



Wetlands, Great Bay NH

# Green Infrastructure, Low Impact Development, and Flood Resilience:

## Every Little Bit Helps

**Trish Garrigan**

**EPA New England**

**Interagency Flood Risk Management  
Workshop**

**Southbridge, MA Dec. 2-4, 2015**



Biofilter, USM Portland, ME



# Outline

- **Green Infrastructure** – range of practices, cost effective, provide multiple benefits, becoming widely accepted and integrated, incentives
- **Low Impact Development** – managing stormwater in new ways
- **Flood Resilience** - one part of a larger movement toward resilience
- **EPA** – we are multifaceted, our role, tools and resources

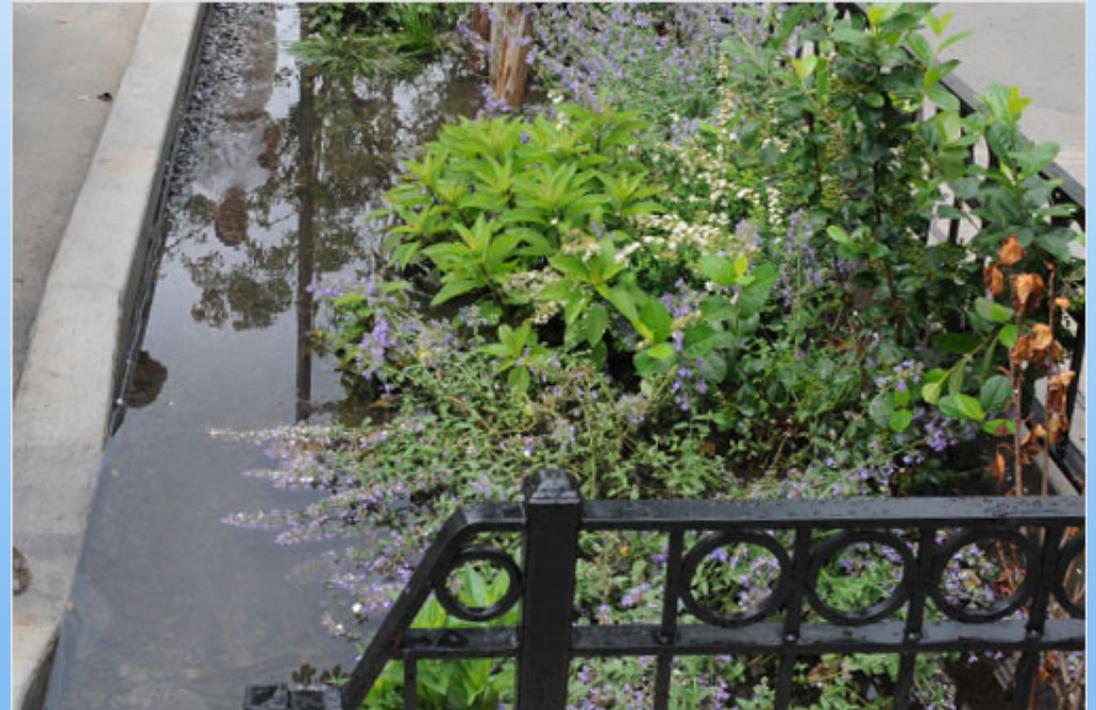


# EPA Programs that can overlap flood risk management

- Water Security Division (W/WW plant flood risk management)
- Area Contingency Planning (Oil Pollution Control Act, Spill Response)
- National Disaster Recovery Framework member
- Watershed planning/Non-point source protection/303d listings
- Sustainable Communities/Climate Readiness
- Wetlands programs/Healthy Watersheds/Stormwater Management/GI
- Regulatory programs - Brownfields, CERCLA, NPDES stormwater, etc
- Funding to states via SRF, 319 grants, and other grants
- Partnership for Sustainable Communities (EPA/HUD/DOT/NOAA)
- EPA/FEMA MOU (Abby Hall/Cathy Allen)

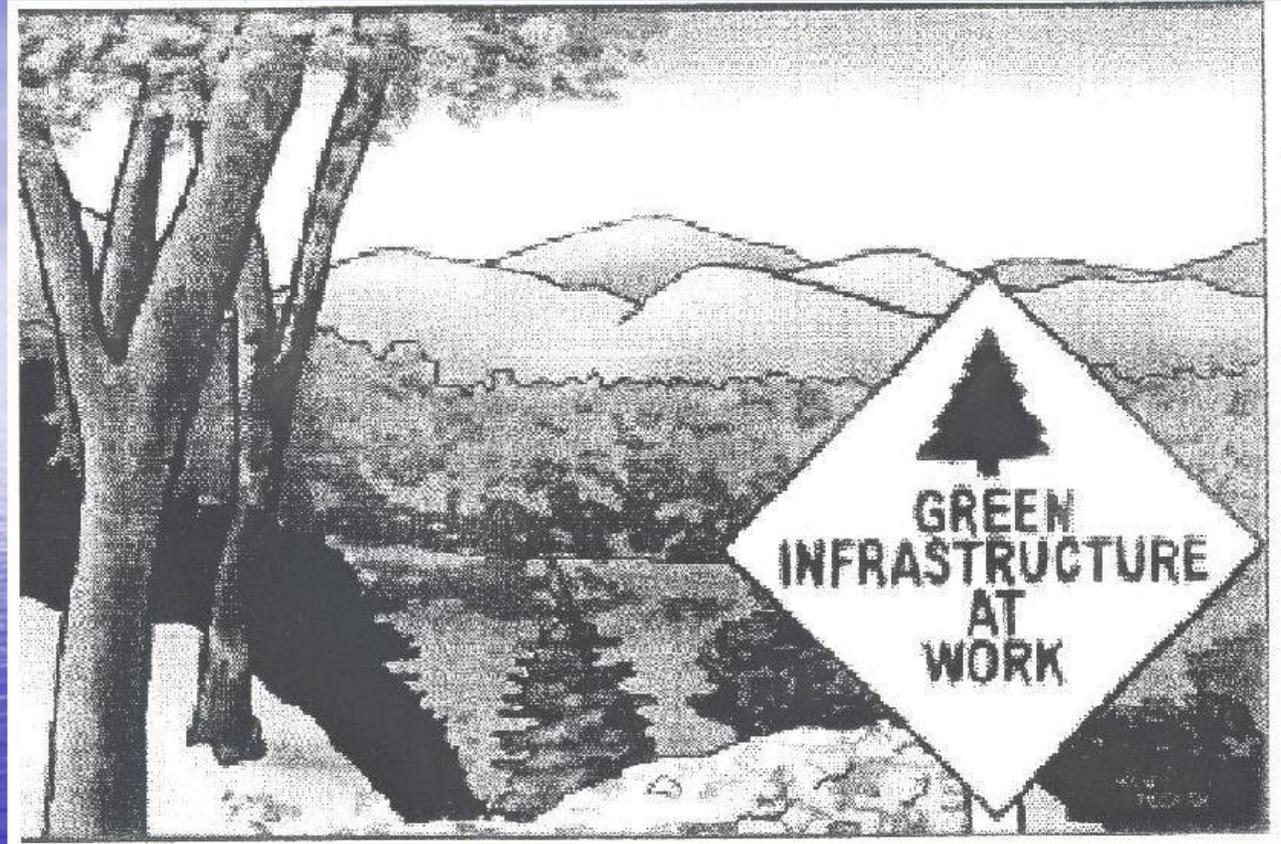
# Flood Risk Management and Water Resource Protection Go Together

