



Office of Research and Development

Monthly Water Research Webinar Series

## SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



October 26, 2016

**TODAY'S TOPIC:**

# Toolkit of Available EPA Green Infrastructure Modeling Software

**Watch as  
you wait**

**Watch the Toolkit video:**

<https://www.epa.gov/water-research/green-infrastructure-modeling-toolkit>

**Webinar Support Phone Number:** 1-800-263-6317

**Audio Controls:** Your audio is muted by the organizer

**To Ask a Question:** Type in the "Questions" box in the lower section of your screen

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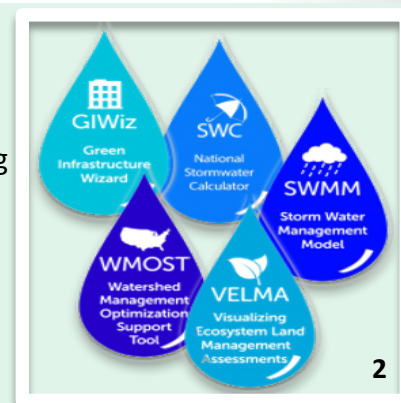
**Need for Water Runoff Control:** Stormwater discharges continue to cause impairment of our Nation's waterbodies. Conventional stormwater infrastructure, or gray infrastructure, is largely designed to move stormwater away from urban areas through pipes and conduit. Runoff from these surfaces can overwhelm sewer systems and end up contaminating local waterways. When stormwater runs off impervious streets, parking lots, sidewalks, and rooftops, it carries pollutants, such as motor oil, lawn chemicals, sediments, and pet waste to streams, rivers, and lakes. Runoff flows can also cause erosion and flooding that can damage property, infrastructure, and wildlife habitat. In addition to runoff problems, impervious surfaces also prevent water from penetrating the soil and recharging groundwater supplies.



**Green Infrastructure:** Green infrastructure, such as rain gardens, green roofs, porous pavement, cisterns, and constructed wetlands, is becoming an increasingly attractive way to recharge aquifers and reduce the amount of stormwater runoff that flows into wastewater treatment plants or into waterbodies untreated. It provides many environmental, social, and economic benefits that promote urban livability, such as improved surface water quality, water conservation, and improved aesthetics and property values. Green infrastructure is also incorporated into municipal separate storm sewer system (MS4) and National Pollutant Discharge Elimination System (NPDES) stormwater permits for retention requirements for various states across the Nation.

**Green Infrastructure Modeling Toolkit:** Researchers in EPA's Office of Research and Development (ORD) have been studying green infrastructure practices and developing models and tools to help communities manage their stormwater runoff and address nutrient impairment. This webinar will present a toolkit consisting of five EPA green infrastructure models and tools, along with communication material, that can be used as a teaching tool and as a quick reference resource for use by planners and developers when making green infrastructure implementation decisions, and can also be used for low impact development design competitions. The models and tools included in the toolkit will be presented during this webinar.

The toolkit is available on EPA's website: [epa.gov/water-research/green-infrastructure-modeling-toolkit](https://epa.gov/water-research/green-infrastructure-modeling-toolkit)





## **Disclaimer**

The views expressed in this presentation are those of the author and do not necessarily reflect the views of the U.S.

Environmental Protection Agency. Any mention of trade names or commercial products does not constitute Agency endorsement or recommendation for use.



**Green Infrastructure Wizard (GIWiz):** GIWiz is an interactive web application that provides users with customized reports containing the EPA tools and resources they select, direct links, and overview information about each.



### Dr. Marilyn ten Brink

Dr. Marilyn ten Brink is a Special Assistant to the Director of the Atlantic Ecology Division (AED) of EPA's National Health and Environmental Effects Research Laboratory (NHEERL) in Narragansett, Rhode Island. She received her Ph.D. in Environmental Geochemistry from Columbia University, New York, and has over 35 years of research experience on pollutant distribution, impacts, and management for aquatic systems. Marilyn is currently leading an interdisciplinary group of scientists to develop tools, including GiWIZ, that enable communities to better utilize Green Infrastructure approaches and improve sustainability.

**Contact:** [tenbrink.marilyn@epa.gov](mailto:tenbrink.marilyn@epa.gov)





# What is GIWiz?

**A database of EPA's Green Infrastructure Tools and Resources**

**An interactive web application that connects communities with these Tools and Resources**

**A wizard that provides customized links and exploration, based on your objectives and specifications**

**A decision support tool for green infrastructure implementation**

**A simple means to generate a report about tools and resources of interest**

<https://cfpub.epa.gov/giwiz/>

<https://www.epa.gov/sustainability/green-infrastructure-wizard>



# Why GIWiz?



Green Infrastructure Workshop & Fair in MA

**Problem  
formulation**

**GI?**

***Connecting  
the Dots Between  
Supply and Demand  
of Information***

**Tools & Resources:**

- What is already available to meet community and stakeholder needs?
- Where are the gaps in research, tools, and information?

**NEEDS:**

What do communities, practitioners, and stakeholders need to make good decisions and improve compliance and sustainability outcomes?

***LEARNING FROM  
COMMUNITIES***

***DEVELOPING  
DECISION CASES***

***EPA has a vast array of **Green Infrastructure** tools, information resources, and case studies; however, this information can be difficult for users to navigate .***

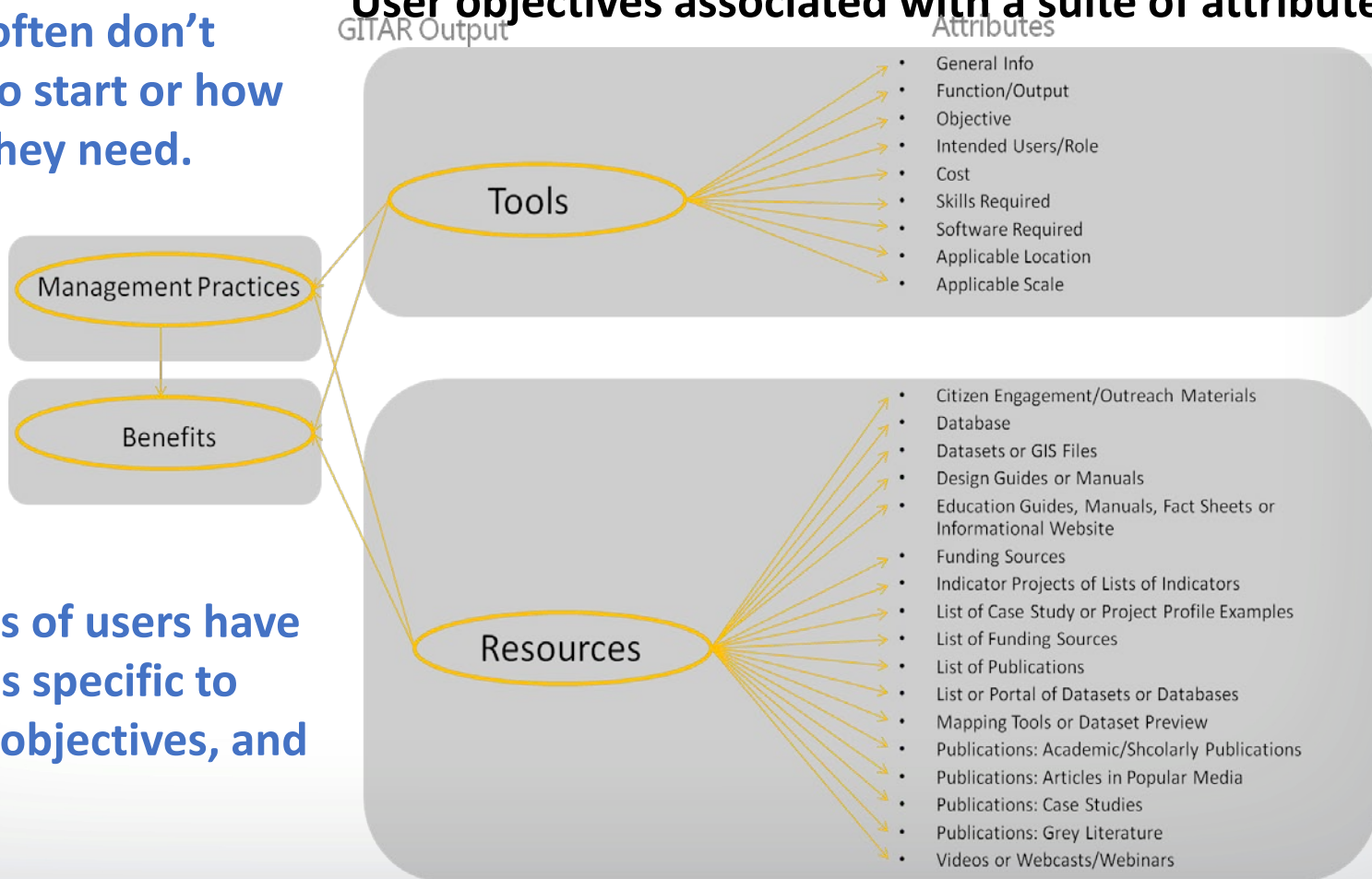


## Attributes tagged for each Tool/Resource entry

## User objectives associated with a suite of attributes

Practitioners often don't know where to start or how to find what they need.

Different types of users have differing needs specific to their context, objectives, and constraints.

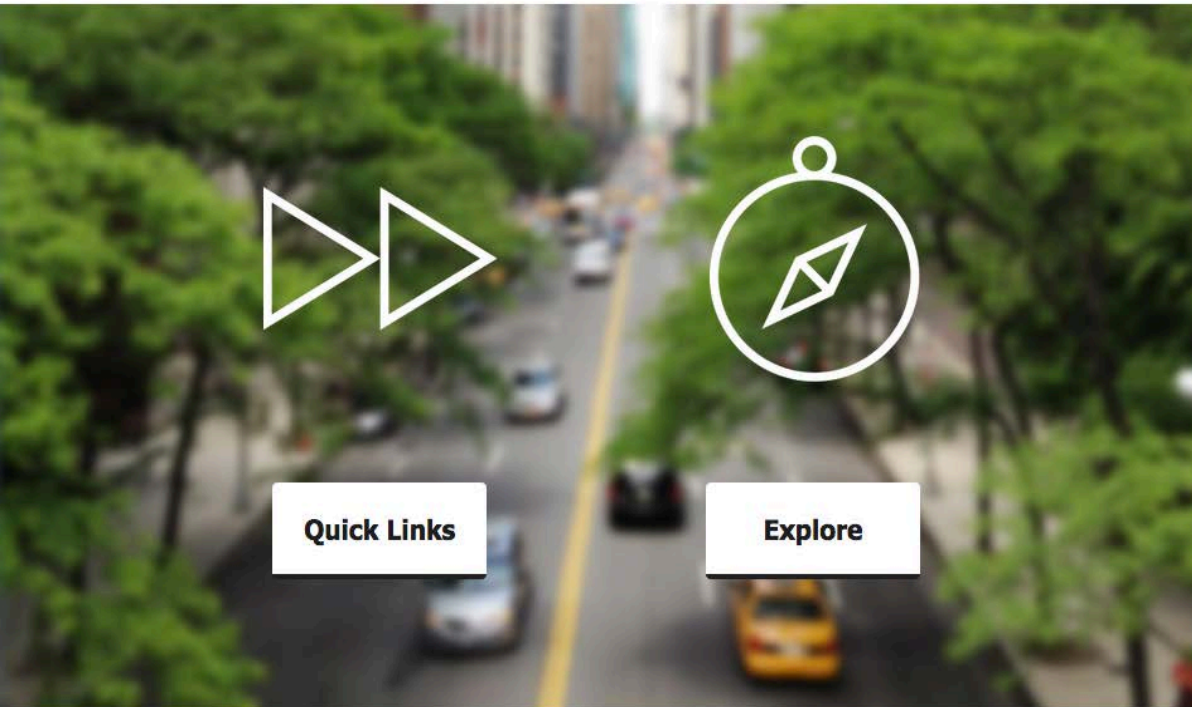




# What does GIWiz provide?



 **Feedback**



*Quick, direct access to  
EPA's Green Infrastructure  
tools and resources*

GIWiz offers you access to a repository of EPA-sourced Green Infrastructure tools and resources designed to support and promote sustainable water management and community planning decisions. The tools and resources available through GIWiz will help you analyze problems, understand management options, calculate design parameters, analyze costs and benefits, evaluate tradeoffs, engage stakeholders, and/or develop education and outreach campaigns. GIWiz is made possible through a cross-agency collaboration involving EPA's Office of Research and Development, Office of Policy, Office of Water, and Regional staff.





## Faster, Easier Access to Information

Searching for: [EPA, Green Infrastructure, Regulator, Compliance] can yield an overwhelming array of results:



**More than 7,000 users have visited GIWiz  
since the October 2015 launch.**





# How can I use GIWiz?



## *First-level 'clicks'*

- Learn
- Research
- Design
- Assess

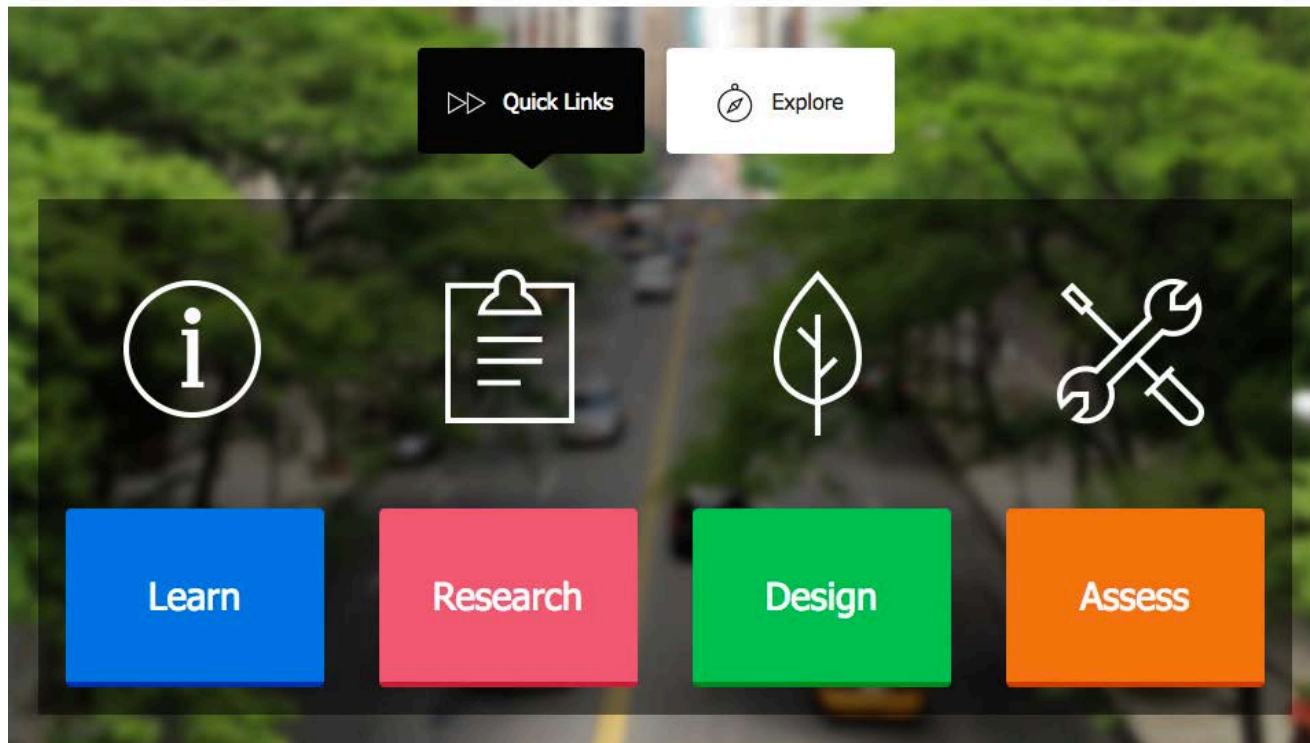
Quick Links

Explore

- Who are you?
- What would you like to do?
- Use the keyword search

- What resources are you interested in?
- What are your objectives?
- What benefits interest you?
- Are these skills applicable to you?
- Which management practices best fit your needs?

GIWiz offers you access to a repository of EPA-sourced Green Infrastructure tools and resources designed to help you analyze problems, understand management options, calculate design parameters, and promote sustainable water management and community planning decisions. The tools and resources available through GIWiz will help you analyze problems, understand management options, calculate design parameters, estimate costs and benefits, evaluate tradeoffs, engage stakeholders, and/or develop education and outreach campaigns. GIWiz is made possible through a cross-agency collaboration involving EPA's Office of Research and Development, Office of Policy, Office of Water, and Regional staff.



Use the Quick Links feature to access green infrastructure tools and resources, customized to a specific objective. Click the button that best matches your needs, and select the corresponding objective to view a tailored list of tools and resources.



