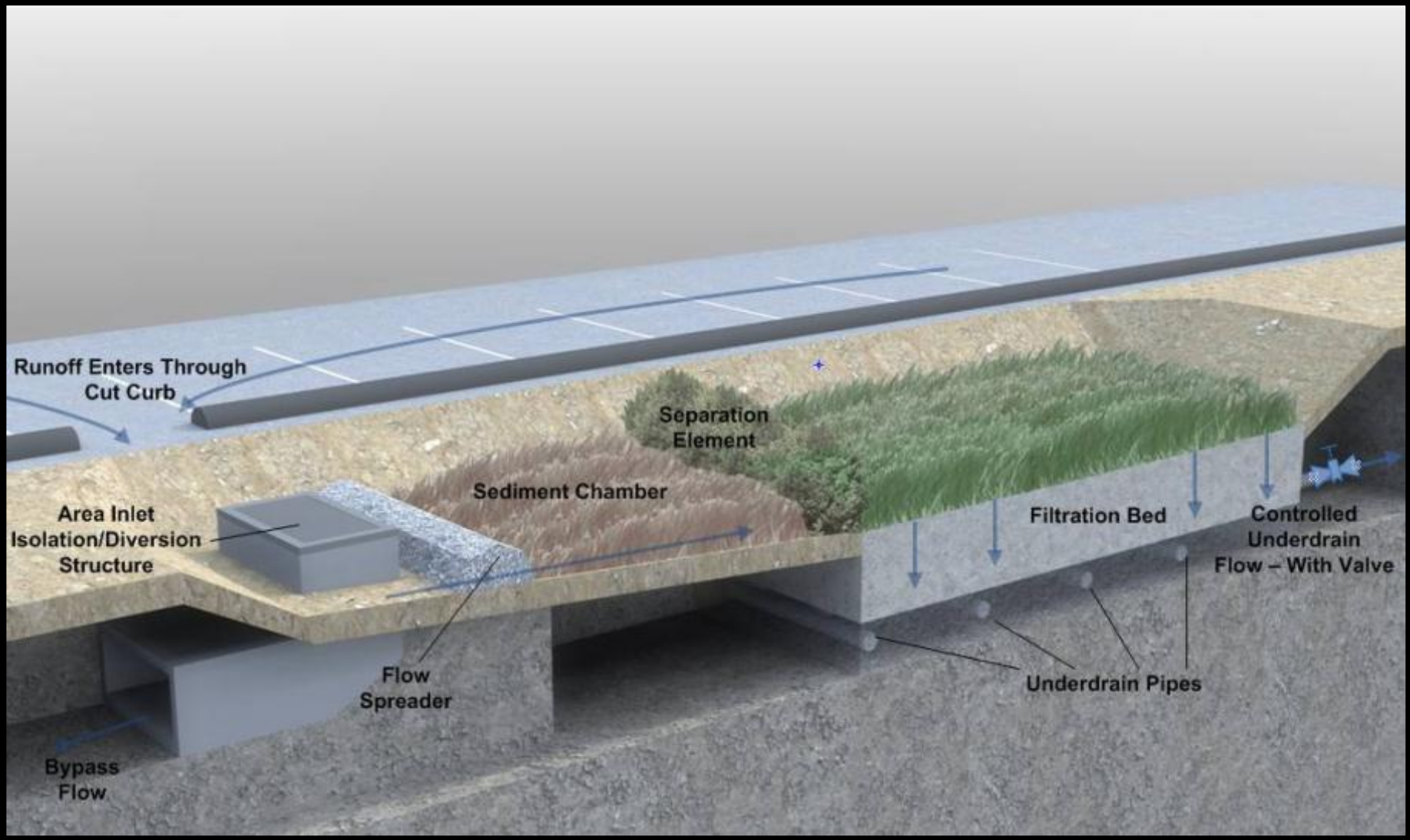
- Transforming Our Cities: High Performance Green Infrastructure