- Protecting areas that absorb floodwaters
- Restoring floodplains, also creating habitat
- Encouraging new development in less flood-prone areas
- Achieving less runoff from developments (LID/buffers)
- Watershed planning for multiple objectives
- Mitigating impacts of future development and weather patterns



“The idea that nature is also infrastructure isn’t new, but it’s now more widely understood to be true”

“At all scales, green infrastructure provides real ecological, economic, and social benefits.”



From: The Conservation Fund, *Common Ground*, Vol. 14, No. 1, January-March 2003.  
Editorial – Words Matter.

- Nancy Somerville, Executive Vice President and CEO  
of American Society of Landscape Architects

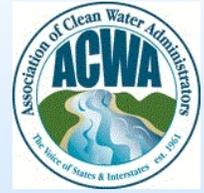


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## Federal Agency Support for the Green Infrastructure Collaborative

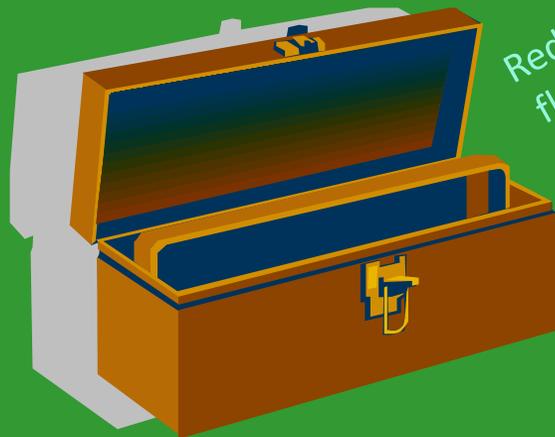
- Federal letter of support introduced July 16, 2014
- Seven federal agencies identified activities that they will undertake to lead by example and promote local green infrastructure use.
- On October 8th, 2014 EPA joined with the federal agencies as well as NGO and private sector entities to form the GI Collaborative and released a Statement of Support outlining commitments from each member to advance coordination around GI initiatives.
- EPA is committing to convening state level engagement that brings key agencies to the table around GI and Hazard mitigation plans (Silver Jackets?)
- DOD has committed to provide training and awareness on GI tools and implementation on bases

**Green Infrastructure  
Statement of Support  
Oct. 8, 2014**



# GREEN INFRASTRUCTURE SOLUTIONS

An increasing number of communities are integrating green infrastructure practices in the design of the project that retain the stormwater volume through infiltration, evapotranspiration and rainwater harvesting