# QUICK LINKS to Tools and Resources



## Learn



- ☐ I have general questions about green infrastructure
- ☐ I want to understand what other communities are doing
- ☐ I am interested in outreach and education
- ☐ I want to understand how green infrastructure can benefit my community



## Design



- ☐ I want to use green infrastructure to manage stormwater and improve water quality
- ☐ I am interested in fostering climate resilience and preparing for extreme weather events
- ☐ I am focused on revitalizing my community and enhancing land use
- ☐ I want to manage, restore, and conserve my watersheds



## Research



- ☐ I want to learn how green infrastructure can help me address regulatory compliance and meet permitting requirements
- ☐ I want to find out how to improve my community through Best Management Practices that target green infrastructure
- ☐ I need to find ways to pay for green infrastructure



## Assess

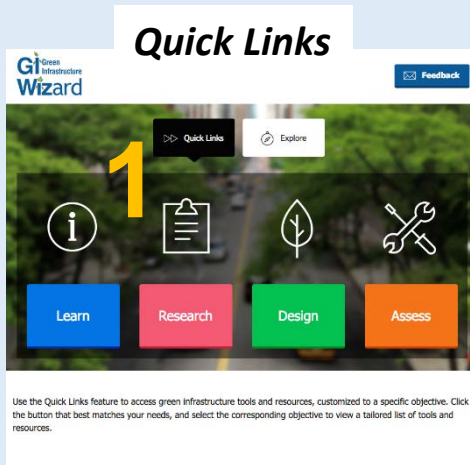


- ☐ I am seeking tools to help me with site design, BMP performance, and maintenance
- ☐ I need help in developing strategies, plans, policies, and incentives
- ☐ I want to calculate, model, or manage data
- ☐ I am curious about mapping and geospatial analysis

*Find the 'who, when, where, why and how' of Green Infrastructure Implementation*

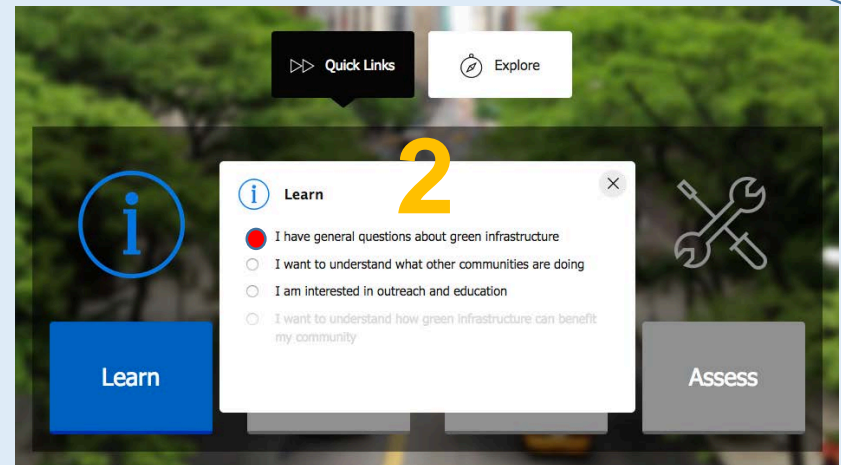


# Using QUICK LINKS



**Selection(s)  
delivers list  
of pertinent  
tools and  
resources**

**Use to access a  
pre-selected list  
of GI tools and  
resources  
grouped by  
specific  
objectives  
and sorted by  
topic**



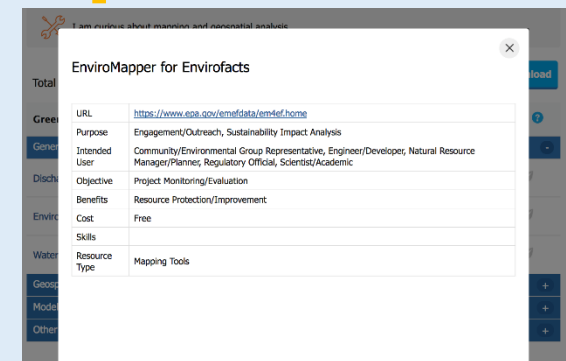
**with links to more  
information and to  
resource websites**

**3**

**I have general questions about green infrastructure**

Total count: 21 [PDF Download](#)

Green Infrastructure Resources	More Info	Resource Type	Like
Different Shades of Green: Green Infrastructure Research at EPA Brochure	<a href="#">i</a>		
EPA Green Infrastructure	<a href="#">i</a>		
Green Infrastructure Collaborative	<a href="#">i</a>		
Green Infrastructure For Climate Resiliency	<a href="#">i</a>		
Green Infrastructure Policy Guides	<a href="#">i</a>		
Green Infrastructure Research	<a href="#">i</a>		
Green Infrastructure Webcast Series	<a href="#">i</a>		
Green Infrastructure Webcast Series: The Many Benefits of Green Infrastructure and Philadelphia Municipal Case Study	<a href="#">i</a>		





- Quick Link Organized by categories
- Include number of returns
- 'More info' and 'Resource Type'
- Downloadable
- Have links to each tool/ resource
- "Feedback" function

## Example (Quick Links: *Research*)

1



I need to find ways to pay for green infrastructure

Total count: 66



PDF Download

### Green Infrastructure Resources

More Info

Resource Type

Like ?

Economic benefits and incentive mechanisms

+

Financial strategy, cost comparison, and cost-benefit analysis

+

Funding sources

+

Other

+

2





# GIWiz Navigation for Your Needs

## Viewing the Resources

### Linked url

5

3

I need to find ways to pay for green infrastructure

Total count: 66

PDF Download

Green Infrastructure Resources

	More Info	Resource Type	Like ?
Economic benefits and incentive mechanisms			+
Financial strategy, cost comparison, and cost-benefit analysis			-
Financing Alternatives Comparison Tool (FACT)			
Fundamentals of Asset Management Step 10. Build Asset Management Plan A Hands-On Approach			
Fundamentals of Asset Management Step 8. Optimize Capital Investment: A Hands-On Approach			
Fundamentals of Asset Management Step 9. Determine Funding Strategy A Hands-On Approach			
Green Infrastructure Approaches to Managing Wet Weather with Clean Water State Revolving Funds			

### More info

4

Financing Alternatives Comparison Tool (FACT)

URL	<a href="https://www.epa.gov/cwstf/financing-alternatives-comparison-tool">https://www.epa.gov/cwstf/financing-alternatives-comparison-tool</a>
Purpose	Drafting Standards and Codes, Economic Analysis/Assessment
Intended User	Community/Environmental Group Representative, Engineer/Developer, Natural Resource Manager/Planner, Regulatory Official
Objective	Address Zoning/Codes, Find Financing Options, Leverage Transportation Funding, Use Roadway Beautification Dollars
Benefits	Cost Savings, Regulatory
Cost	Free
Skills	
Resource Type	Data and Analytic Tools, Financial and Funding Support

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Related Topics: Clean Water State Revolving Fund

## Financing Alternatives Comparison Tool

The Financing Alternatives Comparison Tool (FACT) is a financial analysis tool that helps municipalities, utilities, and environmental organizations identify the most cost-effective method to fund a wastewater or drinking water management project. FACT produces a comprehensive analysis that compares financing options for these projects by incorporating financing, regulatory, and other important costs.

FACT creates several reports showing the results of the analysis. A summary report compares various financing options using key financial figures. Graphical presentations compare annual and total costs of financing options over time.

FACT version 3.1 includes a streamlined analysis option called FACT-Lite. FACT-Lite reduces the amount of information users must enter to compare financing options.

### FACT User Guide

A comprehensive user guide is automatically available as part of the installation of FACT. Once FACT is installed, the user guide is accessed by selecting the Help and Definitions button in the top right corner of the homepage.

Alternatively, you can download the user guide separately, [FACT User Guide](#).

### Downloading FACT

You can install FACT v.3.1 onto your computer by downloading the compressed (.zip) file below. See EPA's page on [Free Viewers and Readers to Read and Print EPA Information](#) to learn more about compressed files.

You will need Microsoft Access 2000 or higher to install and use FACT v.3.1.

**If you have Microsoft Access 2000 or higher on your computer:**

1. Install FACT by clicking on [FACT v.3.1](#) (1 pg, 10 MB) (ZIP)
2. Choose to run the file to install FACT v.3.1 on your computer.

**If you do not have Microsoft Access 2000 or higher on your computer:**

1. Install Access Runtime by clicking on [AccessRuntime](#) (1 pg, 36 MB) (EXE)
2. Install FACT by clicking on [FACT v.3.1](#) (1 pg, 10 MB) (ZIP)
3. Choose to run the file to install FACT v.3.1 on your computer.

After installing FACT, an icon named FACT will appear on your desktop that you can click to run the program.

[Contact Us](#) to ask a question, provide feedback, or report a problem.

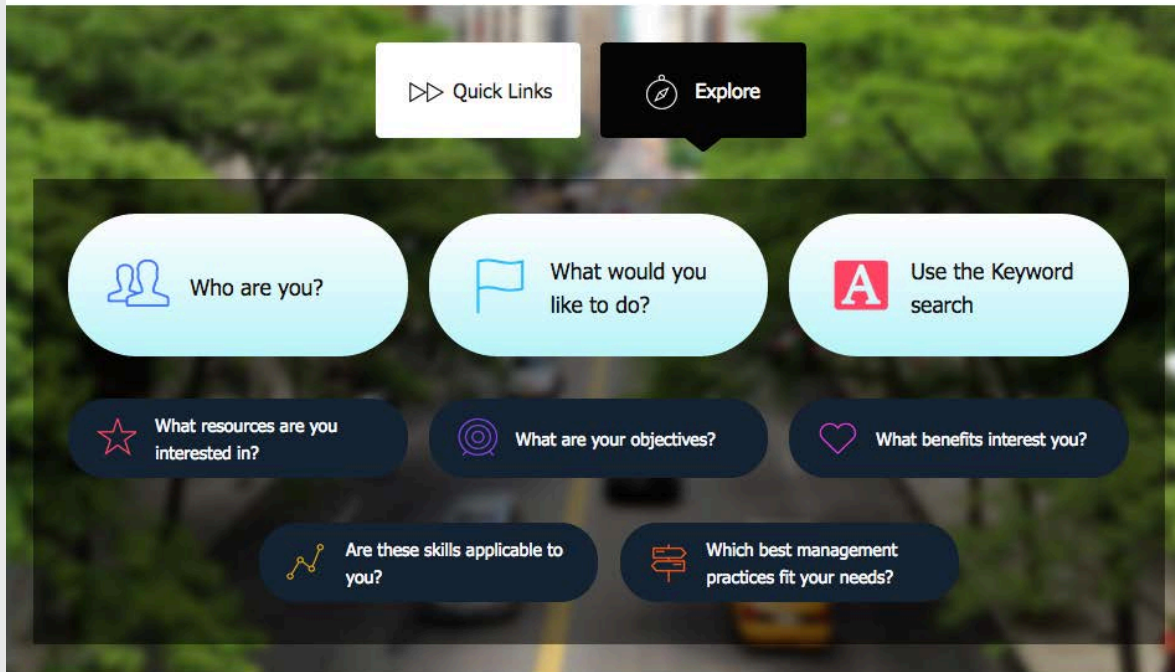
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More social media at EPA



Use the Explore feature to access green infrastructure tools and resources, customized to your specifications. Answer any or all of the questions above by selecting one or more of the corresponding topics that interest you. At any point, click the "Show Results" button to view your customized list of results. Select as many, or as few, questions and corresponding topics as you would like. Click the "Clear Results" button to remove all previous selections and start over.

**Access GI tools and resources. Get a highly targeted report customized to your specifications....**

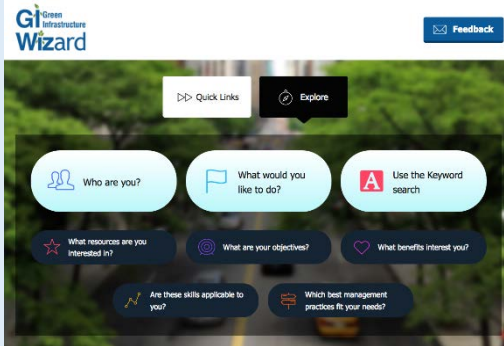
*For example:*

*"I am a **city planner** in a medium sized-city trying to do a **green streets program**. I want to **find design manuals** for various **tree planting scenarios** and for **stormwater management** within a business district."*



# Using EXPLORE

## Explore



**Answer any or all of the questions and click *'show results'* to view your customized list of tools and resources**

***'Clear Results'* to start a new search**

1

2

*Select as many or few as you wish*

Who are you?

What would you like to do?

Use the Keyword search

What resources are you interested in?

What are your objectives?

What benefits interest you?

Are these skills applicable to you?

Which best management practices fit your needs?

- Address Zoning/Codes
- Carbon Sequestration
- Create a Model
- Develop a GI or LID Manual
- Examine Performance Rates
- Find Financing Options
- Leverage Transportation Funding
- Manage Extreme Rain Events
- Maximize Groundwater Quality
- Nutrient Removal
- Outreach/Education
- Project Monitoring/Evaluation
- Sediment Capture/Removal
- Select Trees/Plantings
- Use Roadway Beautification Dollars

Show results Clear results

**Or SEARCH the database using keyword**

Who are you?

What would you like to do?

Use the Keyword search

What resources are you interested in?

What are your objectives?

What benefits interest you?

Are these skills applicable to you?

Which best management practices fit your needs?

Keyword Search

Clear results





# User-Selected Criteria

*Wizard matches Tools and Resources to all user-selected criteria*



## What benefits interest you?

- |  |  |
|--|--|
| <input type="checkbox"/> Aesthetics/Livability               | <input type="checkbox"/> Recreational                    |
| <input type="checkbox"/> Civic/Community Involvement         | <input type="checkbox"/> Regulatory                      |
| <input type="checkbox"/> Cost Savings                        | <input type="checkbox"/> Resource Protection/Improvement |
| <input type="checkbox"/> Economic Development                | <input type="checkbox"/> Right-of-Way Enhancements       |
| <input type="checkbox"/> Ecosystem Health                    | <input type="checkbox"/> Runoff Nutrient Loading         |
| <input type="checkbox"/> Grey Infrastructure Footprint       |  |
| <input type="checkbox"/> Hydrological Improvements           |  |
| <input type="checkbox"/> Pollution/Climate Change Mitigation |  |
| <input type="checkbox"/> Property Value Increases            |  |
| <input type="checkbox"/> Public Health/Safety                |  |



## Are these skills applicable to you?

- |   |   |
|---|---|
| <input type="checkbox"/> Concept Mapping    | <input type="checkbox"/> Environmental / Program Management |
| <input type="checkbox"/> Content Management | <input type="checkbox"/> Geospatial Analysis                |
| <input type="checkbox"/> Cost Estimation    | <input type="checkbox"/> Scientific Knowledge               |
| <input type="checkbox"/> Data and Analysis  | <input type="checkbox"/> Statistics                         |
| <input type="checkbox"/> Engineering        | <input type="checkbox"/> Teaching                           |



## What would you like to do?

- |   |   |
|---|---|
| <input type="checkbox"/> Compliance                       | <input type="checkbox"/> Other Environmental Assessment   |
| <input type="checkbox"/> Data and Modeling                | <input type="checkbox"/> Performance Analysis             |
| <input type="checkbox"/> Decision-Making and Planning     | <input type="checkbox"/> Project Management and Reporting |
| <input type="checkbox"/> Drafting Standards and Codes     | <input type="checkbox"/> Sustainability Impact Analysis   |
| <input type="checkbox"/> Economic Analysis/Assessment     |   |
| <input type="checkbox"/> Engagement/Outreach              |   |
| <input type="checkbox"/> Environmental Footprint Analysis |   |
| <input type="checkbox"/> Mapping and Visualization        |   |
| <input type="checkbox"/> Other Environmental Analysis     |   |



## Which best management practices fit your needs?



- |  |
|--|
| <input type="checkbox"/> Conservation/Restoration    |
| <input type="checkbox"/> Construction                |
| <input type="checkbox"/> Education and Outreach      |
| <input type="checkbox"/> Environmental Management    |
| <input type="checkbox"/> Municipal Management        |
| <input type="checkbox"/> Stormwater/Flood Management |
| <input type="checkbox"/> Transportation              |
| <input type="checkbox"/> Wastewater Management       |



# GIWiz Database

*Connecting the dots between  
Supply and demand for  
GI information*

## Database content is expanding

- V1 Sept 2015: 270 Tools and Resources
- V2 Sept 2016: **395 Tools and Resources**

What resources are you interested in?

- ☒ Case Studies
- ☒ Data and Analytic Tools
- ☒ Fact Sheets
- ☒ Financial and Funding Support
- ☒ Informational Websites
- ☒ Mapping Tools
- ☒ Outreach Materials and How-Tos
- ☒ Popular Press/Media
- ☒ Publications and Reports
- ☒ Videos, Webcasts, and Webinars

**Green Infrastructure Wizard**

Showing 395 Green Infrastructure Resources

**Green Infrastructure Resources**

**A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds**

**Purpose:** Data and Modeling, Decision-Making and Planning, Economic Analysis/Assessment, Environmental Footprint Analysis  
**Intended User:** Community/Environmental Group Representative, Engineer/Developer  
**Objective:** Carbon Sequestration, Create a Model, Maximize Groundwater Quality, Project Monitoring/Evaluation  
**Benefits:** Aesthetics/Livability, Cost Savings, Ecosystem Health, Pollution/Climate Change Mitigation, Property Value Increases, Public Health/Safety, Recreational  
**Cost:**  
**Skills:**  
**Resource Type:** Case Studies, Publications and Reports

**Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans**

**Purpose:**  
**Intended User:** Regulatory Official  
**Objective:**  
**Benefits:**  
**Cost:**  
**Skills:**  
**Resource Type:** Publications and Reports

**Adaptive Management for Urban Watersheds: The Slavic Village Pilot Project**

To create a report of the full GIWiz content, Select all in 'EXPLORE/ What Resources are you interested in?'



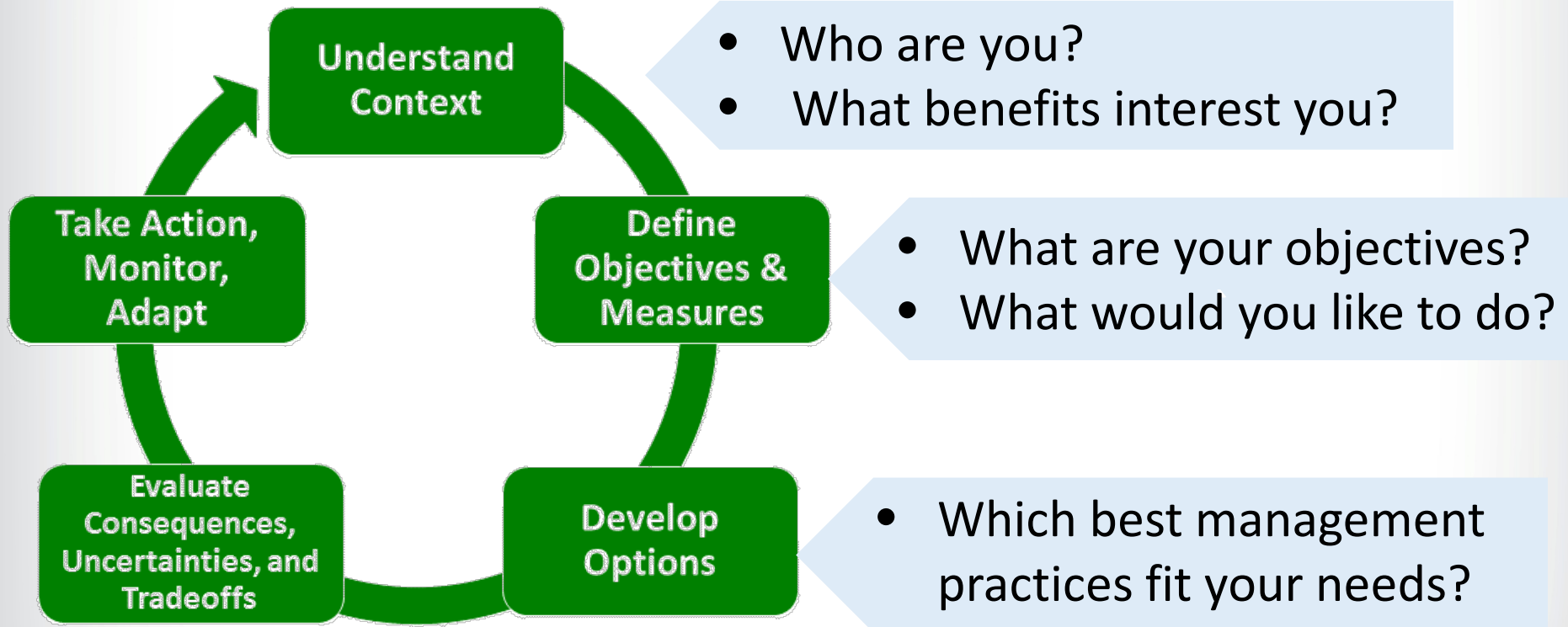


# Decision Support with EXPLORE

Community/Environmental  
Group Representative  
Engineer// Developer  
Natural Resource Manager/ Planner

Landowner/Homeowner  
Scientist/ Academic  
Regulatory Official

## ROLES & STAKEHOLDERS



Green Infrastructure Implementation  
in DASEES Decision Analysis Framework



# GIWiz Reports

Example of report from user-customized criteria in EXPLORE pathway

1

Who are you?