Pilot Technology: Advanced Rainwater Harvesting

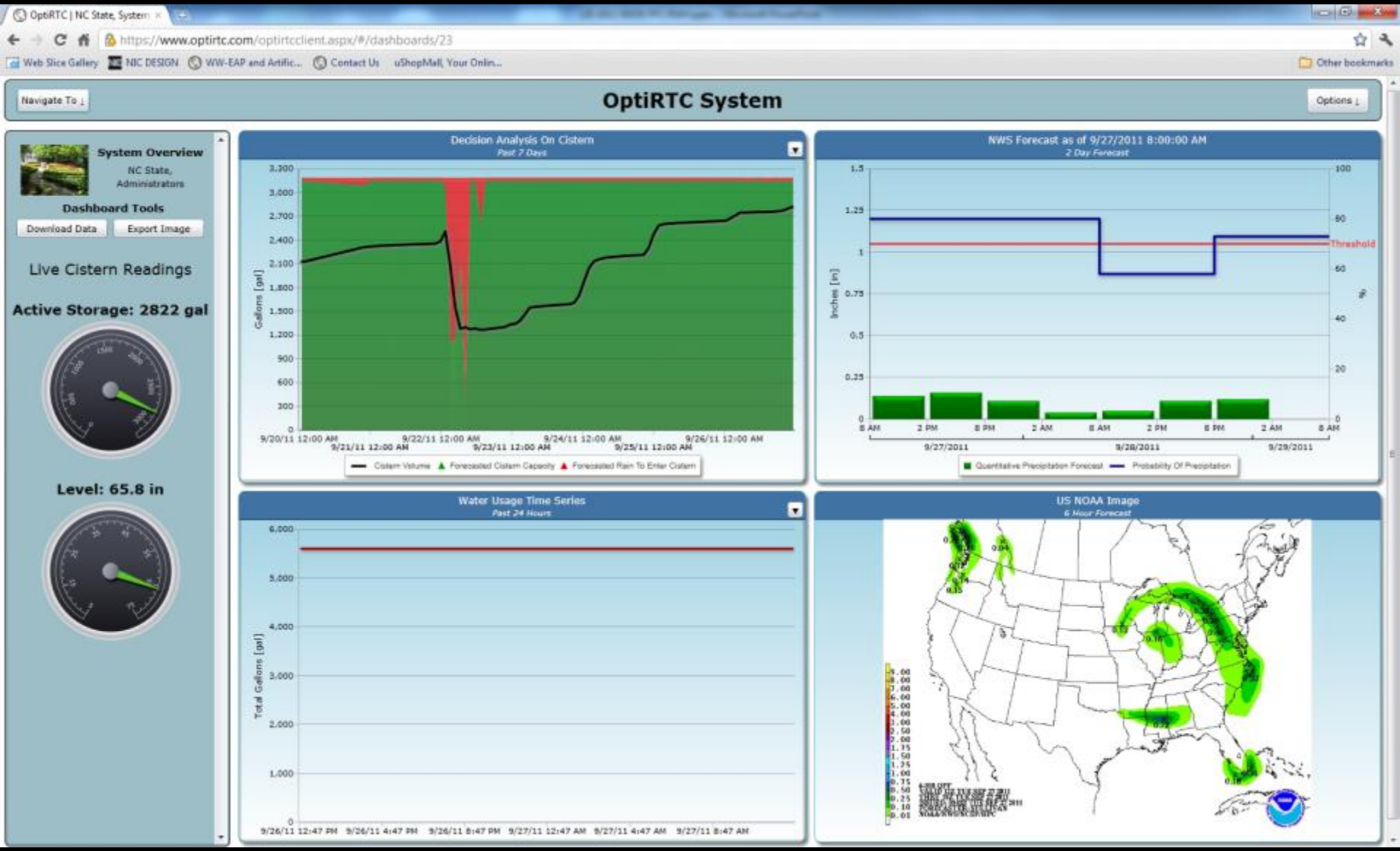


Simplest Definition: Drain storage in advance of predicted rainfall or other trigger

Pilot Technology:
Controlled Under Drain Bioretention



User Experience: Task Specific User Dashboards



Example WERF Pilot Projects

- Advanced Rainwater Harvesting
  - 1 System Online, New Bern, NC
  - 7 Systems Online, St. Louis, MO
  - 2 Systems Online, Washington, DC
  - City of Austin: Control rainwater harvesting system at Twin Oaks Library
  - Urban Drainage and Flood Control District, Denver: control a 3,000 gallon above ground cistern at a school
- Active Green Roof
  - SAP America's Headquarters Building, PA
- Controlled Underdrain Bioretention
  - Gwinnett County, GA
- Controlled Wetland for CSO mitigation
  - St. Joseph, MO
- Smart Detention
  - Seattle University: Control underground cistern

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Future Opportunities

LIFT Technology Evaluation Program

Leaders Innovation Forum for Technology (LIFT)

LIFT is a joint WEF/WERF initiative designed to help move innovation into practice in the water quality industry. LIFT brings together the best scientific minds and industry specialists to accelerate adoption of innovative technologies that enable utilities and industries to reduce costs, improve processes, and enhance the environment. LIFT provides a comprehensive approach to advance innovation that includes technological, social, and regulatory/policy aspects.

"The LIFT program provides a great opportunity for all stakeholders in the water sector to work together collaboratively for quick diffusion of new technologies. This program will serve as an adaptive model for targeted technology evaluation and adoption, by sharing costs, risks, and insights."
— Amit Kaldate, Manager, Biology Group
Infilco Degremont

The LIFT program includes four main components:

- **Technology Evaluation Program (TEP)**
  Provides a means to identify, screen, and evaluate new technologies and share the risk and cost of conducting demonstrations.

- **People & Policy**
  Informs policy at the federal, state, and local level to remove barriers and facilitate adoption of new technologies. Includes benchmarking how utilities accomplish R&D.
- **Communication**
  Provides training, education, and outreach relative to new technologies.
- **Informal Forum for R&D Managers**
  Allows individuals responsible for technology identification and deployment to share experiences, activities, and interests.

WERF leads the TEP program. Through this program all WERF subscribers gain:

- A credible, well-documented vetting system to screen new technologies and processes
- Ability to more rapidly deploy new technologies and remove existing impediments.
- Mitigation of the risk and cost of innovative technology deployment through collaborative partnerships.
- Facilitation of collaboration among facilities for the evaluation and testing of new technologies.
- Peer reviewed information about emerging technologies.

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Thank You!

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