Reducing flooding

## Some of the Many Benefits In the Green Infrastructure Toolbox

Improving livability

Reducing small stream erosion

Enhancing water supplies

Reducing human health impacts

Reducing urban heat island effect

Enhancing resiliency

Reducing energy demands

Reducing combined sewer overflows

Improving air quality



Rain Barrels



Rain Gardens



Gravel wetland



Permeable Pavement



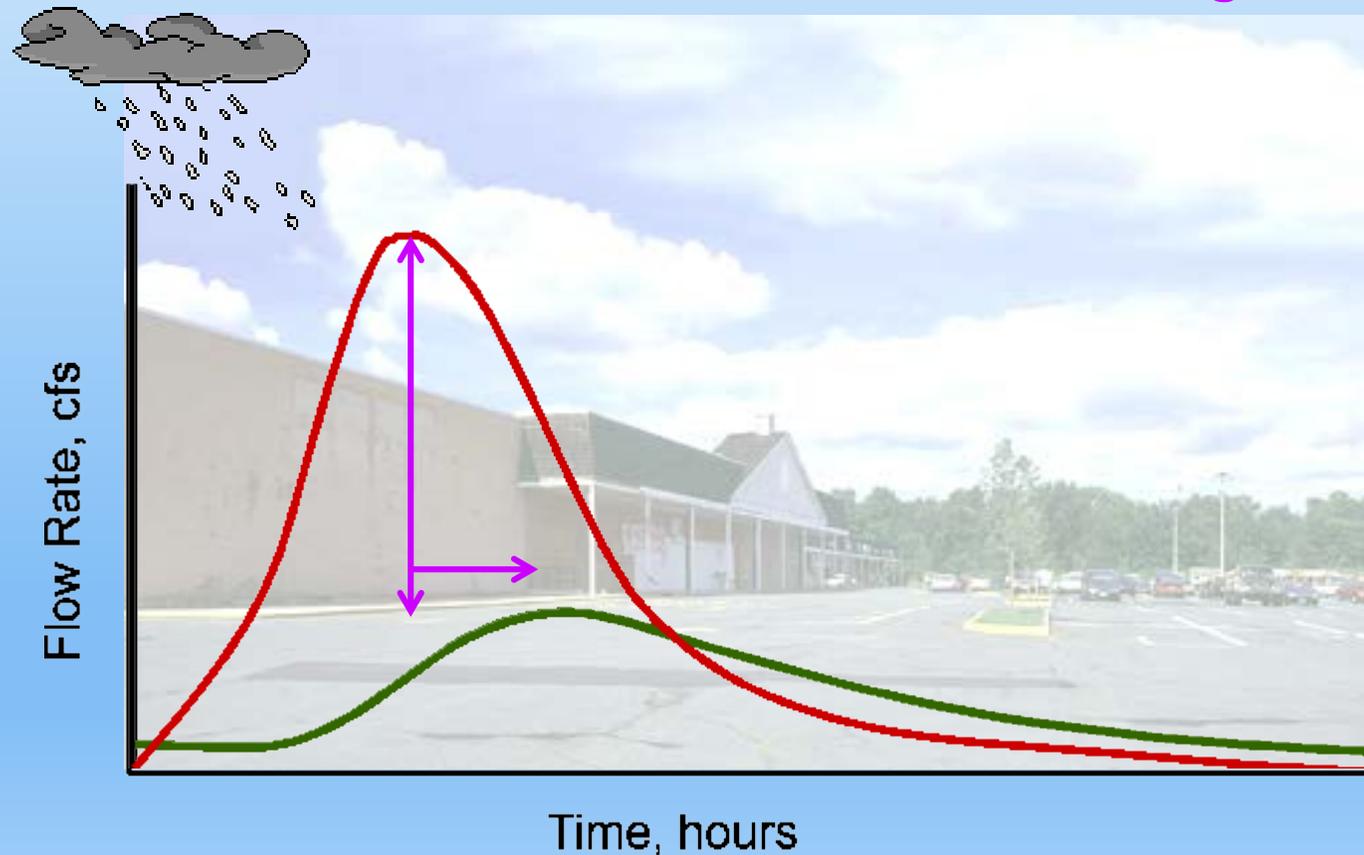
Biofiltration

Tree filter

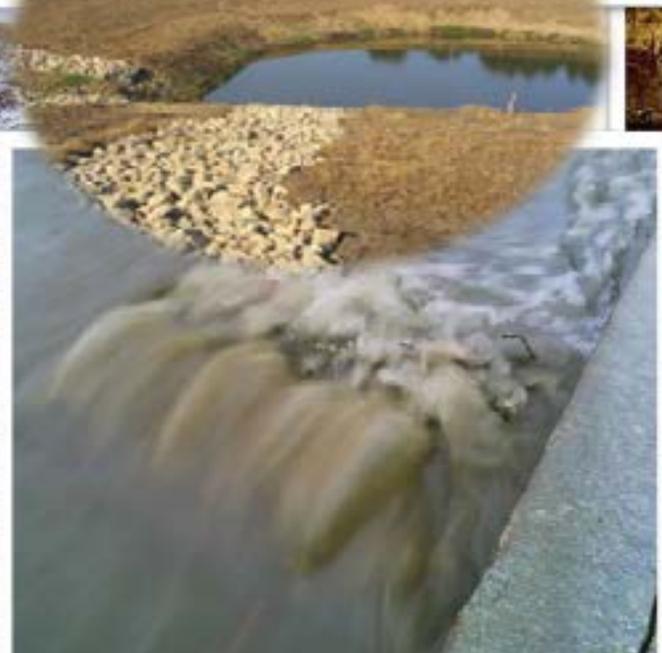


# Hydrologic Impacts of Development

- more water
- arriving more quickly



# Conventional Stormwater Management



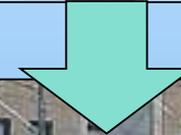
# Low Impact Development





# Green Streets

- Alleys typically have low volumes of traffic at lower speeds; they can be the “low hanging fruit” in greening streets.
- Water infiltrates through permeable pavement or infiltration basins, alleviating flooding and reducing alley runoff.



- Rain gardens can be added to pedestrian bulb-outs on busier commercial streets.
- Stormwater is allowed to infiltrate but the added benefit is reduced crossing distances for pedestrians.





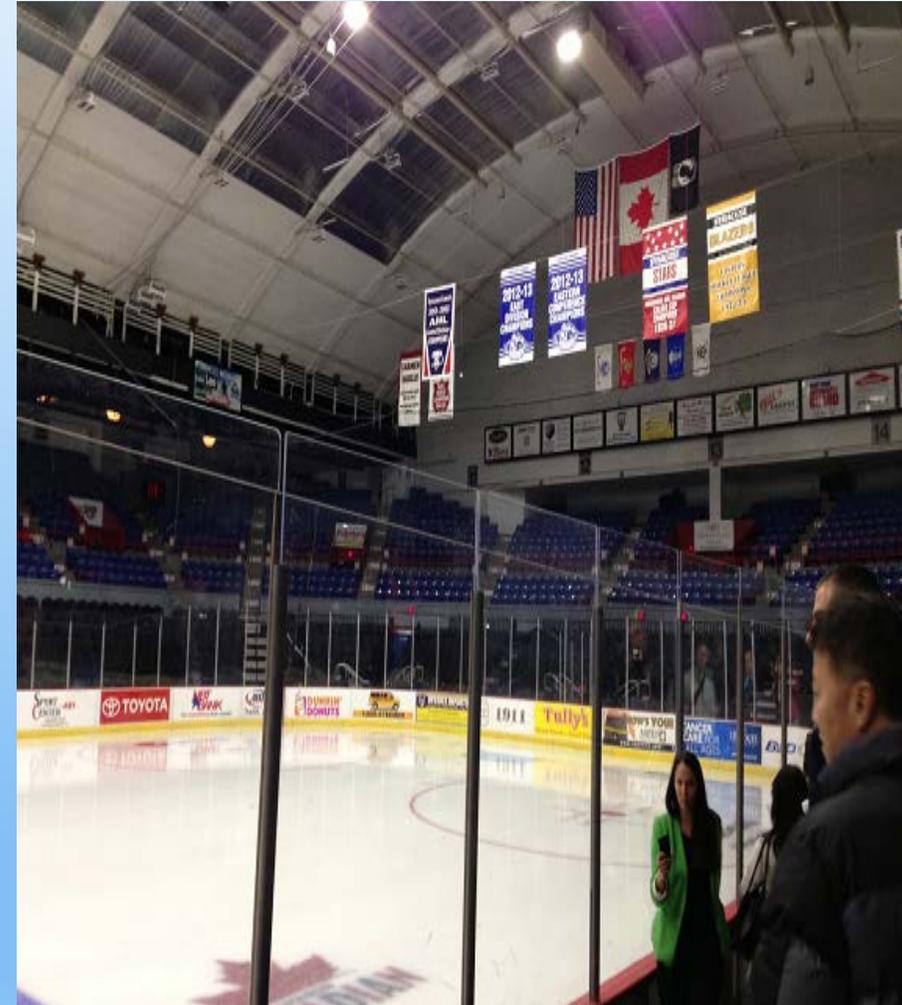
Never, ever,  
think outside the box



# GREEN INFRASTRUCTURE EXAMPLES: STORMWATER AS A RESOURCE

## Syracuse, NY

- Has developed a Save the Rain program and have over 100 green infrastructure practices in their community
- Syracuse Crunch fans get to watch their hockey games take place on re-used rain water
- The War Memorial project is the first system in the country designed to use recycled stormwater (15,000 gallon cistern system) for a hockey rink and is one of only a handful around the world