What would you like to do?

Use the Keyword search

What resources are you interested in?

What are your objectives?

What benefits interest you?

Are these skills applicable to you?

Which best management practices fit your needs?

Community/Environmental Group Representative

☒ Engineer/Developer

Landowner/Homeowner

Natural Resource Manager/Planner

Regulatory Official

Scientist/Academic

2

3

Show results Clear results

Total count: 201

Show 10 entries

results

PDF Download

Green Infrastructure Resources	More Info	Resource Type	Like ?
A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds			
Adaptive Management for Urban Watersheds: The Slavic Village Pilot Project			



# Knowledge Base through Collaboration

This is a collaborative project aimed at bridging the gap between the expert knowledge contained within our Green Infrastructure Tools and Resources, and the institutional and user knowledge about where they are located and what they are for.



[www.epa.gov/giwiz](http://www.epa.gov/giwiz)

## GIWiz

- **Helps people considering Green Infrastructure**
- **to find the tools and resources they need**
- **to make sound decisions and advance Green Infrastructure implementation**



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[www.epa.gov/giwiz](http://www.epa.gov/giwiz)

EPA Office of Research and Development (ORD)  
Safe and Sustainable Waters Research (SSWR)  
and Sustainable and Healthy Communities  
Research (SHC), Office of Policy, Office of Water,  
Office of Environmental Information, Regions 1, 2  
and 3 and Community partners.

**Marilyn Buchholtz ten Brink, Ph.D.**  
**(ORD/NHEERL) RI**

**Michael Nye, Ph.D. (ORD/NERL) CO**  
**Robert Sachs (AA/Office of Policy) DC**  
**Ingrid Heilke, MCP (ORISE Fellow) RI**



**Watershed Management Optimization Support Tool (WMOST):** WMOST is a software application designed to facilitate integrated water resources management across wet and dry climate regions. It allows water resources managers and planners to screen a wide range of practices across their watershed or jurisdiction for cost-effectiveness and environmental and economic sustainability. WMOST allows users to select up to fifteen stormwater management practices, including traditional grey infrastructure, green infrastructure, and other low impact development practices.



### Dr. Naomi Detenbeck

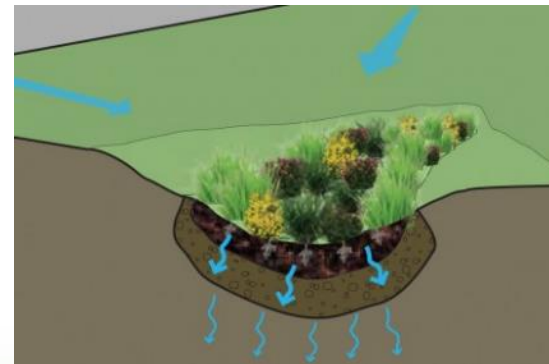
Dr. Naomi Detenbeck is an ecologist in NHEERL AED in Narragansett, RI, with an adjunct faculty appointment in Natural Resources Science at the University of Rhode Island. Her current research is focused on the watershed-scale effects of natural and constructed green infrastructure, development of decision-support tools for integrated water resources management, such as WMOST, and development of EPA's Estuary Data Mapper. Naomi's past research has included work on biogeochemistry, wetlands, landscape ecology, nutrient criteria development, and watershed classification. She earned her M.S. and Ph.D. in Ecology from the University of Minnesota.

**Contact:** [detenbeck.naomi@epa.gov](mailto:detenbeck.naomi@epa.gov)



Decision-support tool for integrated water management at the small watershed/community scale

- Optimizes cost (given targets for base flows, peak flows, water storage, water quality\*)
- Evaluates management options in multiple programs
  - Stormwater, including green infrastructure (GI)
  - Wastewater
  - Drinking water
  - Land conservation



\* Water quality module available for beta testing in fall 2016



# Who and What is WMOST Designed For?

- Community decision-makers:
  - Municipal, regional, or watershed planners
  - Utility managers
  - Community consultants
- Planning level assessments within the following:
  - Watershed Implementation Plans
  - Applications for Grants, State Revolving Fund loans, FEMA Community Rating System credits,...
  - Long-range strategies (utility 20-year horizons, smart growth, climate resilience)
  - Integrated management plans (e.g. wastewater + stormwater)



# Example Applications

- **Ipswich River, MA**

What is the most cost-effective suite of management actions to meet target baseflows in the Ipswich River?

- **Monponsett Ponds watershed, Halifax, MA**

What are the tradeoffs among flood control, recreational use, downstream aquatic life use, and sustainable water supply?

- **Subwatersheds of Taunton River, MA (multiple communities)**

What is the value of natural and constructed green infrastructure in reducing flooding and water quality impairments under different development and climate change scenarios?

- **Subwatersheds of Montgomery County, MD**

What are the most cost effective management practices and tradeoffs involved in meeting both local sediment TMDLs and N/P/SS targets for the Chesapeake Bay TMDL?

- **Subwatersheds of Middle Kansas River, KS**

What are the most cost-effective management practices to both reduce water quality impairments and manage for resilience in the face of climate change?

- Accepts inputs from commonly used hydrology models, e.g.,
  - HSPF, SWAT (HAWQS\*), SWMM, GWLF, PRMS
  - National USGS Monthly Water Balance Model (Bock et al. 2016)
- Allows automated import of time series from existing calibrated models or addition of user-supplied datasets
- Links with EPA SUSTAIN/SWMM to automate calculation of gray and green infrastructure BMP runoff (v1-2) and load reductions (v3)\*\*
- Accepts flood-cost curves derived using FEMA HAZUS tool with publically available data from Flood Insurance Studies

- \*beta version tests underway

- \*\*Beta version available for testing Fall 2016





# MS-Excel interface

WMOSTv2\_042415\_LWD.xlsm - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

Calibri 16 A A B I U Font Alignment Number Styles Cells Editing

E22 : Summary table of management decisions and costs

A B C D E F G H I J K L M N O P Q R S T

1 **Watershed Management Optimization Support Tool (WMOST) v2**

2 **Compatible with Microsoft Excel 2010 © Please refer to the documentation before using the model to understand its uses and limitations.**

3

4 Original model was created in 2007 (Zoltay et al. 2010). WMOST development is sponsored by EPA. Contact for questions: Viktoria Zoltay, Abt Associates, Inc. 617-520-2721, viktoria\_zoltay@abtaassoc.com

5 Please report software errors to Naomi Detenbeck, detenbeck.naomi@epa.gov, with the subject "WMOST bug". To register for notices of updates and new releases, email detenbeck.naomi@epa.gov with the subject "WMOST register".

6

7

8

9

10 **ENTER INPUT DATA**

11

12 **Proceed to**

13 The input data tab summarizes all input data necessary.

14 Specific input tables and fields are accessed from this sheet.

15 **RUN OPTIMIZATION**

16

17 **Optimize**

18 This button initiates the optimization program

19 and processes the output for viewing.

20 **EVALUTATE RESULTS**

21

22 **Results Table**

23 Summary table of management decisions and costs

24 for meeting user-specified goals (e.g., demand, in-stream flow targets)

25 **Compare to Measured Flow**

26 Graph comparing modeled streamflow to measured streamflow

27 **Compare to Target Flow**

28 Graph comparing modeled streamflow to target streamflow

29

30

READY Intro Input Runoff Recharge Surface Water Results Results\_Raw Flow Chart Tables 100%



# Management options in WMOST

- Land conservation
- Water conservation
- Changes in drinking water infrastructure
- Changes in wastewater infrastructure
- Water reuse facility and aquifer storage/recharge
- Interbasin transfer
- Best Management Practices (BMPs), including green infrastructure (GI)

- Existing
  - Detention (dry) ponds (gray infrastructure)
  - Bioretention (GI)
  - Infiltration trench (GI)
- In progress
  - Forested riparian buffers
  - Biofiltration with internal storage reservoir (denitrification)
  - Grass swale
  - Gravel wetland
  - Infiltration basin
  - Infiltration chambers
  - Porous pavement
  - Sand filter
  - Wet pond



# Ongoing WMOST Activities

- Water quality module – beta version available for testing Fall 2016
- Reduced Sewer Overflows module (Winter 2016)
- More input time series
  - New England loading time series (Fall 2016)
  - New England HSPF models: climate change scenarios
  - EPA 20 watershed study sites (historic and future climate change scenarios)
  - HAWQS (nationwide SWAT; undergoing testing now)
  - USGS Monthly water balance model (nationwide)
- Climate change/robust decision making modules (Fall 2016 - 2017)
- Co-benefit estimation (2017-2018)
  - Ecosystem benefits
  - Human health
  - Energy savings
- Training/tech transfer (workshops, support for 4 ongoing case studies)
- Optimize results across multiple objectives (2018)
- Strategies for scaling up and linking watersheds (2018)





# WMOST Download Site

Browser address bar: <https://www.epa.gov/exposure-assessment-models/wmost-20-download-page>

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You are here: EPA Home » Exposure Assessment Models » WMOST 2.0 Download Page

## WMOST 2.0 Download Page

### Watershed Management Optimization Support Tool (WMOST) v2.0 Specifications

Software Specifications

Exposure Assessment Models

- Modeling Products
- Groundwater Models
- Surface Water Models
- Food Chain Models

<http://www2.epa.gov/exposure-assessment-models/wmost-20-download-page>

Tools & Data

Information Sources

<b>Development Status</b>	General Release
<b>Development Information</b>	Release notes - changes and known deficiencies
<b>Operating System</b>	Windows
<b>Development Language</b>	Excel 2010 with Macros, Excel 2013 with Macros

### Download Files

#### Documents

Document	Description
<a href="#">Readme</a> (1 pg, 2 K)	Installation notes, Text, 3KB
<a href="#">WMOST Theoretical Documentation</a>	PDF, 80pp, 6185KB
<a href="#">WMOST User Guide</a>	PDF, 109pp, 11,590KB
<a href="#">Managing Watersheds Presentation</a>	PDF, 55pp, 18678KB

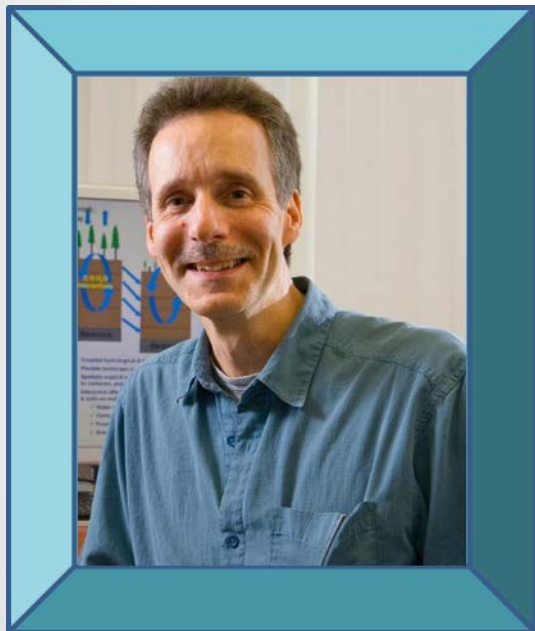
#### Files

File Name / Size / Format	File Description
<a href="#">WMOST v2.0 Install files</a> (2 pp, 22 MB) Excel 2010	WMOST 2.0 tool with blank input and output tables
<a href="#">WMOST Support Files</a> (21 pp, 93 MB) Excel 2010, PDF	WMOST 2.0 Supportfiles subdirectory
<a href="#">WMOST 2.0 Casestudy 100215</a> (1 pg, 25 MB) Excel 2010	Casestudy 100215 Halifax, MA setting up a validation run



### Visualizing Ecosystems for Land Management Assessment (VELMA) Model:

VELMA is a computer software model that regional planners and land managers can use to quantify the effectiveness of natural and engineered green infrastructure management practices for reducing nonpoint sources of nutrients and contaminants in streams, estuaries, and groundwater. These practices include riparian buffers, cover crops, and constructed wetlands.



### Dr. Bob McKane

Dr. Bob McKane is a Research Ecologist with NHEERL's Western Ecology Division in Corvallis, Oregon. He received his Ph.D. in Soil Science from the University of Minnesota, and has over 25 years of experience in the use of simulation models for analyzing effects of climate, soils, and land use on biogeochemical and hydrological processes. Bob is currently leading an interdisciplinary group of scientists to develop and apply the VELMA ecohydrology model, which is currently being used by EPA's ORD and Regions 7 and 10, tribes, and community groups to evaluate the effectiveness of alternative green infrastructure scenarios for improving water quality and ecosystem service co-benefits.

**Contact:** [mckane.bob@epa.gov](mailto:mckane.bob@epa.gov)

**Purpose:** Identify green infrastructure (GI) best management practices for enhancing water quality & ecosystem service co-benefits.

**Results:** Modeled effects of riparian buffers and other GI on water quality and quantity are well validated for ag, forest & rangeland systems

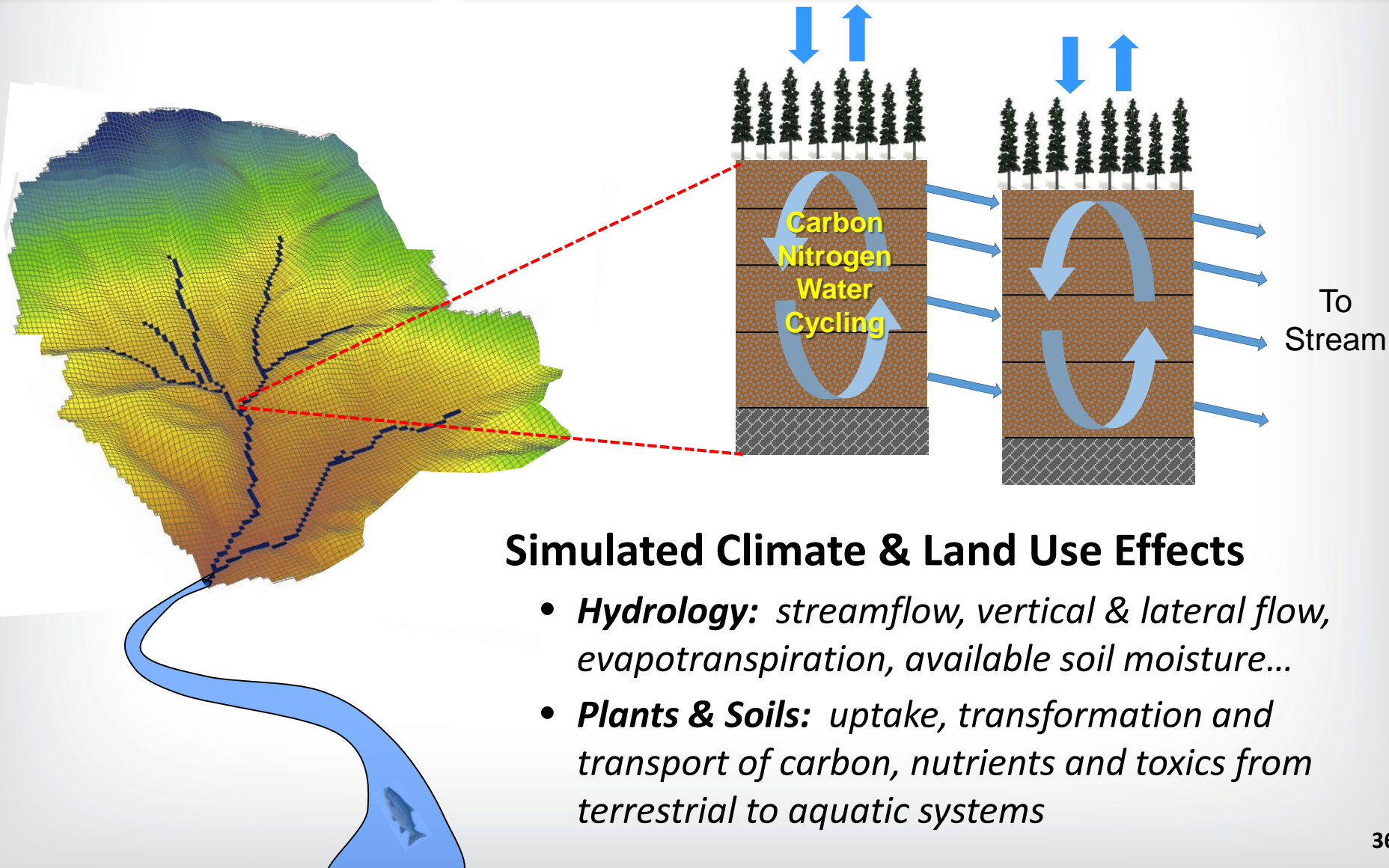
**Applications:** Users include communities, tribes, land managers, and EPA regions and scientists in Pacific Northwest, Central Plains, Midwest and East Coast