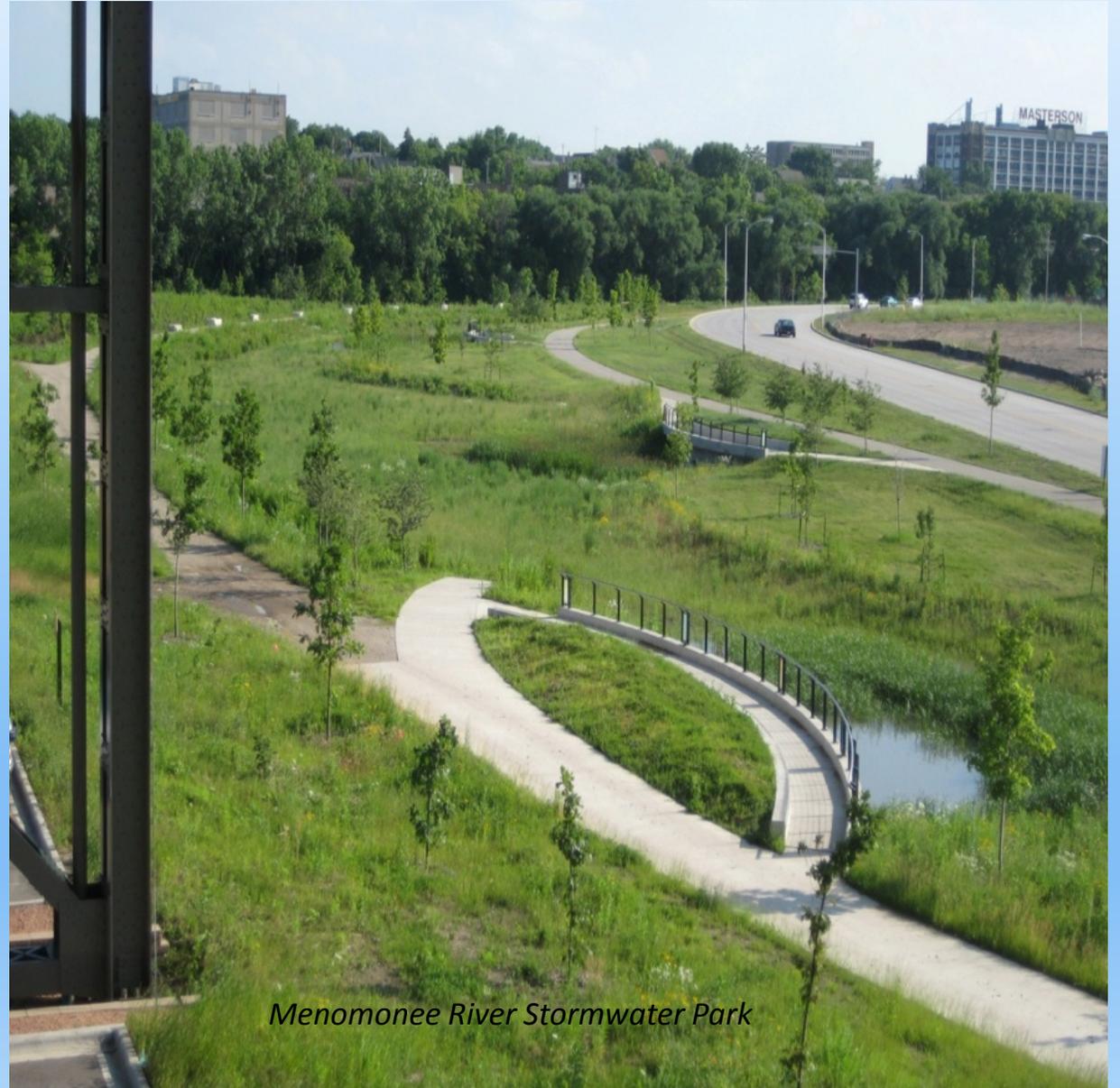


*Hockey rink made of stormwater*

# GREEN INFRASTRUCTURE EXAMPLES: LOCALIZED FLOODING & RESILIENCY

## Milwaukee, WI

- Revitalized brownfield site now mitigates impacts of localized flooding up to the 100 year storm event
- 70 acre stormwater park provides a high-value community recreation asset



*Menomonee River Stormwater Park*

# 700 Gallon Cistern functions as public art and irrigates planters



Lancaster PA

Water: Green Infrastructure

Contact Us

You are here: Water » Water Infrastructure » Green Infrastructure

Green Infrastructure



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Home Basics Tools Case Studies Research Library Contacts



- Tools
- Operations and Maintenance (O&M)
- Design
- Funding
- Climate Resiliency



- Basics
- Cost Benefit Resources
- Performance
- Research
- Campus RainWorks
- Policy
- Permitting
- Training



- Green Infrastructure Collaborative
- Technical Assistance
- Collaborative Resources

To join greenstream, an EPA listserv featuring updates on green infrastructure publications, training, and funding opportunities, send an email to [join-greenstream@lists.epa.gov](mailto:join-greenstream@lists.epa.gov).

To learn more about the relationship between green infrastructure and low impact development please visit EPA's [Low Impact Development Page](#).

Webinar: Dec. 2, 2014

Green Infrastructure for Localized Flood Management

Examples from:

Toledo, OH – Approx. 50% reduction in flood damages due to GI (900K to 500K)

Cuyahoga Falls, OH - Reduced 100year discharge by 10%. Turned damaged flood area into a park

# Stillwater, Oklahoma



- ASCE paper 2015 – “Retrofitting Stormwater Systems with LID Techniques” ( Stevens, Chavez, Whittenburg)
- 180 acre Babcock basin flooded by 100 year storm, fully developed ¼ acre lots, developed quickly, no coordinated stormwater management
- Did a “regional” retrofit design
  - Existing farm pond became wet detention
  - Excess flow diverted to underutilized dry detention
  - Large 3 cell bio retention area added
  - Discharge at culvert bridge went from 219cfs to 57cfs – no longer flooded
  - Benefit to cost ratio on the order of 1.75

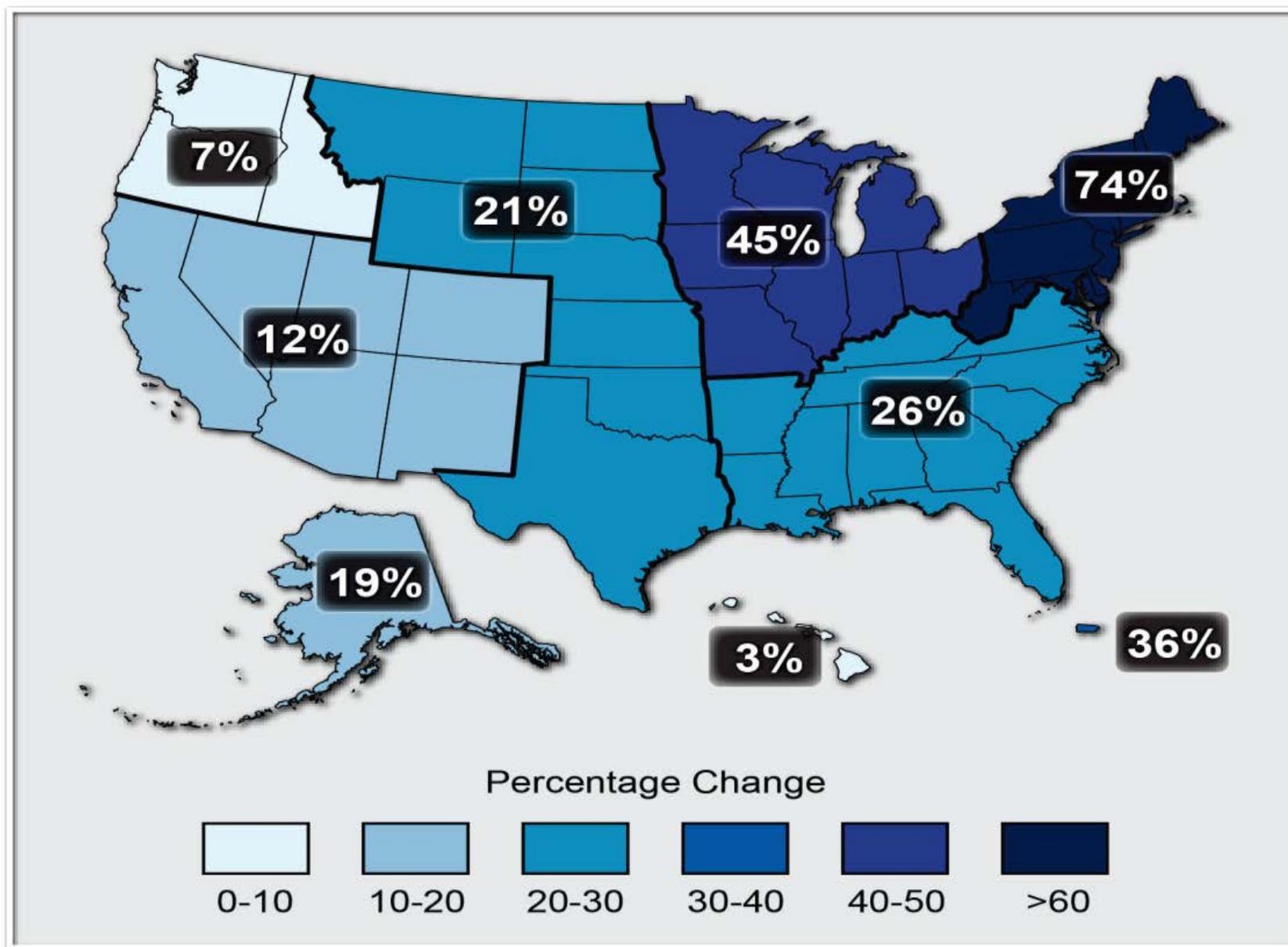
Study was funded by FEMA

www.epa.gov/giwiz



A screenshot of the EPA Green Infrastructure Wizard website. The top navigation bar includes the EPA logo, the text 'United States Environmental Protection Agency', and language options: 'Español', '中文: 繁體版', '中文: 简体版', 'Tiếng Việt', and '한국어'. Below the navigation bar are menu items: 'Learn the Issues', 'Science &amp; Technology', 'Laws &amp; Regulations', and 'About EPA'. A search bar labeled 'Search EPA.gov' is on the right. The main header features the 'GI Green Infrastructure Wizard' logo and a 'Feedback' button. The central image shows a city street with trees and cars, overlaid with a white play button icon and a white compass icon. Below these icons are two white buttons: 'Quick Links' and 'Explore'. At the bottom, a text block describes the website's purpose: '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.'