# Fate & Transport of Water & Nutrients

plots → watersheds, days → centuries



## Simulated Climate & Land Use Effects

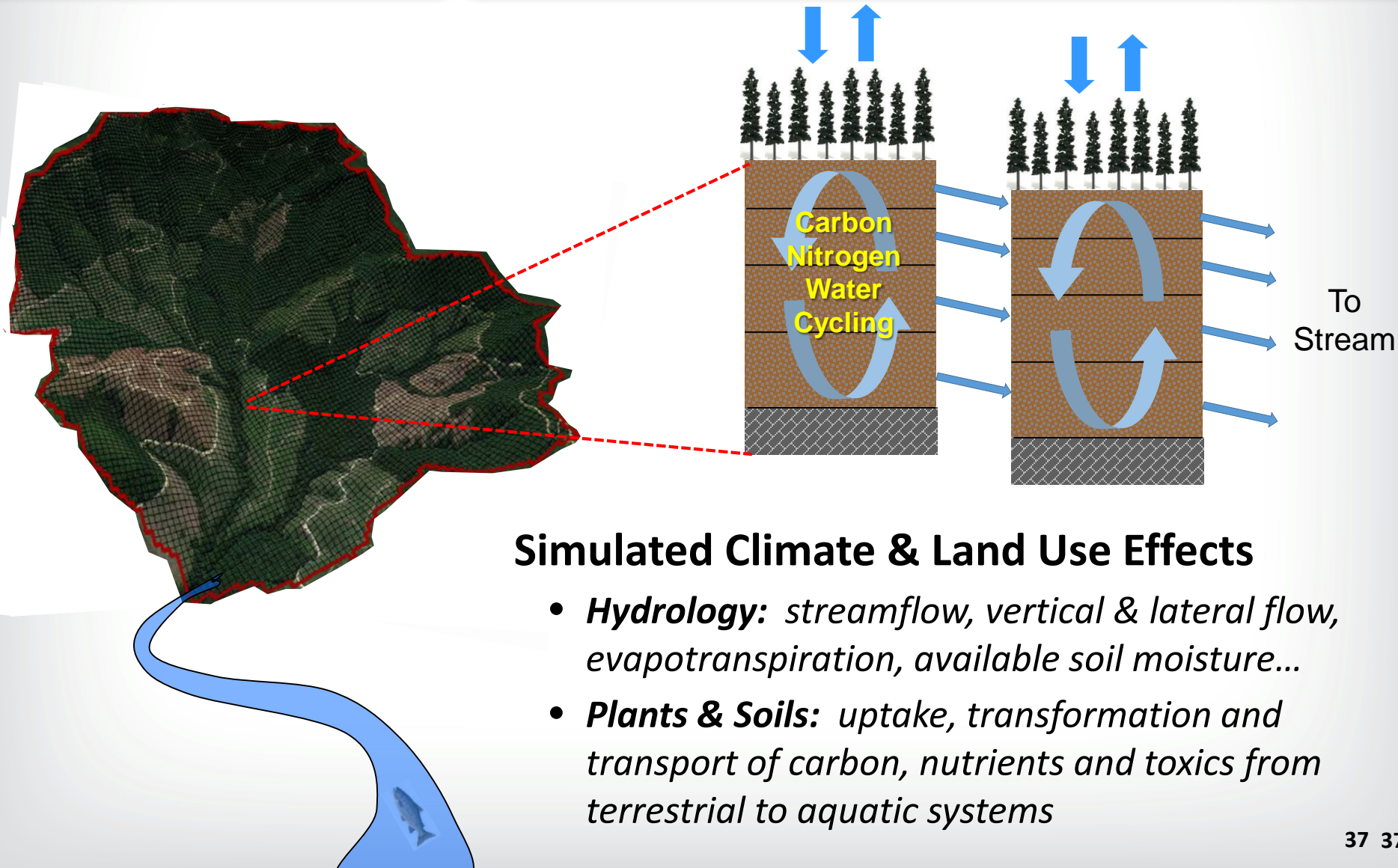
- **Hydrology:** streamflow, vertical & lateral flow, evapotranspiration, available soil moisture...
- **Plants & Soils:** uptake, transformation and transport of carbon, nutrients and toxics from terrestrial to aquatic systems





# Fate & Transport of Water & Nutrients

plots → watersheds, days → centuries



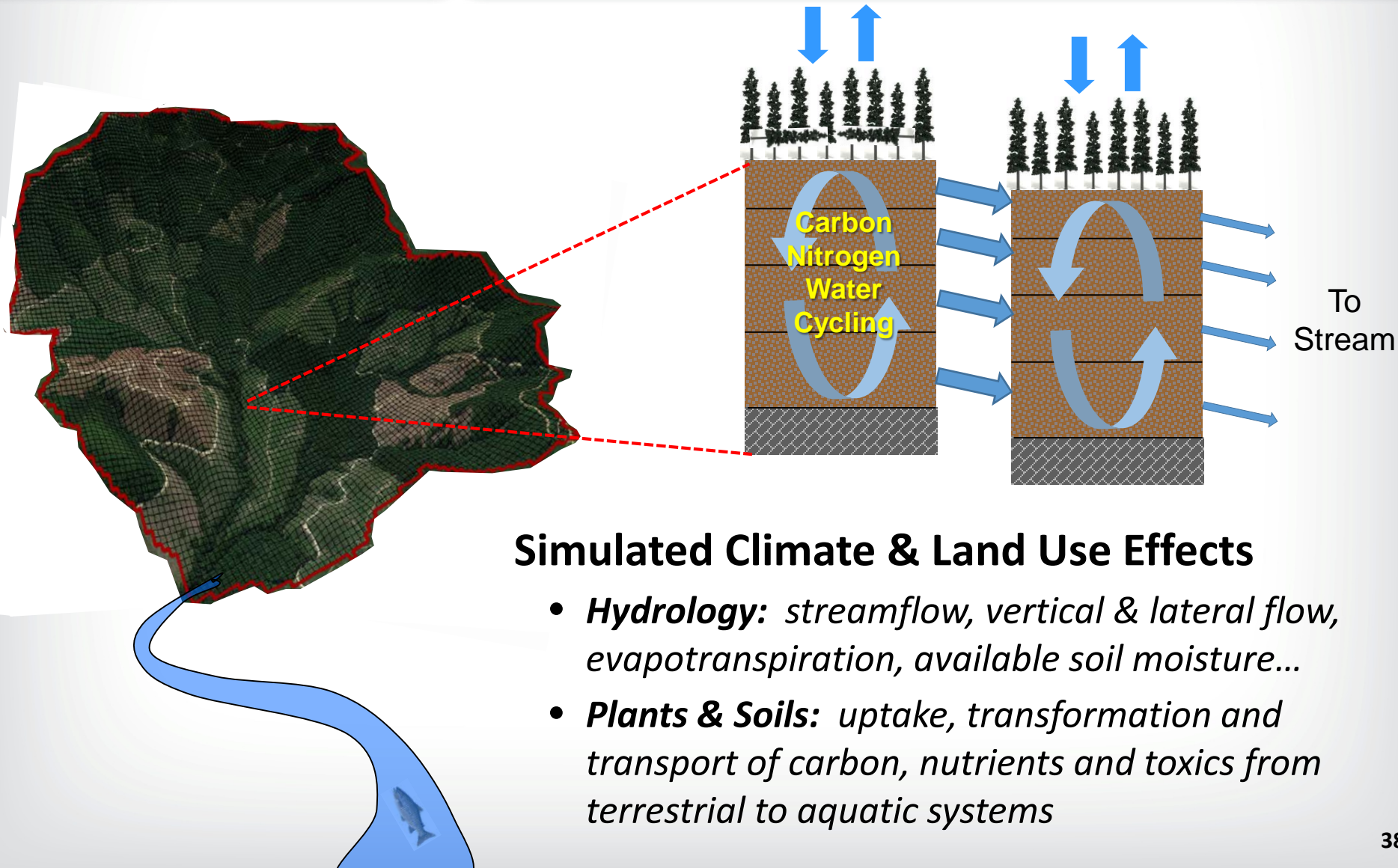
## Simulated Climate & Land Use Effects

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# Fate & Transport of Water & Nutrients

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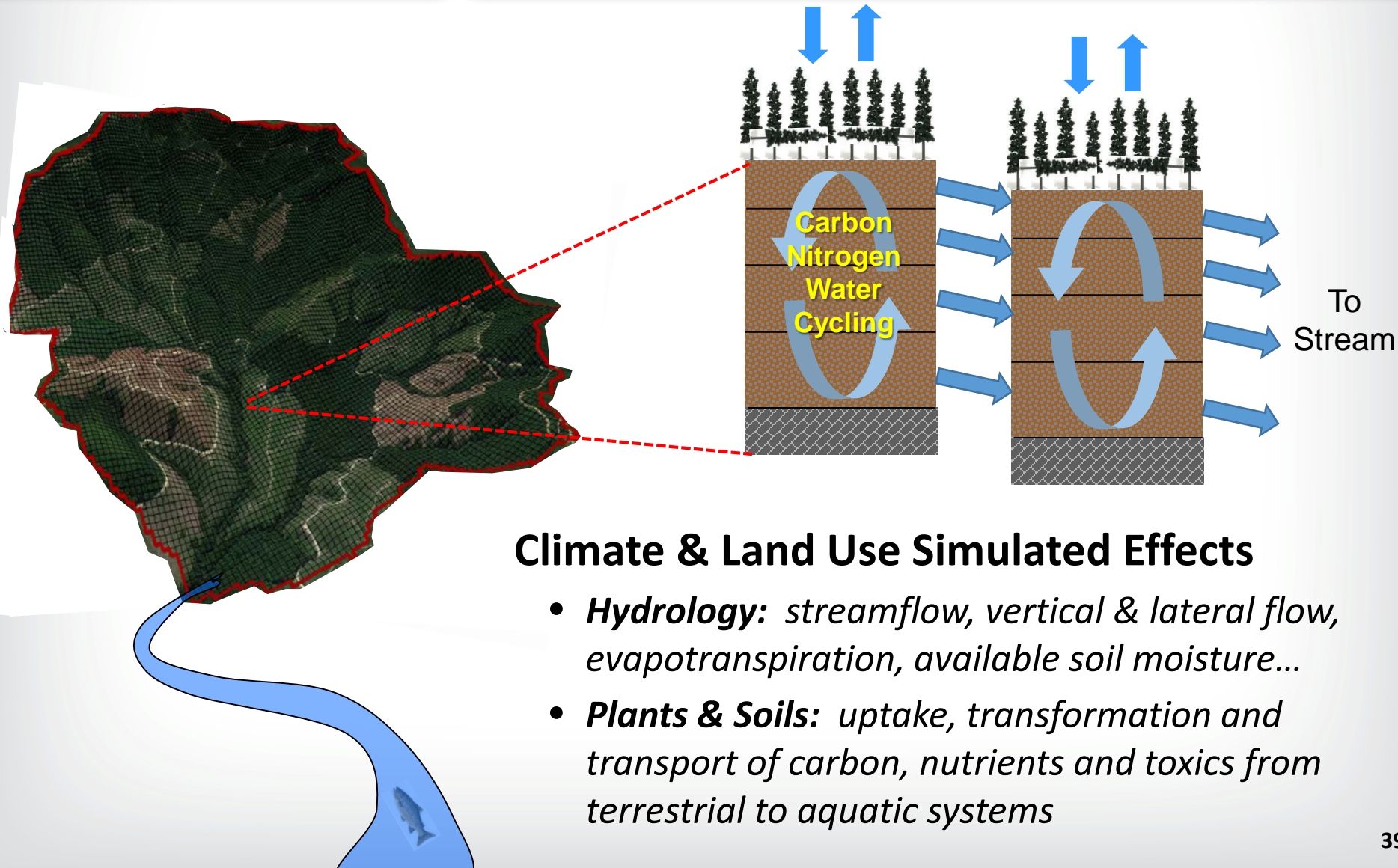
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# Fate & Transport of Water & Nutrients

plots → watersheds, days → centuries



## Climate & Land Use Simulated Effects

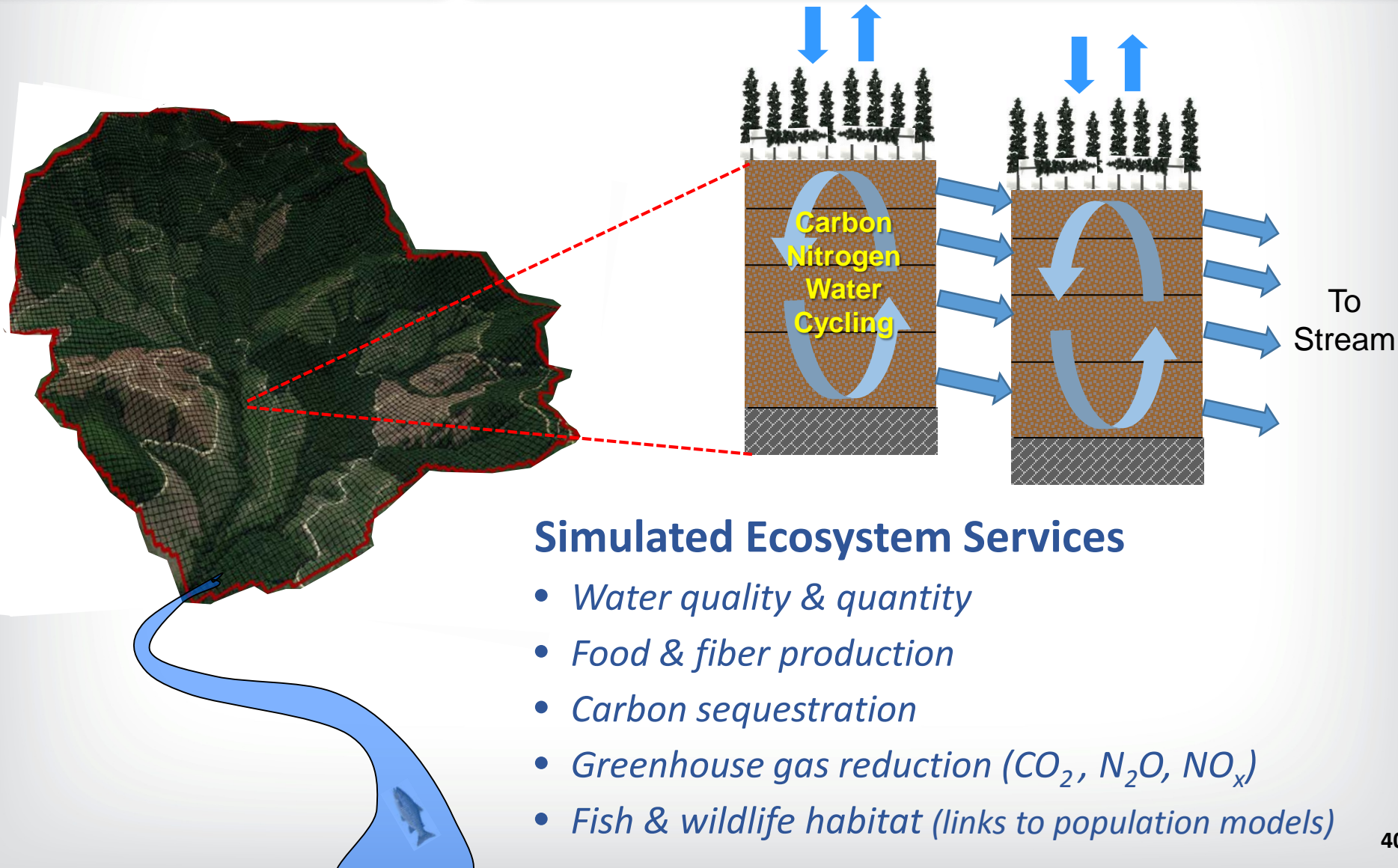
- **Hydrology:** streamflow, vertical & lateral flow, evapotranspiration, available soil moisture...
- **Plants & Soils:** uptake, transformation and transport of carbon, nutrients and toxics from terrestrial to aquatic systems





# Fate & Transport of Water & Nutrients

plots → watersheds, days → centuries



## Simulated Ecosystem Services

- *Water quality & quantity*
- *Food & fiber production*
- *Carbon sequestration*
- *Greenhouse gas reduction ( $CO_2$ ,  $N_2O$ ,  $NO_x$ )*
- *Fish & wildlife habitat (links to population models)*





## Broad Applicability



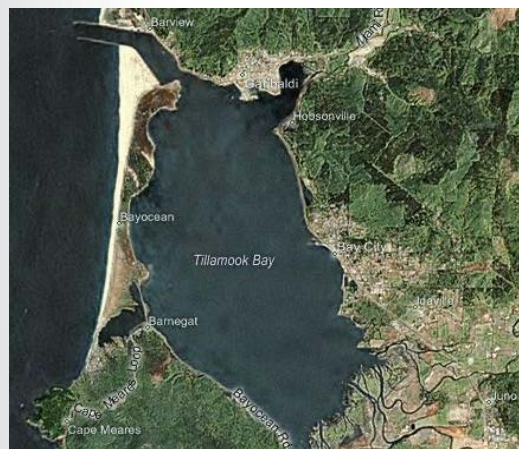
**Salmon Recovery Planning**  
Puget Sound, WA



**Urban GI Effectiveness**  
Seattle, Duluth, Mobile Bay



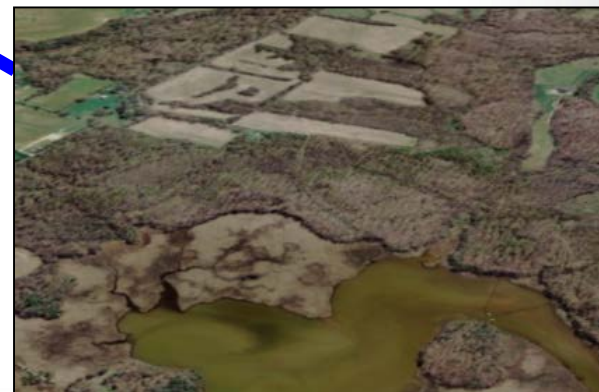
**Constructed Wetland Effectiveness**  
Agricultural Watershed, OH



**Estuarine Water Quality**  
Tillamook Bay Estuary, OR



**Smoke Management Planning**  
Central Plains Rangelands, KS



**Forest Buffer Effectiveness**  
Chesapeake Bay Agriculture, MD







## Broad Applicability



**Salmon Recovery Planning**  
Puget Sound, WA



**Urban GI Effectiveness**  
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Tillamook Bay Estuary, OR



**Smoke Management Planning**  
Central Plains Rangelands, KS



**Forest Buffer Effectiveness**  
Chesapeake Bay Agriculture, MD





# Chesapeake Ag Water Quality Effectiveness of Riparian Forest Buffers

**Product:** Validated VELMA model for informing green infrastructure planning for Chesapeake ag systems

**Goal:** Transfer VELMA to *Smithsonian Environmental Research Center* and *EPA Region 3*





# Chesapeake Ag Water Quality

## Effectiveness of Riparian Forest Buffers

**Product:** Validated VELMA model for informing green infrastructure planning for Chesapeake ag systems

**Goal:** Transfer VELMA to *Smithsonian Environmental Research Center and EPA Region 3*

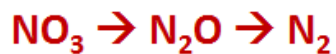
To what extent can riparian buffers and other GI reduce non-point sources of nitrogen to Chesapeake Bay?