# Percentage Change in Very Heavy Precipitation



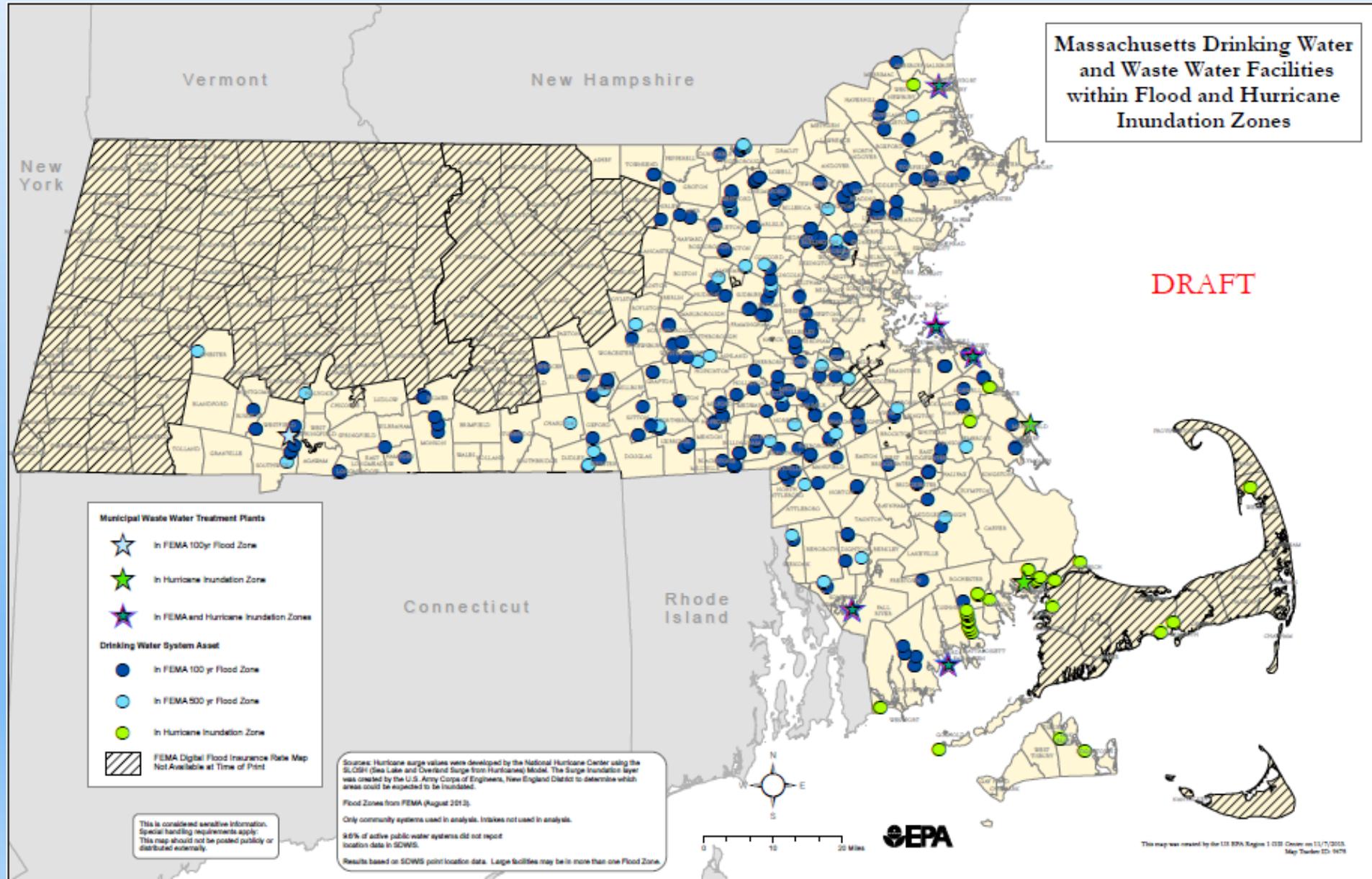


# Treatment Plant Warwick, RI | March 2010



# THE RISKS (MA)

<http://www2.epa.gov/crwu/see-coastal-storm-surge-scenarios-water-utilities>





# FLOOD RESILIENCE

## A Basic Guide for Water and Wastewater Utilities

*Select a menu option below.  
First time users should start with the Overview.*



[www.epa.gov/climatechange/impacts-adaptation/adapt-tools.html](http://www.epa.gov/climatechange/impacts-adaptation/adapt-tools.html)

### Climate Ready Water Utilities

<http://water.epa.gov/infrastructure/watersecurity/climate/>

### All Hazards Emergency Preparedness for Drinking Water Systems

[www.epa.gov/region1/eco/drinkwater/emergency\\_preparedness.html](http://www.epa.gov/region1/eco/drinkwater/emergency_preparedness.html)

#### Is Your Water or Wastewater System Prepared? What You Need to Know About Generators.

Loss of electricity quickly becomes a major challenge during natural disasters and could raise public health concerns. Without backup power for an extended period, many water and wastewater services cannot be provided. However, as demonstrated during incidents such as hurricanes and ice storms, not all minutes are equal to get their systems operational again. This brochure provides tools and prompts utilities to better prepare for emergency generator needs, provides tips on running and maintaining generators, and includes an easy-to-copy form to determine and document backup power needs.

**How do I know what my backup power needs are?**

- 1. Classify** the electrical needs at your utility:
  - **Critical need:** Equipment essential to maintain public health protection (e.g., pumps).
  - **Secondary need:** Equipment that would enhance operation, but is not critical (e.g., SCADA components).
  - **Noncritical need:** Equipment provided for convenience/comfort, but not essential (e.g., pumphouse lights).

Only consider needs critical to maintaining an acceptable level of service during power outages at your utility.

- 2. Identify** the electrical equipment within the critical needs at your utility and determine their voltage, phase configuration, and horsepower/usage requirements. Remember, electrical equipment starting power demands are usually two to three times higher than their running demands, which may dictate a larger generator. A licensed electrician can provide assistance in determining your backup power needs.
- 3. List** all your critical electrical equipment and their starting order to determine your required starting power. At a minimum, your generator(s) must have the capacity to supply the maximum starting power demands and the running demands of the connected equipment.
- 4. Determine** your generator needs. Make it easy by using the attached form.

*"Having a backup generator is essential, but ours failed when we needed it most. It is critical to keep your generator maintained and to test it regularly under its operating load. Our lesson learned? Make sure you get to know your local emergency planners and have a plan for backup power."*

*-Massachusetts Operator*



Page 1 • EPA 501-F-09-027 • www.epa.gov/region1/eco/drinkwater • September 2009

#### CLIMATE CHANGE

Energy & Climate Change in New England

### Flooding: Is Your Water Utility Prepared?

U.S. EPA | CLIMATE CHANGE OUTREACH AT EPA NEW ENGLAND

**WATER RESOURCES:** Future changes to temperature and precipitation patterns will have a significant effect on the way we manage our water resources. Based on the Northeast Climate Impacts Assessment report from 2006, New England will experience the following over the next century: longer, hotter, drier summers; shorter, warmer winters; fewer rain events with more frequent and intense storms; and rising sea level.

**INTRO:** Small water utilities are particularly vulnerable to floods because they might not have adequate funds or resources for repairing unexpected damage to treatment plants, intake, and sewage collection and water distribution systems. Although some may have generators and enough water storage for several days to compensate for disruption of services, many do not. EPA New England encourages all systems to take action now to plan, prepare, and protect against future flooding.

**KEY CONTACTS:** DENISE SPRINGBERG  
EPA New England



#### CLIMATE READY WATER UTILITIES

SEPA

### Preparing for Extreme Weather Events: Workshop Planner for the Water Sector

Intro | Workshop Process | Climate Science | Regional Info | Plan Workshop | Resources | Help

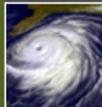
#### Which Funding Is Right for You?



#### Be Prepared to Tap into Funding



#### Federal Disaster Funding Programs



#### Utility Examples, Training, & Assistance



#### Currently In a Disaster?



Here are forms to document the damage, costs, and repairs.