Rhode River  
Watershed #109

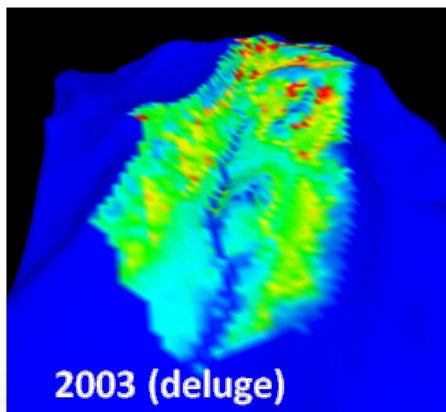
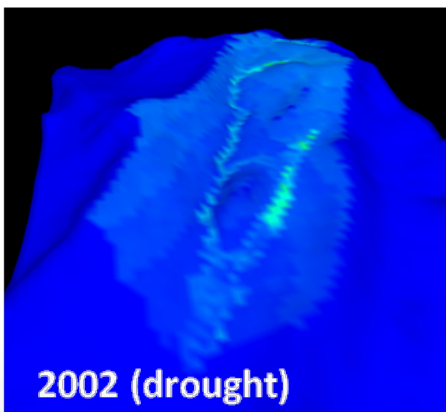
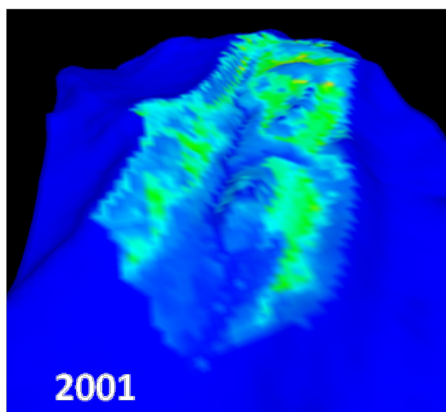
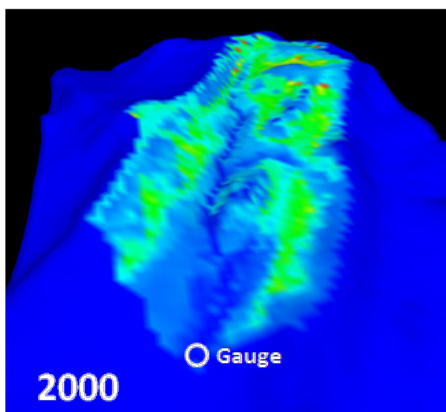
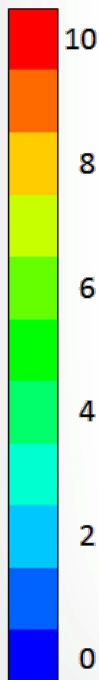
# Chesapeake Ag Water Quality

## Effectiveness of Riparian Forest Buffers



### Simulated Annual Denitrification

Denitrification  
 $\text{g N m}^{-2} \text{ yr}^{-1}$





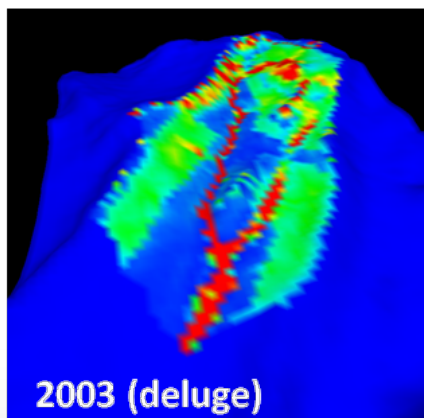
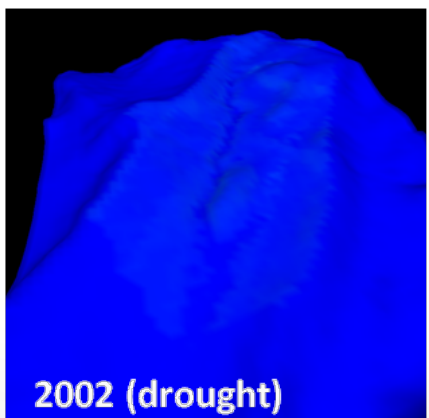
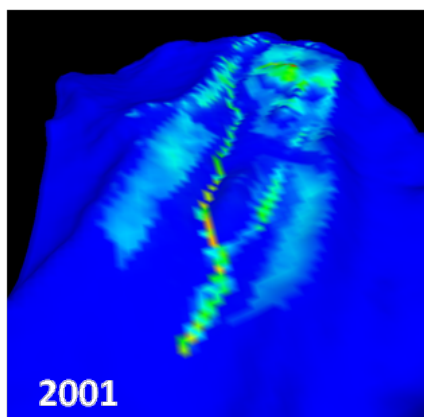
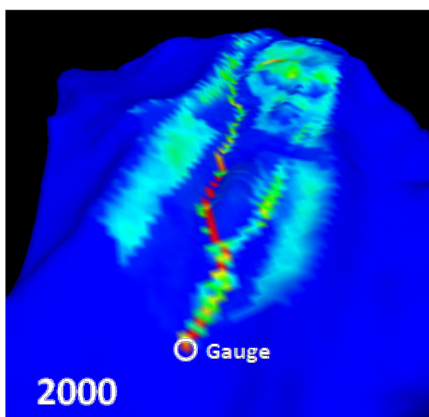
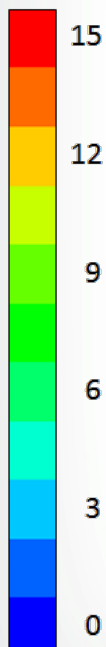


# Chesapeake Ag Water Quality

## Effectiveness of Riparian Forest Buffers

### Simulated Nitrate PPM in Groundwater Flow

Annual mean  
Nitrate-N PPM



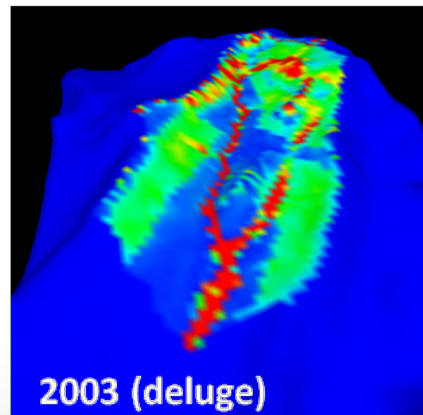
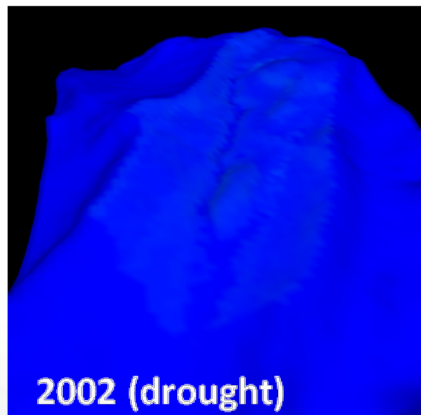
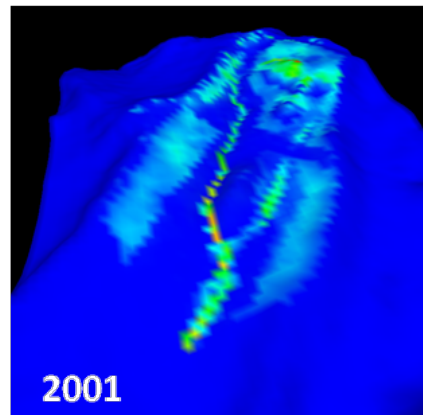
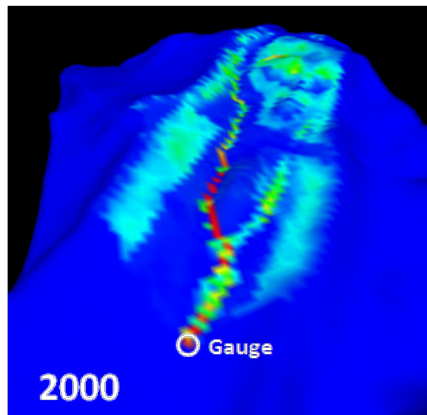
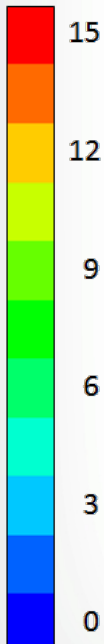


# Chesapeake Ag Water Quality

## Effectiveness of Riparian Forest Buffers

### Simulated Nitrate PPM in Groundwater Flow

Annual mean  
Nitrate-N PPM



## Summary

- Riparian forest buffers 20-30 meters wide can decrease ag nitrate stream loads by >90%
- 10m buffers = +50% load
- Buffers can be overwhelmed by extreme climatic events, such as a very dry year (2002) followed by a very wet year (2003)
- Model results are consistent with the observed sharp decrease in Chesapeake Bay water quality in 2003

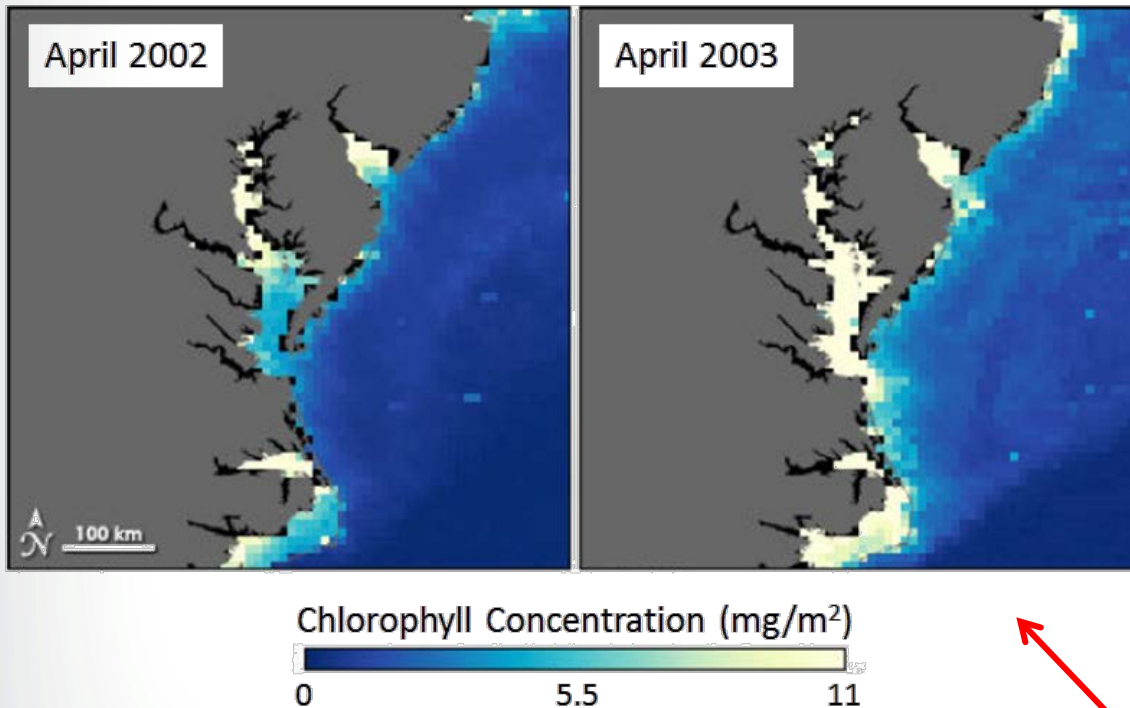


# Chesapeake Ag Water Quality

## Effectiveness of Riparian Forest Buffers

Source: James Acker

[earthobservatory.nasa.gov/Features/ChesapeakeBay/chesapeake\\_bay3.php](http://earthobservatory.nasa.gov/Features/ChesapeakeBay/chesapeake_bay3.php)



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- Buffers can be overwhelmed by extreme climatic events, such as a very dry year (2002) followed by a very wet year (2003)
- Model results are consistent with the observed sharp decrease in Chesapeake Bay water quality in 2003, **about 2x 2002 chlorophyll**



# Puget Sound, WA

## Salmon Recovery Planning



Puget Sound salmon populations have decreased by about 90% during the last 30 years. Tribes, communities and others have mobilized to develop salmon recovery plans. 49



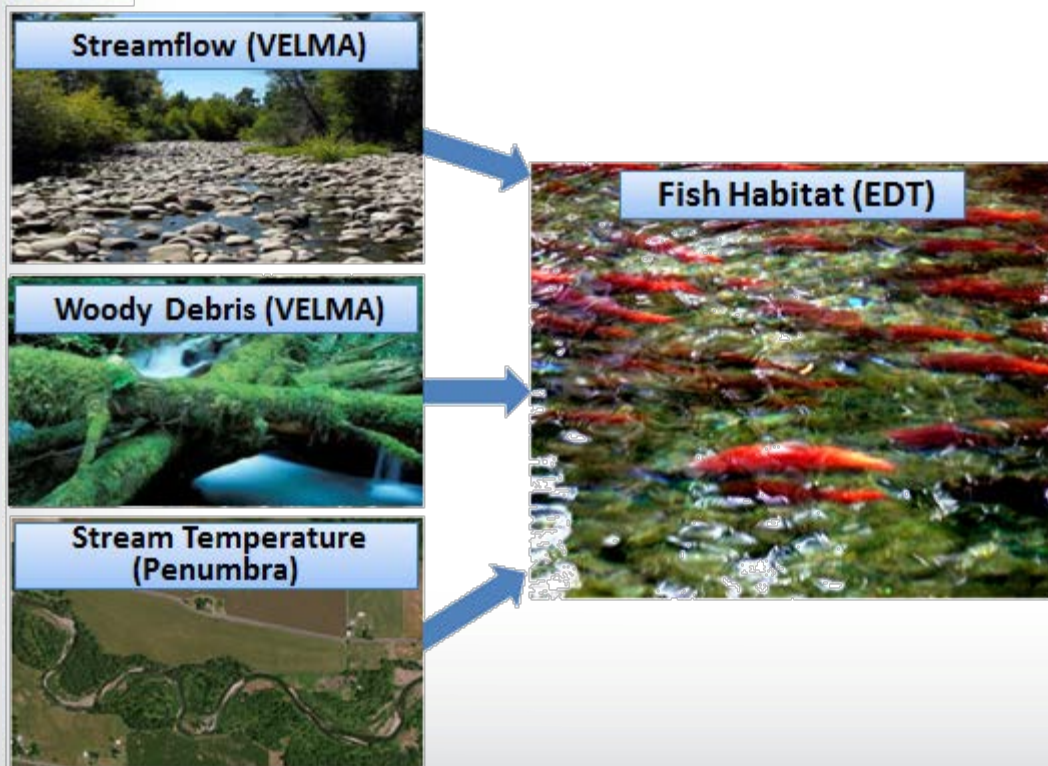


# Puget Sound, WA

## Salmon Recovery Planning

**Product:** Integrated modeling framework for informing community-based salmon recovery planning in Puget Sound

**Goal:** Transfer VELMA-Penumbra-EDT to *tribes, communities, state agencies and EPA Region 10*



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# Puget Sound, WA

## Salmon Recovery Planning

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**Goal:** Transfer VELMA-Penumbra-EDT to *tribes, communities, state agencies and EPA Region 10*



### Results:

- ✓ VELMA is now being used by Nisqually Community Forest managers for land acquisition & salmon recovery planning in 80 mi<sup>2</sup> Mashel River Watershed.
- ✓ VELMA predicts that increasing current forest harvest intervals from 40-50 yr to >80 yr would double streamflow during the summer dry season, a critical time for salmon migration & spawning.

VELMA-EDT Training Workshop for Nisqually Community Forest manager and collaborating EPA & ICF scientists

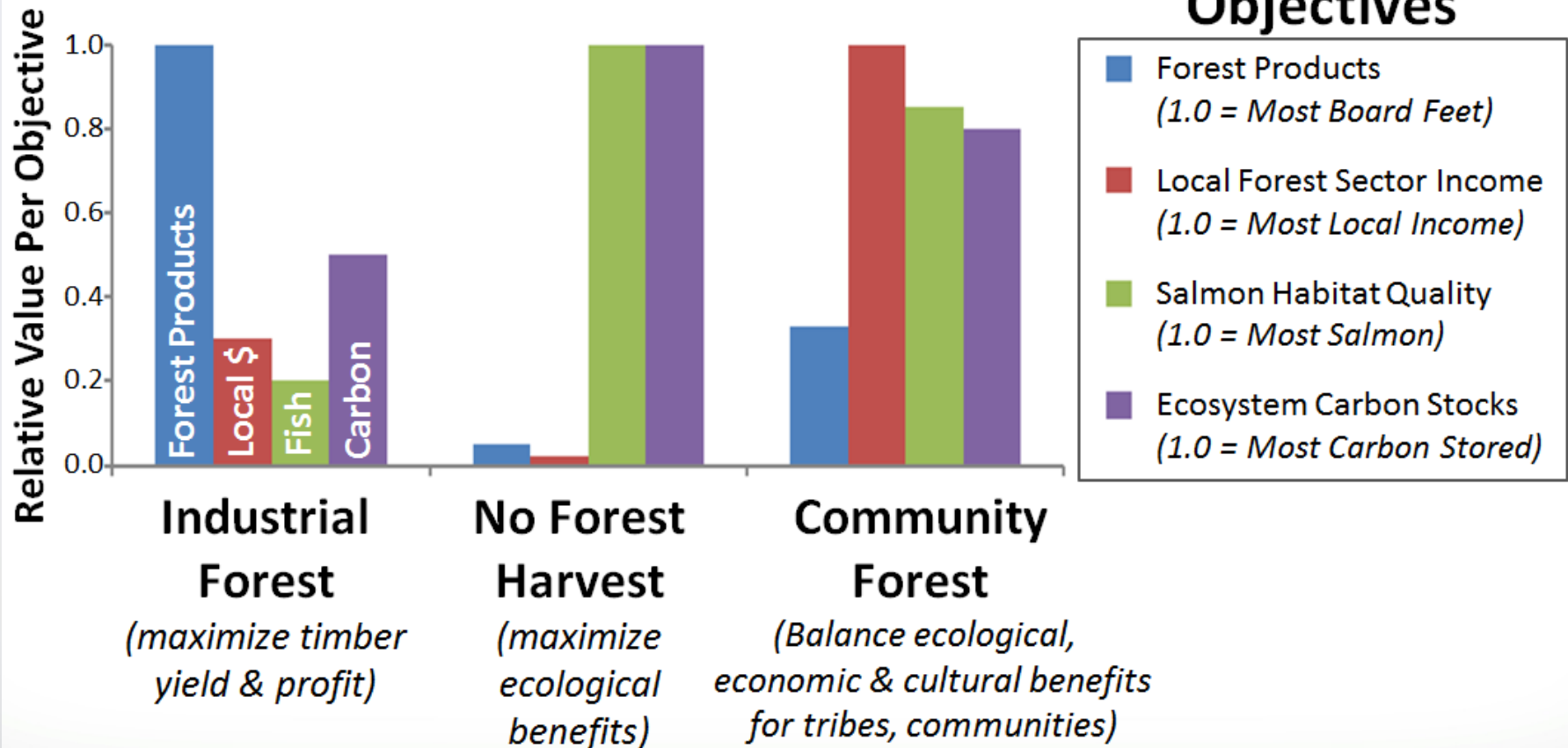




# Puget Sound, WA Salmon Recovery Planning

## Tradeoffs for Alternative Forest Management Scenarios

Hypothetical Example



Bob McKane ([mckane.bob@epa.gov](mailto:mckane.bob@epa.gov))

Allen Brookes, Kevin Djang, Brad Barnhart  
Jonathan Halama, Paul Pettus, Don Phillips  
Marc Stieglitz, Feifei Pan, Alex Abdelnour





**Storm Water Management Model (SWMM):** SWMM is a software application that is used widely throughout the world for large-scale planning, analysis, and design related to stormwater runoff, combined and sanitary sewers, and other drainage systems in urban areas – although there are many applications for drainage systems in non-urban areas as well. It allows users to represent combinations of green infrastructure practices to determine their effectiveness in managing runoff. SWMM was developed to help support local, state, and national stormwater management objectives to reduce runoff through infiltration and retention.



### Dr. Michael Tryby

Dr. Michael Tryby joined the Water Supply and Water Resources Division in EPA's National Risk Management Research Laboratory located in Cincinnati, Ohio in September 2011. He holds a B.S. in Civil Engineering and an M.S. in Environmental Engineering from the University of Cincinnati, where he worked on drinking water treatment for disinfection byproduct control and systems analysis of water distribution system disinfection practices. Michael received his Ph.D. in Civil Engineering from North Carolina State University while working in commercial software development as a water distribution modeling domain expert. His immediate responsibilities include work on modeling green infrastructure and low impact development best management practices using EPA's SWMM 5.0.

**Contact:** [tryby.michael@epa.gov](mailto:tryby.michael@epa.gov)

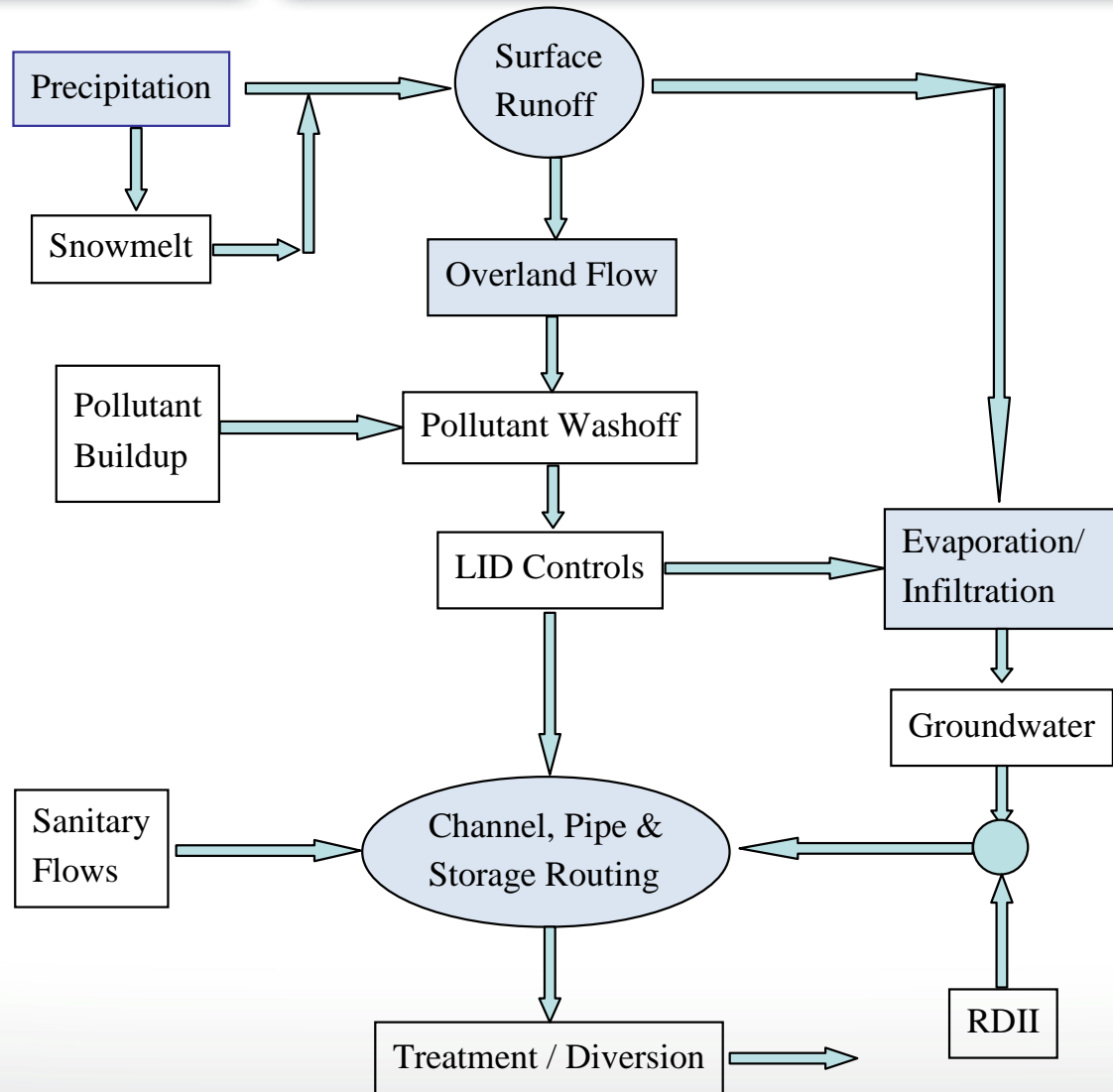


# SWMM: What is it?



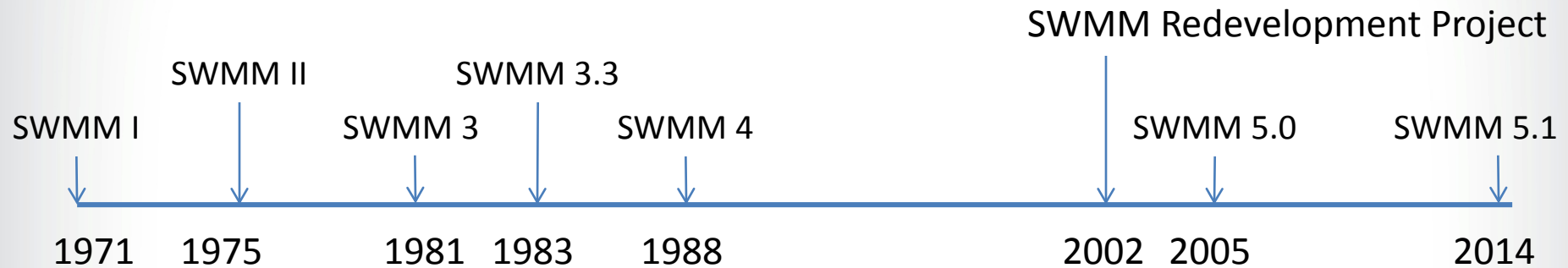
SWMM is a public domain, distributed, dynamic hydrologic - hydraulic - water quality model used for continuous simulation of runoff quantity and quality from primarily urban areas.

# SWMM's Process Models





# SWMM's History



U.S. ENVIRONMENTAL PROTECTION AGENCY

## Risk Management Water Research

Contact Us      Search:

You are here: [EPA Home](#) > [Research](#) > [Risk Management Research](#) > [Water Research](#) > [Storm Water Management Model \(SWMM\)](#)

### Storm Water Management Model (SWMM)

**Version 5.0.022 with Low Impact Development (LID) Controls**

- [Description](#)
- [Capabilities](#)
- [Applications](#)
- [Support](#)
- [Downloads](#)
- [Links](#)
- [Contact](#)

**Description**

EPA's Storm Water Management Model (SWMM) was first developed in 1971, and has since undergone several major upgrades. It continues to be widely used throughout the world for planning, analysis and design related to stormwater runoff, combined sewers, sanitary sewers, and other drainage systems in urban areas, with many applications in non-urban areas as well.

This general purpose urban hydrology and conveyance system hydraulics software is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of subcatchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage, detention, conveyance, and outfall.

- SWMM is a professional tool used by Civil / Environmental Engineers
- SWMM is used at the municipal level to design and manage stormwater and sanitary sewer infrastructure
- Many large cities across the US and around the world rely on SWMM



Design and sizing of drainage system components including detention facilities.

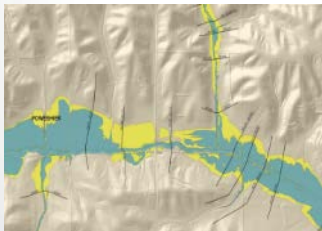


Control of combined and sanitary sewer overflows.

Modeling I&I in sanitary sewer systems.



Generating non-point source pollutant loadings for waste load allocation studies.



Evaluating BMPs and LIDs for sustainability goals.

Flood plain mapping of natural channel systems.