# EPA's Climate Resilience Evaluation Awareness Tool:



## Build Awareness

- Explore local climate data
- View links to publications, models and other tools



## Assess Risk

- Catalog data and assumptions
- Understand and assess climate impacts



## Plan Adaptation

- Compare adaptation options
- Generate reports to support decisions

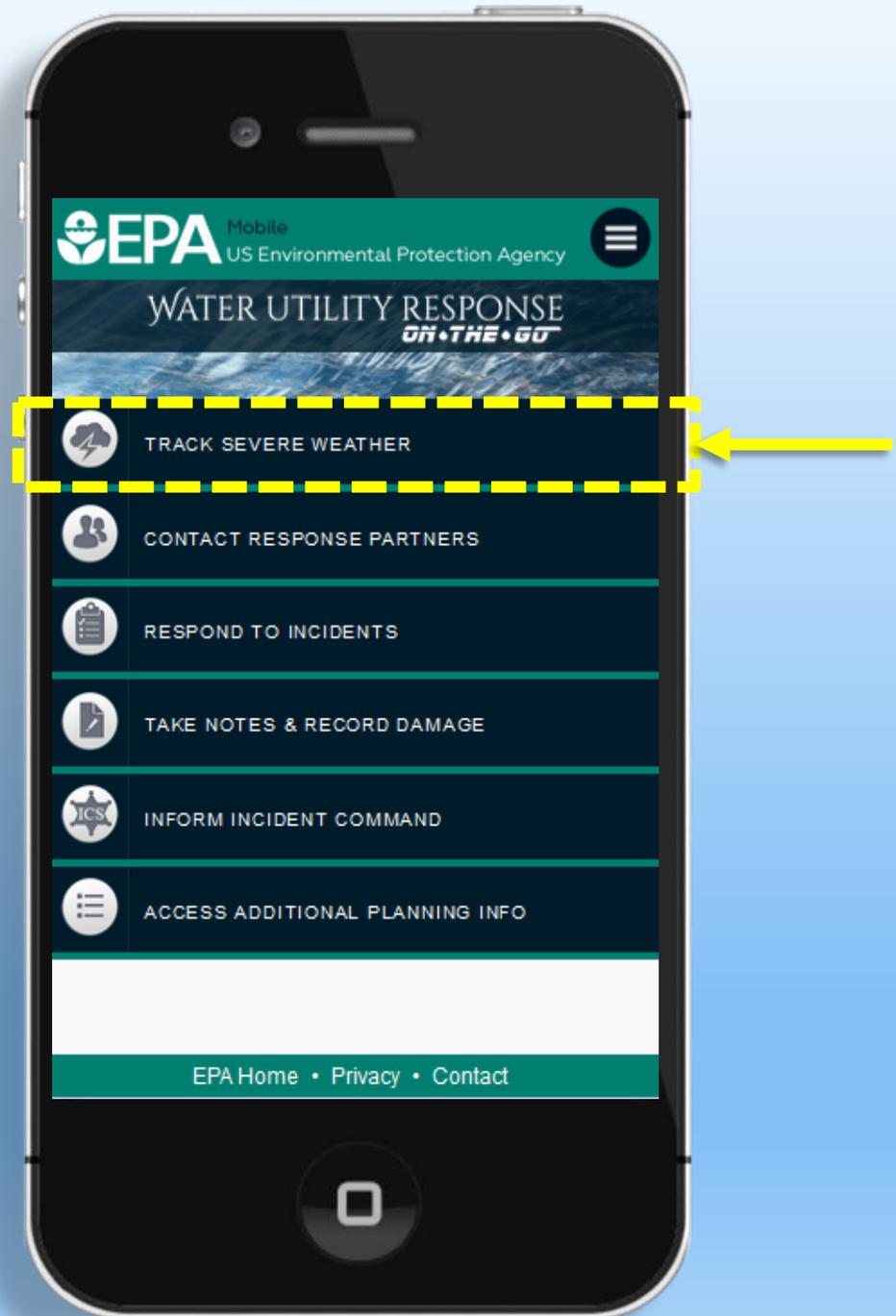
CREAT Version 3.0 will be available in November 2015

# Water Utility's Response On- The- Go!

Track  
Severe  
Weather

*\*Increase situational  
awareness*

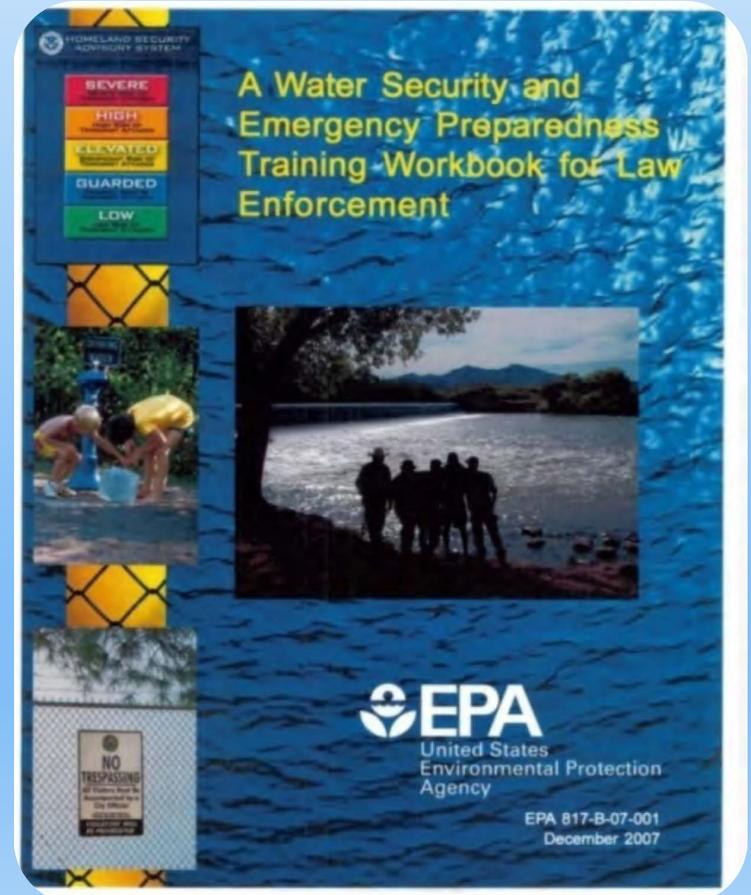
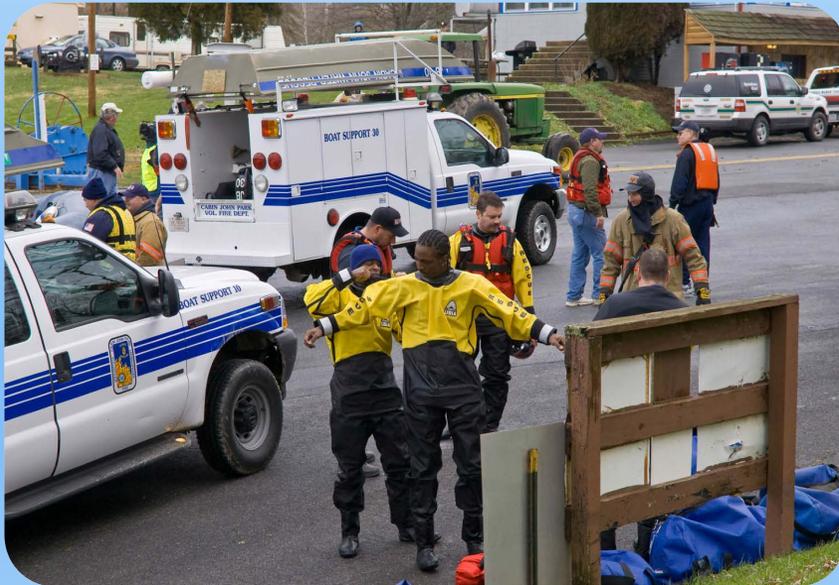
Type into your browser:  
[epa.gov/responseotg](http://epa.gov/responseotg)