# Source Control BMPs



Disconnection



Infiltration Basin



Rain Garden



Cistern



Infiltration Trench



Green Roof



Permeable Pavement



Vegetative Swale

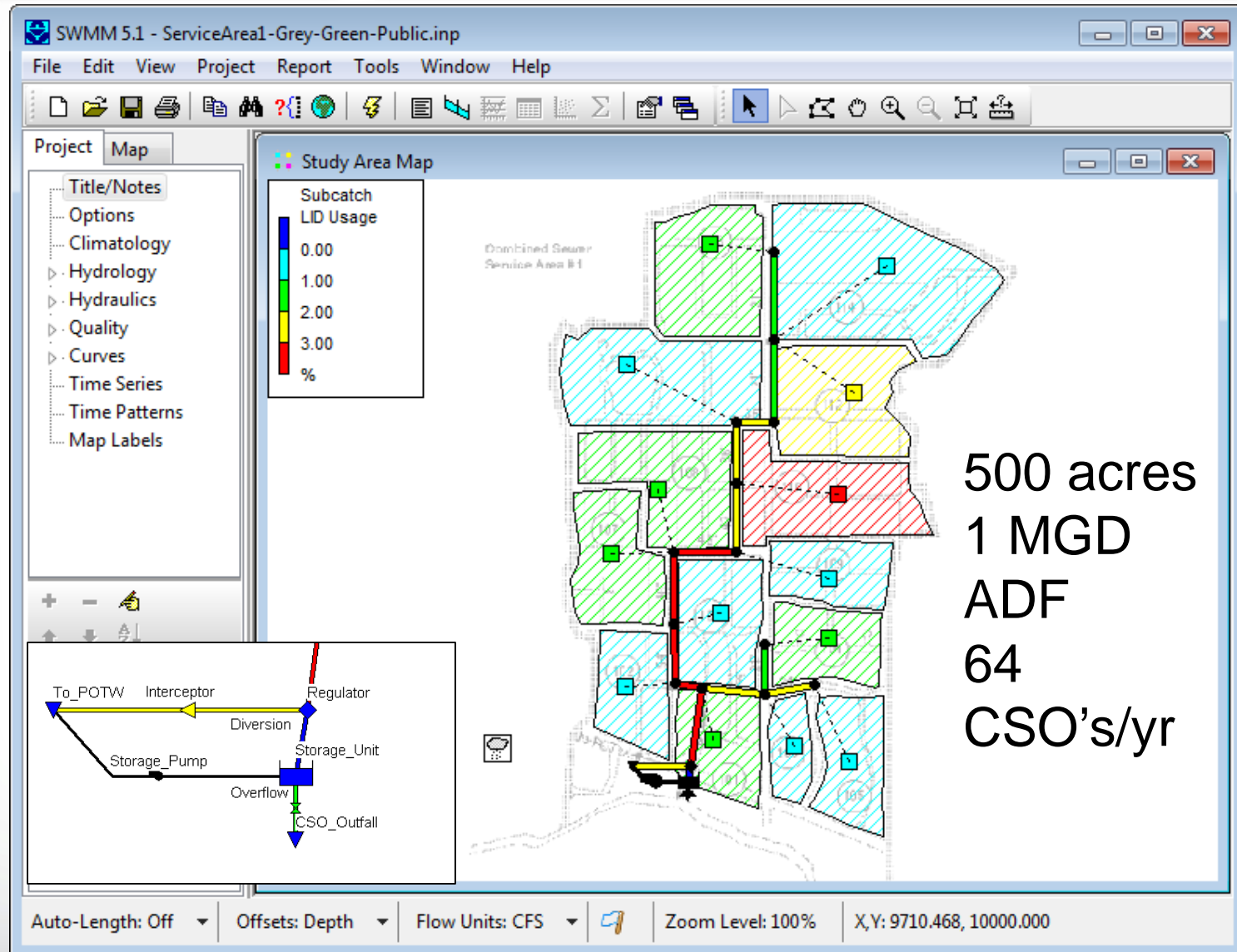


Street Planter

# SWMM CSO Example

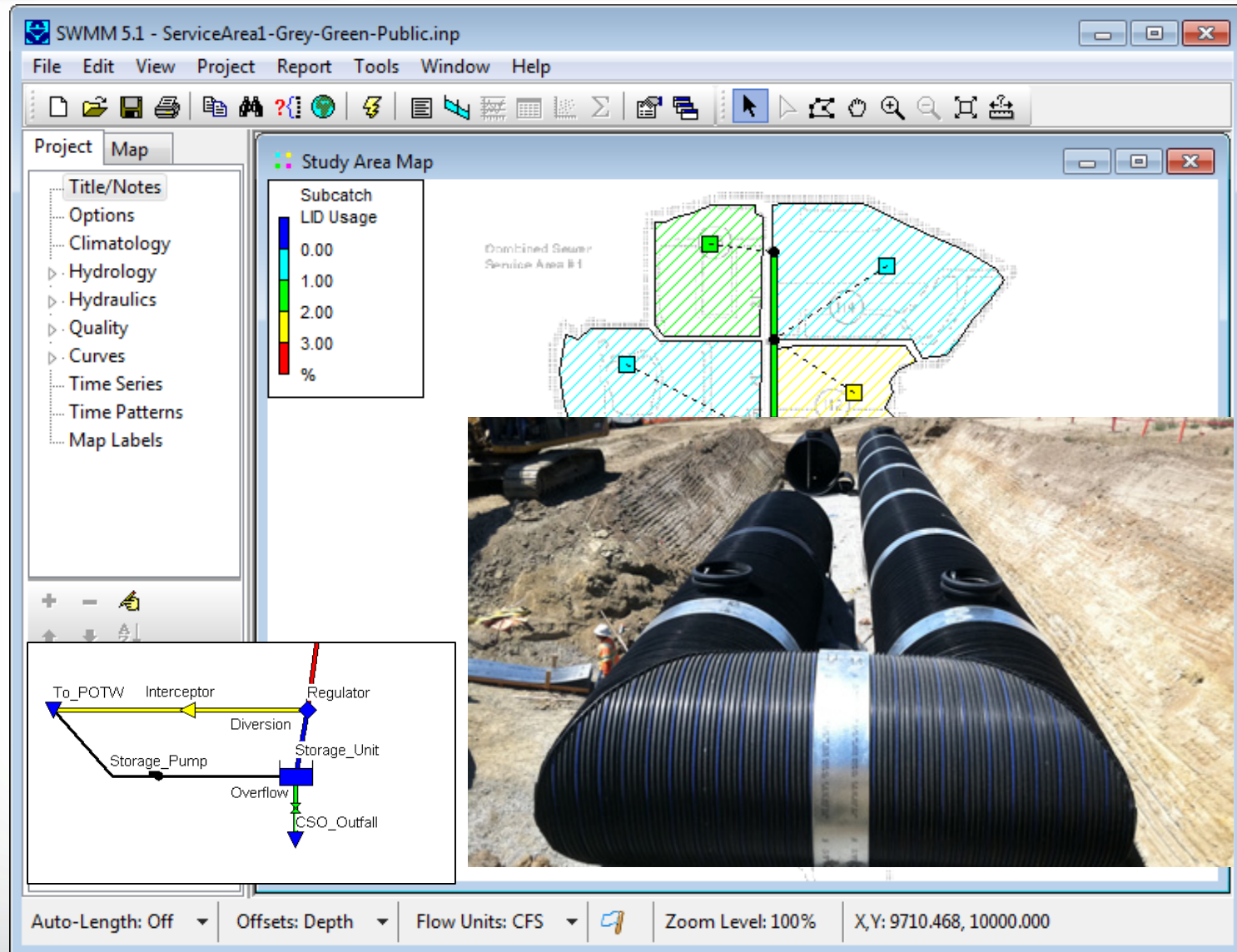


# CSO Example





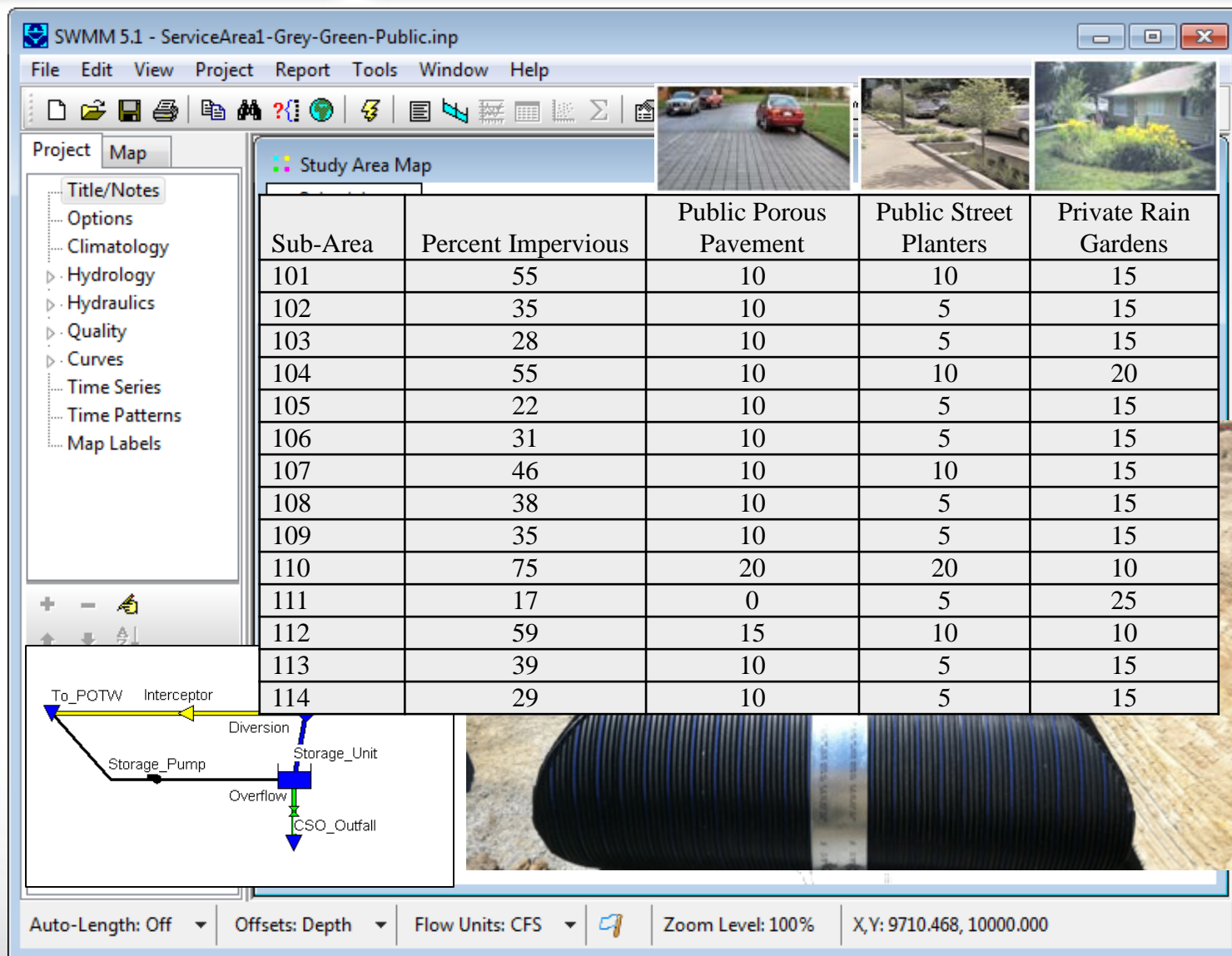
# CSO Example





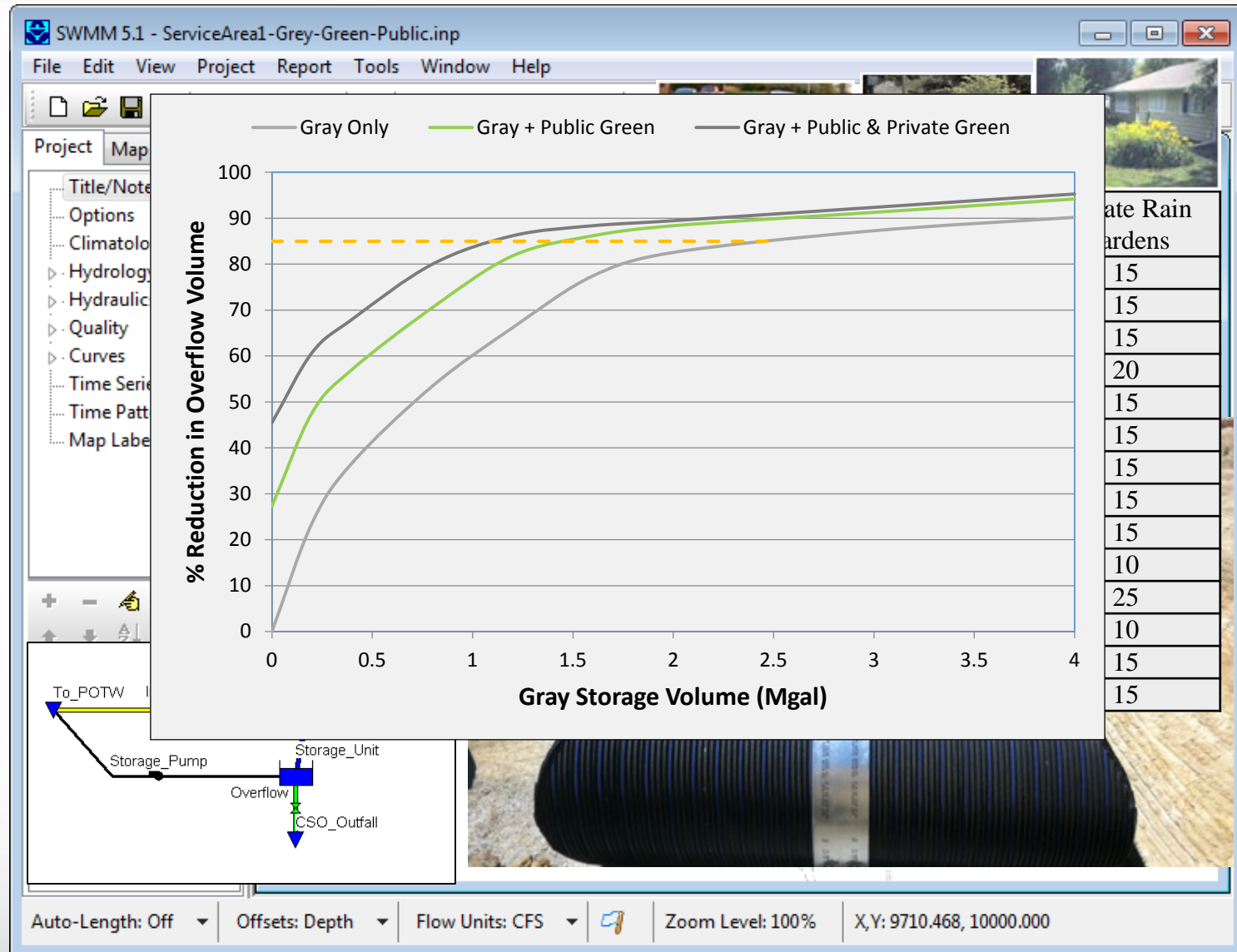


# CSO Example





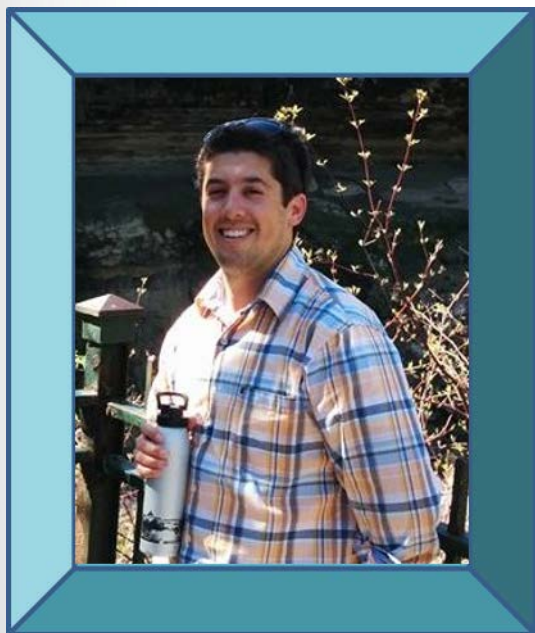
# CSO Example



- SWMM is widely used to evaluate gray infrastructure stormwater control strategies
- SWMM now offers a useful complement of LID stormwater controls
- SWMM is a useful tool for creating cost effective green / gray hybrid stormwater control solutions



**National Stormwater Calculator (SWC):** SWC is a desktop application that estimates the annual amount of stormwater runoff from a specific location in the United States (including Puerto Rico), based on local soil conditions, land cover, and historic rainfall records. It is used to inform site developers on how well they can meet a desired stormwater retention target with and without the use of green infrastructure. It also allows users to consider how runoff may vary based both on historical weather and potential future climate. SWC was mentioned in President Obama's Climate Action Plan and is now a resource for LEED Project Credit 16 (Rainwater Management) certification by the U.S. Green Building Council for projects that are designed to reduce runoff volume and improve water quality of a site.



### Jason Berner

Jason Berner is trained as a landscape architect and has been with EPA for over nine years. He has worked in EPA's Region 2 and Office of Water, and is currently working as a biologist in ORD. His research focuses on the application of green infrastructure planning tools, urban planning and design, community capacity building with municipalities and utilities, and supporting innovative water technologies. Jason has a Master of Landscape Architecture and a B.S. in Environmental Sciences from the University of Illinois at Urbana-Champaign.

**Contact:** [berner.jason@epa.gov](mailto:berner.jason@epa.gov)



## U.S. EPA National Stormwater Calculator

- What, Why, and Who?
- Stormwater Calculator & Stormwater Management Model (SWMM)
  - Green Infrastructure/Low Impact Development (LID) practices
- Using the Calculator
- **Potential Applications:** Post Construction Stormwater Standards, LEED, Sustainable Sites, Stormwater Concept Designs, LID Design Competitions
- **Example Applications:**
  - **Redevelopment Plan for Spartanburg, SC: Green Street Design**  
(EPA Green Infrastructure 2013 Technical Assistance Project)
  - **U.S. Climate Resilience Toolkit**
- Development of Cost Estimation Module and Mobile Web App



# What Have We Created and Why?

## Stormwater Management (Green Infrastructure/Low Impact Development) Design and Planning Tool

- **Model pre- and post-construction stormwater runoff discharges**
- **Allow for screening-level analysis of various green infrastructure practices (green roofs, rain gardens, cisterns, etc.) throughout the U.S.**
- **Allow non-modelers to conduct screening level stormwater runoff analyses for small to medium sized ( less than 1 acre to 1 dozen of acres) urban development sites**



## Who We Created the Calculator for...

- **Urban & municipal planners**
- **Land developers**
- **Landscape architects**
- **Homeowners, etc.**

**...to meet stormwater design goals or requirements.**

- ✓ **What kind of user are you?**
- ✓ **How do you perform conceptual planning or design for stormwater management?**



# Website

A screenshot of the EPA website's "Water Research" section, specifically the "National Stormwater Calculator" page. The page has a blue header with the EPA logo and navigation links. The main content area is white with a blue sidebar on the left. The title "National Stormwater Calculator" is prominently displayed. Below the title, there is a paragraph describing the calculator, followed by a list of users it is designed for, and then a list of seven green infrastructure practices it recommends.

**EPA** United States Environmental Protection Agency

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## National Stormwater Calculator

EPA's National Stormwater Calculator (SWC) is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). Estimates are based on local soil conditions, land cover, and historic rainfall records.

It is designed to be used by anyone interested in reducing runoff from a property, including


- site developers,
- landscape architects,
- urban planners, and
- homeowners.

The Calculator accesses several national databases that provide soil, topography, rainfall, and evaporation information for the chosen site. The user supplies information about the site's land cover and selects the types of low impact development (LID) controls they would like to use. The LID controls that the user can choose are the following seven green infrastructure practices:

1. Disconnection
2. Rain harvesting
3. Rain gardens
4. Green roofs
5. Street planters
6. Infiltration basins
7. Porous pavement

<http://www2.epa.gov/water-research/national-stormwater-calculator>




United States Environmental Protection Agency

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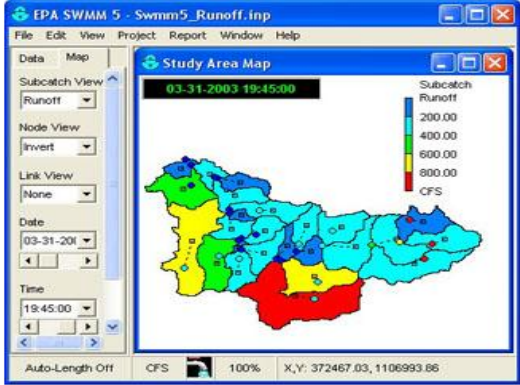
## Storm Water Management Model (SWMM)

Version 5.1.006 with Low Impact Development (LID) Controls

- [Description](#)
- [Capabilities](#)
- [Applications](#)
- [Support](#)
- [Downloads](#)
- [Helpful Resources](#)
- [Contact](#)

### Description

EPA's Storm Water Management Model (SWMM) is used throughout the world for planning, analysis and design related to stormwater runoff, combined and sanitary



- Calculator is based on SWMM: dynamic rainfall-runoff simulation model for long-term simulation of runoff quantity
- SWMM runs in background of Stormwater Calculator



# Desktop Application

**Welcome to the EPA National Stormwater Calculator**

This calculator estimates the amount of stormwater runoff generated from a land parcel under different development and control scenarios over a long-term period of historical rainfall.

The analysis takes into account local soil conditions, topography, land cover and meteorology. Different types of low impact development (LID) practices can be employed to help capture and retain rainfall on-site. Localized climate change scenarios can also be analyzed.

Site information is provided to the calculator using the tabbed pages listed above. The Results page is where the site's runoff is computed and displayed.

This program was produced by the U.S. Environmental Protection Agency and was subject to both internal and external technical review. Please check with local authorities about whether and how it can be used to support local stormwater management goals and requirements.

Release 1.1.0.0

**National Stormwater Calculator**

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | LID Controls | Results

Map of North America showing the United States, Canada, and Mexico. The map includes labels for the Pacific Ocean, Atlantic Ocean, Caribbean Sea, and Sargasso Sea. A red square indicates the selected location in the United States. The map is powered by Bing and includes a scale bar (500 miles, 1000 km) and copyright information (© 2014 Microsoft Corporation, © 2014 Nokia).

Select the Location tab to begin analyzing a new site.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)



# Stormwater Runoff Analysis

**National Stormwater Calculator**

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | LID Controls | Results

Site Name (Optional)  
Typical Singe Family Home

Search for an address or zip code:  
mount rainer, md

Site Location (Latitude, Longitude)  
38.94282161053263, -76.9632926223497

Site Area (acres - Optional)  
0.2

[Open a previously saved site](#)

Bring your site into view on the map and then mark its exact location by clicking the mouse pointer over it.

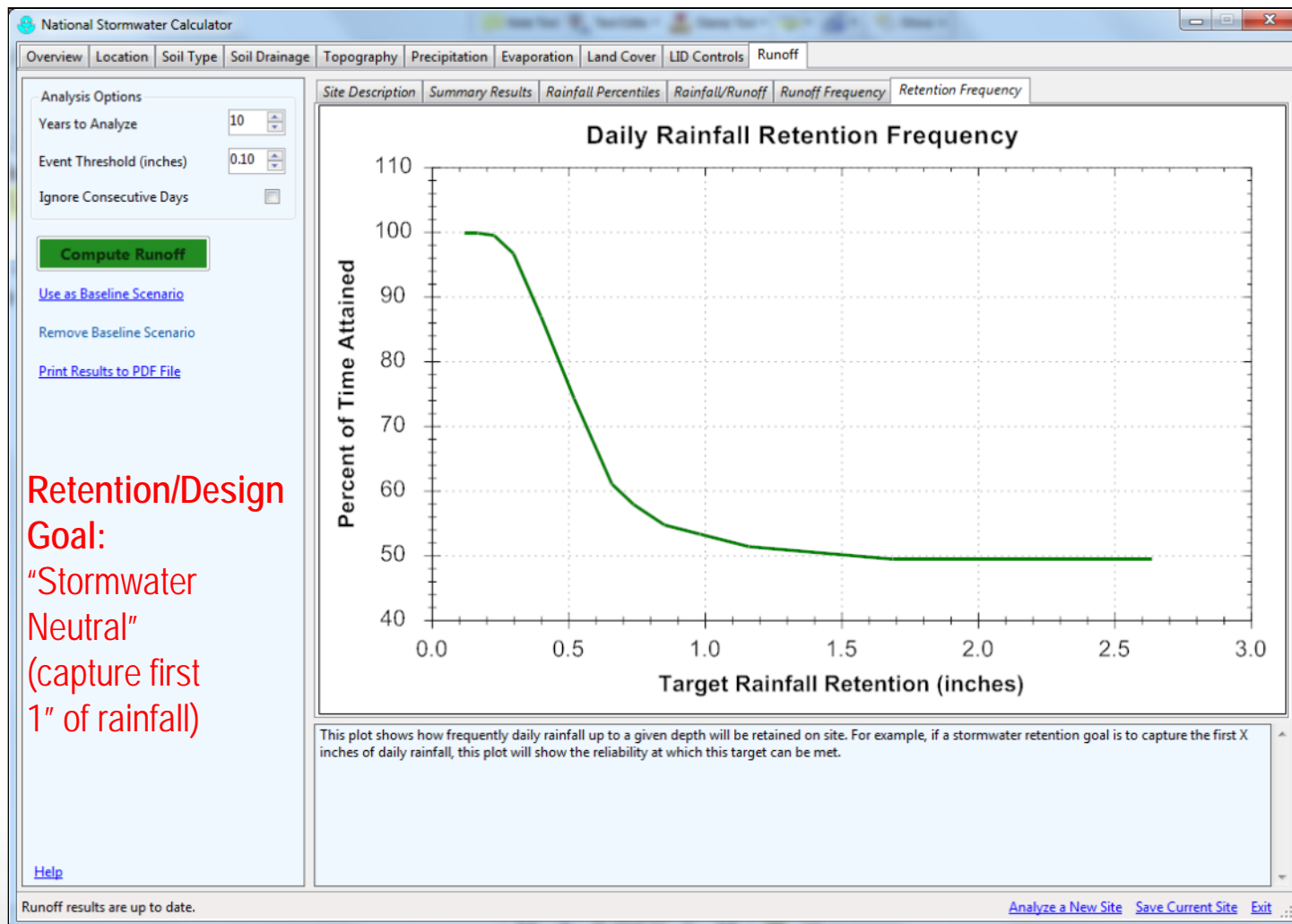
**Map View:** Bird's eye view. The map shows a residential area with a red square marking a house, which is circled in red. A large white number '32' is overlaid on the map. The map includes a scale bar (25 feet / 10 m) and copyright information: © 2016 Microsoft Corporation, Pictometry Bird's Eye © 2016 Pictometry International Corp.

Locate the site on the map.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)



# Meeting Stormwater Runoff Design Goals



Retention/Design Goal:  
"Stormwater Neutral"  
(capture first 1" of rainfall)





# Sizing LID Controls

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | **LID Controls** | Results

What % of your site's impervious area will be treated by the following LID practices?

<a href="#">Disconnection</a>	45
<a href="#">Rain Harvesting</a>	10
<a href="#">Rain Gardens</a>	25
<a href="#">Green Roofs</a>	0
<a href="#">Street Planters</a>	0
<a href="#">Infiltration Basins</a>	0
<a href="#">Permeable Pavement</a>	0

Design Storm for Sizing (inches) (see Help) 0.00

Click a practice to customize its design.


**Design Changes:**

- \*Downspout disconnection
- \*Rain barrels
- \*Rain gardens

[Help](#)

**LID Design**


**Rain Garden**



Rain Gardens are shallow depressions filled with an engineered soil mix that supports vegetative growth. They are usually used on individual home lots to capture roof runoff.

Typical soil depths range from 6 to 18 inches.

The Capture Ratio is the ratio of the rain garden's area to the impervious area that drains onto it.



[Learn more ...](#)

Ponding Height (inches) 6

Soil Media Thickness (inches) 12

Soil Media Conductivity (in/hr) 10.00

% Capture Ratio 5

Size for Design Storm | Restore Defaults | Accept | Cancel

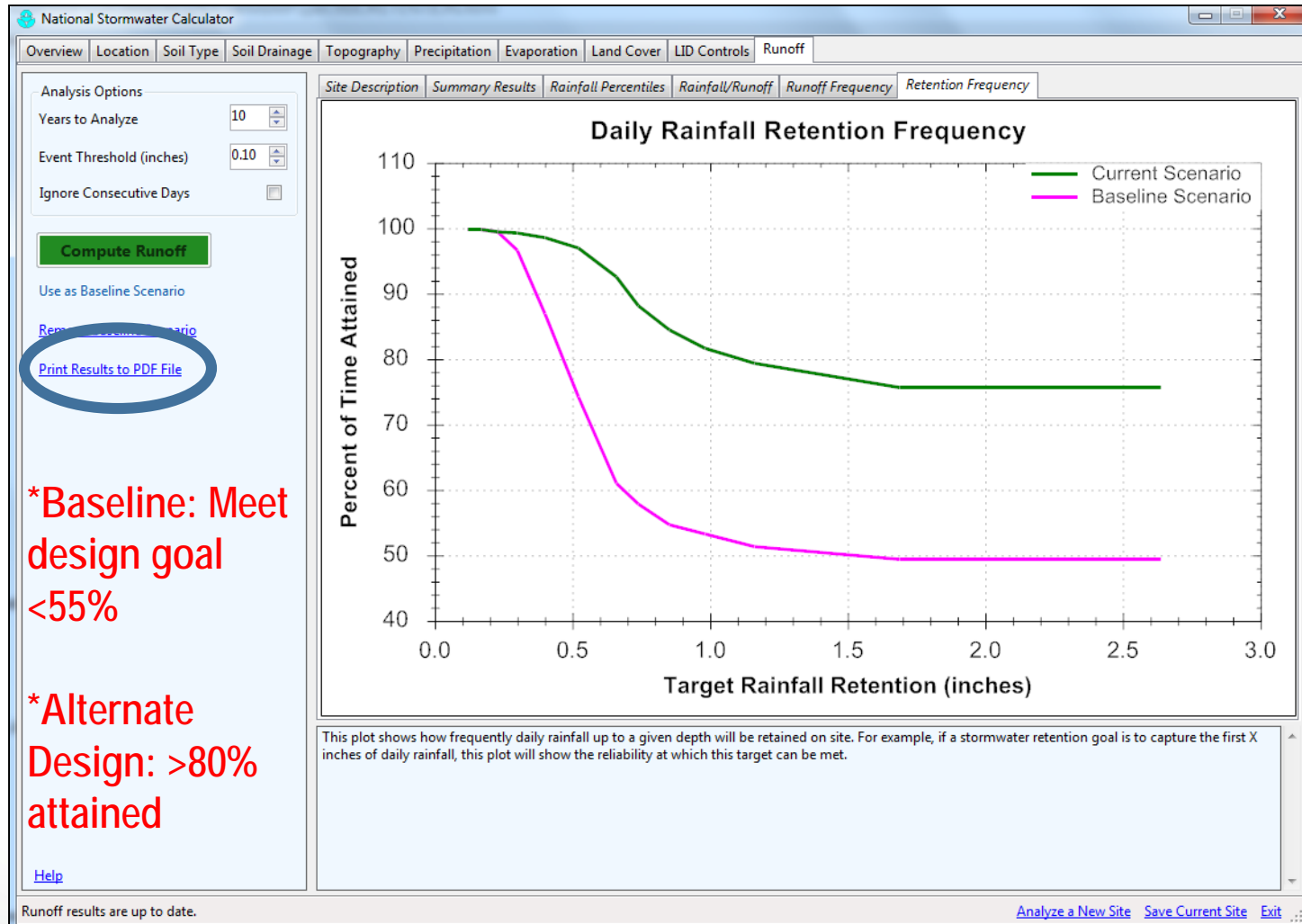
© 2016 Microsoft Corporation | Picometry Bird's Eye © 2016 Picometry International Corp

Assign LID practices to capture runoff from impervious areas.

[Analyze a New Site](#) | [Save Current Site](#) | [Exit](#)



# Comparing Design Scenarios: Meeting Runoff Reduction Goals





## Potential Applications

- State or MS4 (Municipal Separate Storm Sewer System) Post Construction Stormwater Design Standards
- Voluntary Stormwater Retrofits for private property owners
- Voluntary Programs: LEED (US Green Building Council) and Sustainable Sites Initiative stormwater credits, Rockefeller Foundation's 100 Resilient Cities
- Climate Resiliency Planning
- LID/Green Infrastructure Design Competitions: Campus RainWorks Challenge, DC Water Green Infrastructure Challenge, etc.



# Applications and Outreach



PUBLIC RELEASE: 22-APR-2016

## UTA student team wins EPA Campus RainWorks Challenge for plan to reduce stormwater runoff

*Sustainable environment*

UNIVERSITY OF TEXAS AT ARLINGTON



PRINT E-MAIL

A University of Texas at Arlington student team's design to reduce stormwater runoff that could result from future campus construction projects has won a national Environmental Protection Agency's Office of Water award as part of the agency's 2015 Campus RainWorks Challenge.

The College of Architecture, Planning and Public Affairs team included landscape architecture graduate students Baishaki Biswas, Sherry Fabricant, Jacob Schwarz and Ahoura Zandiatashbar, a doctoral student in urban planning and public policy. Their winning entry in the Master Plan category was called "Eco-Flow: A Water-Sensitive Placemaking Response to Climate Change" and centered on water runoff rates at sites of potential UTA student living, dining, recreation and parking facilities.

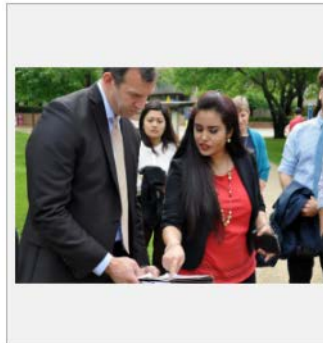
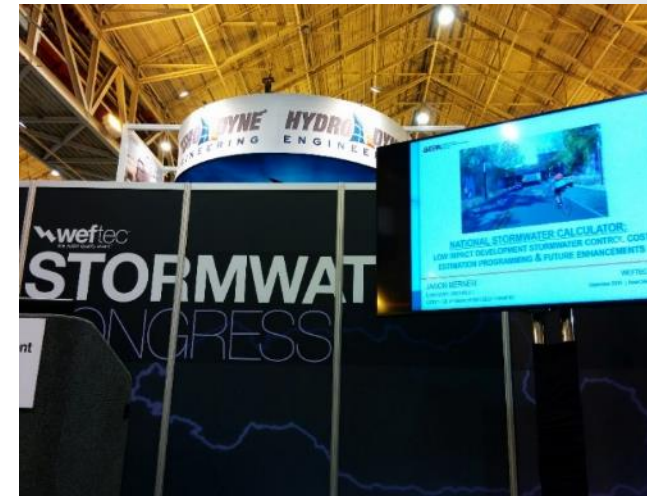


IMAGE: BAISHAKHI BISWAS, A UTA COLLEGE OF ARCHITECTURE, PLANNING AND PUBLIC AFFAIRS STUDENT, SHOWS STORMWATER-REDUCTION PLANS TO JOEL BEAUVAIS, EPA'S DEPUTY ASSISTANT ADMINISTRATOR IN THE OFFICE OF WATER. [view more >](#)


CREDIT: UT ARLINGTON



AAAS (American Association for the Advancement of Science): [http://www.eurekalert.org/pub\\_releases/2016-04/uota-ust042216.php](http://www.eurekalert.org/pub_releases/2016-04/uota-ust042216.php)

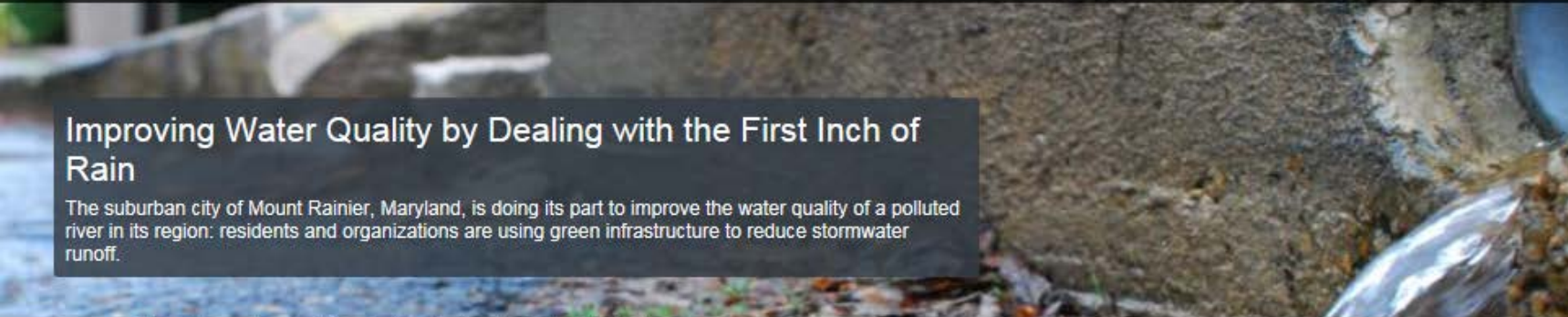


# Climate Resiliency Planning Application



U.S. Climate  
Resilience  
Toolkit

[Steps to Resilience](#)
[Case Studies](#)
[Tools](#)
[Topics](#)
[Expertise](#)




## Improving Water Quality by Dealing with the First Inch of Rain

The suburban city of Mount Rainier, Maryland, is doing its part to improve the water quality of a polluted river in its region: residents and organizations are using green infrastructure to reduce stormwater runoff.

[Taking Action](#) > [Improving Water Quality by Dealing with the First Inch of Rain](#) >

Just outside the northeastern boundary of Washington, D.C., the suburban city of Mount Rainier, Maryland, features affordably priced homes, pedestrian-friendly sidewalks, and a handful of historic buildings. The city—named after the better-known mountain in the Pacific Northwest—expanded in the early 1900s after a streetcar line began offering service in and out of the capital. Since the 1970s, officials in Mount Rainier have made substantial efforts to improve air and water quality for the town's residents, and to become a sustainable "green" community.

Mount Rainier lies within the watershed of the Anacostia River, which flows into the Potomac River. In turn, the Potomac River flows into the ecologically productive Chesapeake Bay. Unfortunately, the Anacostia—sometimes referred to as Washington's "forgotten river"—is severely polluted with toxic sediments, agricultural nutrients, and trash. As climate



### Steps to Resilience:

- ✓ Step 1: Explore Climate Threats
- ✓ Step 2: Assess Vulnerability & Risks
- ✓ Step 3: Investigate Options
- ✓ Step 4: Prioritize Actions
- ▶ Step 5: Take Action

### Tools:

[National Stormwater Calculator—Climate Assessment Tool](#) >

### Topic:

[Built Environment](#) > [Water and](#)



# Conceptual Design of Green Streets: Spartanburg, SC

## EPA Green Infrastructure Technical Assistance



<https://www.epa.gov/green-infrastructure/northside-neighborhood-green-infrastructure-master-plan-spartanburg-sc>



## Spartanburg, SC Green Street Design

### Stormwater runoff results from EPA Stormwater Calculator

Scenario	Runoff	Infiltration	Evapo-transpiration
Baseline	84%	5%	11%
Scenario 1 (Street Planters)	18%	67%	15%
Scenario 2 (Pervious Pavement)	17%	75%	8%



# Development of Cost Estimation Module

- Intended Uses:
  - Planning level capital and operations & maintenance cost estimates (magnitude of costs between planning scenarios)
  - Regionalized and national cost estimates







# LID Controls: Cost Estimation Enhancements

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | LID Controls | Results

What % of your site's impervious area will be treated by the following LID practices?

<a href="#">Disconnection</a>	0
<a href="#">Rain Harvesting</a>	0
<a href="#">Rain Gardens</a>	0
<a href="#">Green Roofs</a>	0
<a href="#">Street Planters</a>	0
<a href="#">Infiltration Basins</a>	12
<a href="#">Permeable Pavement</a>	0

Design Storm for Sizing (inches) (see Help) 0.00

Click a practice to customize its design.

Verify cost-estimation variables below

☐ Project is [Re-Development](#)

☒ Project is [New Development](#)

☐ Site Suitability - [Poor](#)

☒ Site Suitability - [Moderate](#)

☐ Site Suitability - [Excellent](#)

[Cost Region](#) Boston (100 miles) 1.04

Regional Multiplier 1.04

[Help](#)

Assign LID practices to capture runoff from impervious areas.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

**LID Design**

**New Development**

New development is construction that occurs on a greenfield (undeveloped) site or does not fit into the definition of redevelopment or retrofit.

New development allows site planners to more efficiently place infrastructure to balance costs of grading, protection of existing topography, and other natural features which can often reduce or avoid these costs and the costs more typical of redevelopment including removal, decommissioning and alteration of existing structures.

**Pre-development**

**Post development**

Selecting "New Development" on the "LID Controls" tab of the National Stormwater Calculator influences the site complexity, and shifts the costs towards a lower complexity cost estimation.

New development combined with information on site suitability, topography, and soil drainage determines whether complex, typical, or simple cost curves apply. See User Guide for more information.



# Capital and Maintenance Cost Estimates

Options

Years to Analyze

20

Event Threshold (inches)

0.10

Ignore Consecutive Days

Actions

[Refresh Results](#)

[Use as Baseline Scenario](#)

[Remove Baseline Scenario](#)

[Print Results to PDF File](#)

Reports

☐ Site Description

☐ Summary Results

☐ Rainfall / Runoff Frequency

☐ Rainfall Retention Frequency

☐ Runoff By Rainfall Percentile

☐ Extreme Event Rainfall / Runoff

☒ Cost Summary

[Help](#)

Overview

Location

Soil Type

Soil Drainage

Topography

Precipitation

Evaporation

Climate Change

Land Cover

LID Controls

Results

Estimate of Probable Capital Costs (estimates in 2015 US.\$)

[Maintenance Costs](#) | [Graphical View](#)

Cost By LID Control Type	Drainage Area %	Has Pre-trt?	Current Scenario (C) Area Treated 11.00 ac		Baseline Scenario (B) Area Treated 11.00 ac		Difference (C - B) Area Treated 0.00 ac	
	Current / Baseline	Current / Baseline	Low	High	Low	High	Low	High
Disconnection	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Rainwater Harvesting	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Rain Gardens	60 / NA	No / No	\$4,289	\$15,386	\$0	\$0	\$4,289	\$15,386
Green Roofs	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Street Planters	NA / NA	No / No	\$0	\$0	\$0	\$0	\$0	\$0
Infiltration Basins	12 / 12	No / No	\$4,325	\$5,340	\$4,325	\$5,340	\$0	\$0
Permeable Pavement	25 / NA	No / No	\$285,567	\$428,932	\$0	\$0	\$285,567	\$428,932

Note: site complexity variables that affect cost shown below:

Current Scenario	Baseline Scenario
Dev. Type New Development	New Development
Site Suitability Moderate	Moderate
Topography Steep (> 15% Slope)	Steep (> 15% Slope)
Soil Type A	A
Cost Region Boston (100 miles) 1.04	Boston (100 miles) 1.04

[Help](#)

Runoff results are up to date.

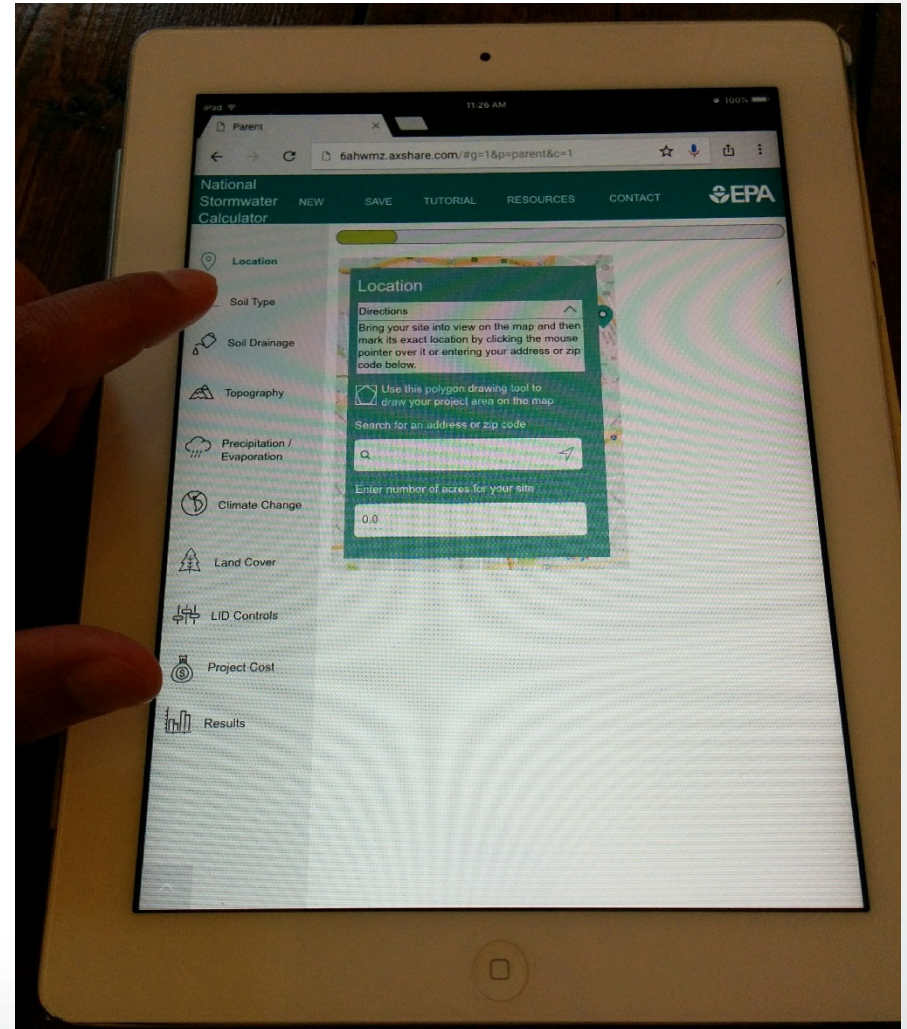
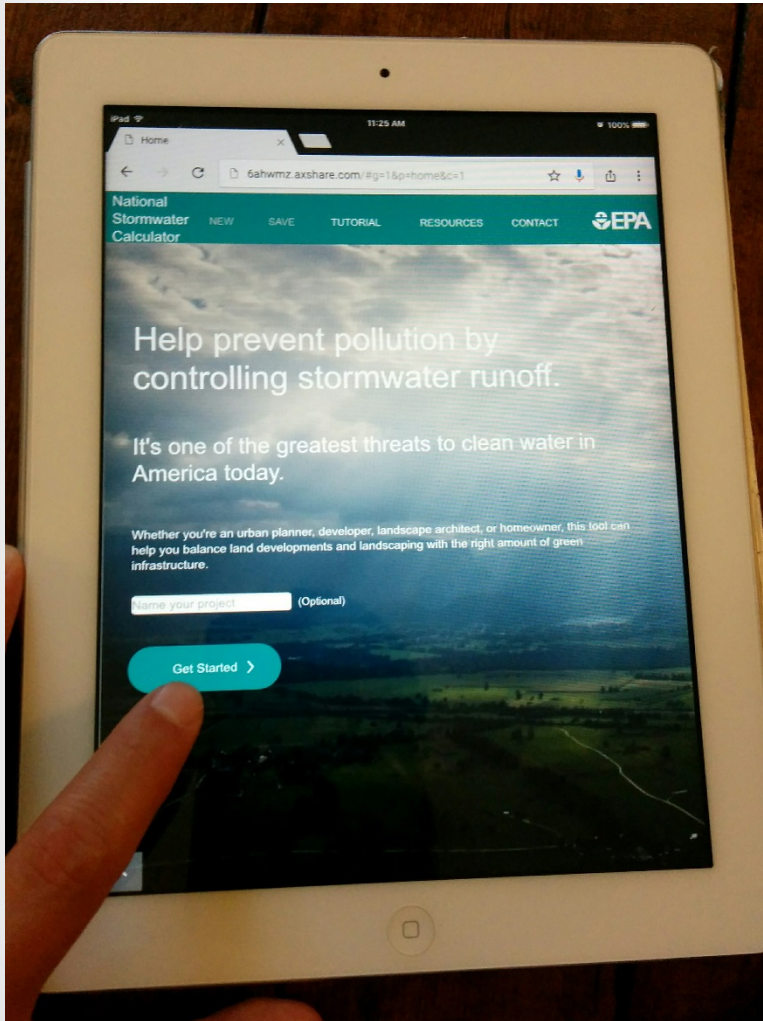
[Analyze a New Site](#)

[Save Current Site](#)

[Exit](#)



# Mobile Web App Development







## Contact Information

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National Stormwater Calculator Website:  
[epa.gov/water-research/national-stormwater-calculator](http://epa.gov/water-research/national-stormwater-calculator)





Office of Research and Development

## SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



## Questions and Answers Session