# Build a Response Partner Network

## Important to raise the priority of water in emergency response

- While communities rely on drinking water and wastewater to provide vital services, they often do not realize the need for prioritization of water service restoration after emergencies.
- “Make a friend before you need a friend”



## Flood Resilience Checklist

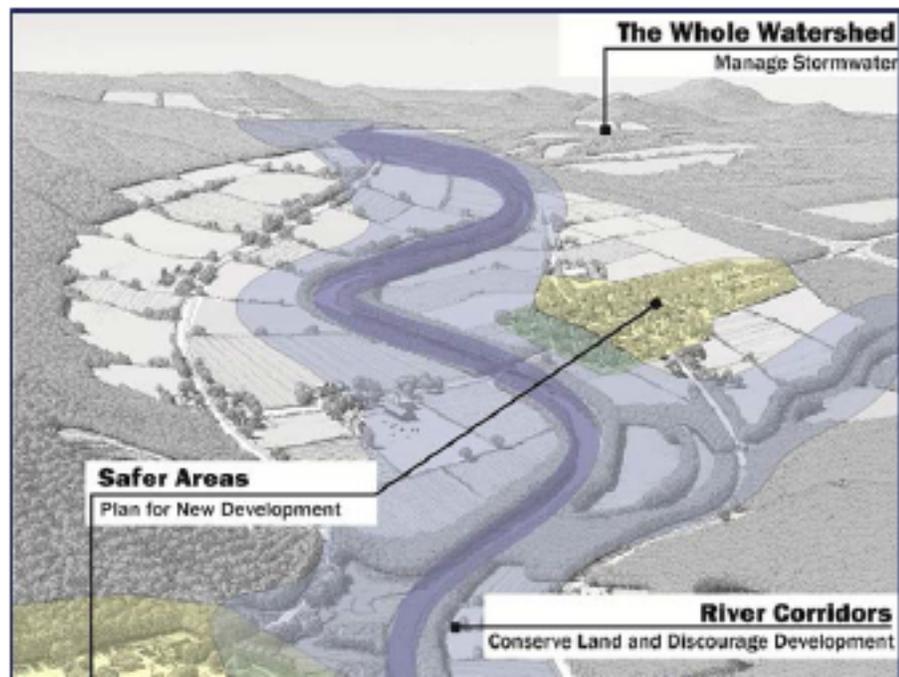
Is your community prepared for a possible flood? Completing this flood resilience checklist can help you begin to answer that question. This checklist was developed as part of the U.S. Environmental Protection Agency's Smart Growth Implementation Assistance project in the state of Vermont. More information about the project can be found by reading the full report, *Planning for Flood Recovery and Long-Term Resilience in Vermont*, found online at [www.epa.gov/smartgrowth/sgia\\_communities.htm#rec1](http://www.epa.gov/smartgrowth/sgia_communities.htm#rec1).

### What is the Flood Resilience Checklist?

This checklist includes overall strategies to improve flood resilience as well as specific strategies to conserve land and discourage development in river corridors; to protect people, businesses, and facilities in vulnerable settlements; to direct development to safer areas; and to implement and coordinate stormwater management practices throughout the whole watershed.

### Who should use it?

This checklist can help communities identify opportunities to improve their resilience to future floods through policy and regulatory tools, including comprehensive plans, Hazard Mitigation Plans, local land use codes and regulations, and non-regulatory programs implemented at the local level. Local government departments such as community planning, public works, and emergency services; elected and appointed local officials; and other community organizations and nonprofits can use the checklist to assess their community's readiness to prepare for, deal with, and recover from floods.





Otter Creek, Middlebury VT

Flood Ready VT

Tropical Storm Irene

Otter Creek in Rutland VT  
30,000 cfs - significant damage

30 miles **downstream** in Middlebury , VT

15,000 cfs minimal damage

Benefit of floodplains and wetlands

# New Hazard Mitigation Plan Guidance

- FEMA's *State Mitigation Plan Review Guide (2015)* encourages comprehensive planning with *natural resources, sustainable communities and other sectors*
- *Enhanced* plans (eligible for more funds) must include these sectors
- States submitting plans in 2016 must meet new guidelines
- Silver Jacket teams are cited as a way to integrate federal agencies for long-term solutions

# Closing thoughts

- GI (LID practices) can help reduce localized flooding, larger scale GI can provide storage and minimize flood damage
- GI provides multiple benefits for resilience
- Incentives exist for considering GI
- Design standards and precipitation data need to be updated
- Resilience is multifaceted
- Partnership is key, tools are out there, EPA is a willing partner
- Consider the whole system, think long term, and consider unintended consequences, GI/LID shouldn't go just anywhere
- Think outside the catch basin





Region 1: VT, NH, ME, MA, RI, CT

Region 2: NY, NJ, Puerto Rico, Virgin Islands

Region 3: PA, WV, VA, MD, DE

Region 4: KY, TN, NC, SC, GA, FL, AL, MS

Region 5: MN, WI, MI, OH, IN, IL

Region 6: NM, TX, OK, AR, LA

Region 7: NE, IA, MO, KS

Region 8: MT, ND, SD, WY, SD, UT, CO

Region 9: CA, NV, AZ, HI

Region 10: WA, OR, ID

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For monthly GI webinars