EPA
United States
Environmental Protection
Agency

Safe and Sustainable Water Resources

SAB/BOSC Meeting
July 10-11, 2012

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National Program Director

National Drinking & Wastewater Issues

Water main break on River Road

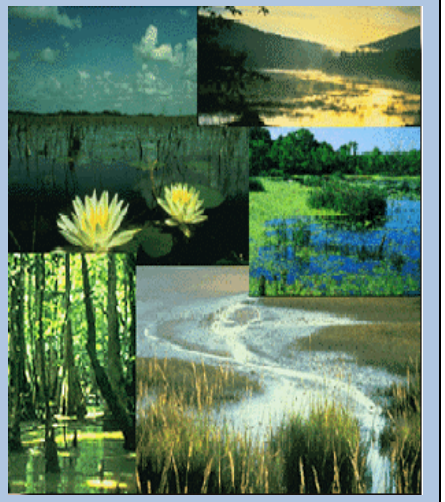
- Wastewater and drinking water systems rated D- by the American Society of Civil Engineers (2009).
- 240,000 water main breaks per year in the U.S.
- Up to 75,000 Sanitary Sewer Overflows per year resulting in the discharge of 3-10 billion gallons of untreated wastewater.
- 5,500 annual illnesses due to exposures to contaminated recreational waters.
- 5-20% of energy expenditures on a state level are to transport water from sources to users, and back to treatment and discharge facilities.
- USGS estimates that water lost from water distribution systems is 1.7 trillion gallons per year at a annual national cost of $2.6 billion.

National Water Resource Issues

- Nation's Water Resource Conditions (based on biology)
  - 42% of streams (1st-3rd order) are in poor condition
  - 22% of lakes are in poor condition
  - 19% of estuaries are in poor condition

National Lakes Survey, 2009

- Continued decline in Nation's Wetlands that serve as storm buffers, absorb pollution to reduce the levels reaching drinking water, and provide vital habitat for fish, wildlife and plants (*Status and Trends of Wetlands in the Conterminous United States 2004-2009)*
  - ↓62,300 acres between 2004 and 2009



- Nutrients as stressors on conditions
  - 32% of streams have high [N]; 31% have high [P]
  - 19% of lakes in poor condition due to [N]; 18% for [P]
  - 2% of estuaries poor condition due to DIN; 8% for DIP

- Increased incidences of extreme temperature and precipitation events

SSWR OVERVIEW

Problem Statement:

Increasing demands for sources of clean water combined with changing land use practices, growth, aging infrastructure, and climate change and variability, pose significant threats to our Nation's water resources. Failure to manage our Nation's waters in an integrated, sustainable manner will limit economic prosperity and jeopardize both human and aquatic ecosystem health.

Vision:

SSWR uses an integrated, systems approach to research for the identification and development of the scientific, technological and behavioral innovations needed to ensure clean, adequate and equitable supplies of water that support human well-being and resilient aquatic ecosystems.

SSWR Goals

1. Protect public health and the environment
2. Provide safe and sustainable water to meet societal, economic and environmental needs
3. Water resources managed in a sustainable manner
   a. integrate wastewater, stormwater, drinking water, and reclaimed water;
   b. maximize energy production, nutrients and materials management, and water recovery; and
   c. incorporate comprehensive water planning and optimum combinations of built, green and natural infrastructure

SAB FY11 Recommendations to SSWR

- ✓ Continue to align research with regional and national strategic goals
- ✓ Continue to engage a wide range of stakeholder groups
- ✓ Continue the integration of the drinking water and water quality research programs
- ✓ Continue to use sustainability theme as a guide
- ✓ Take a leadership role in establishing multi-agency partnerships that leverage resources and provide comprehensive solutions
- ✓ Innovative technologies are especially important to the water infrastructure theme
- ❑ Social science research should be integrated in all of the programs in explicit ways

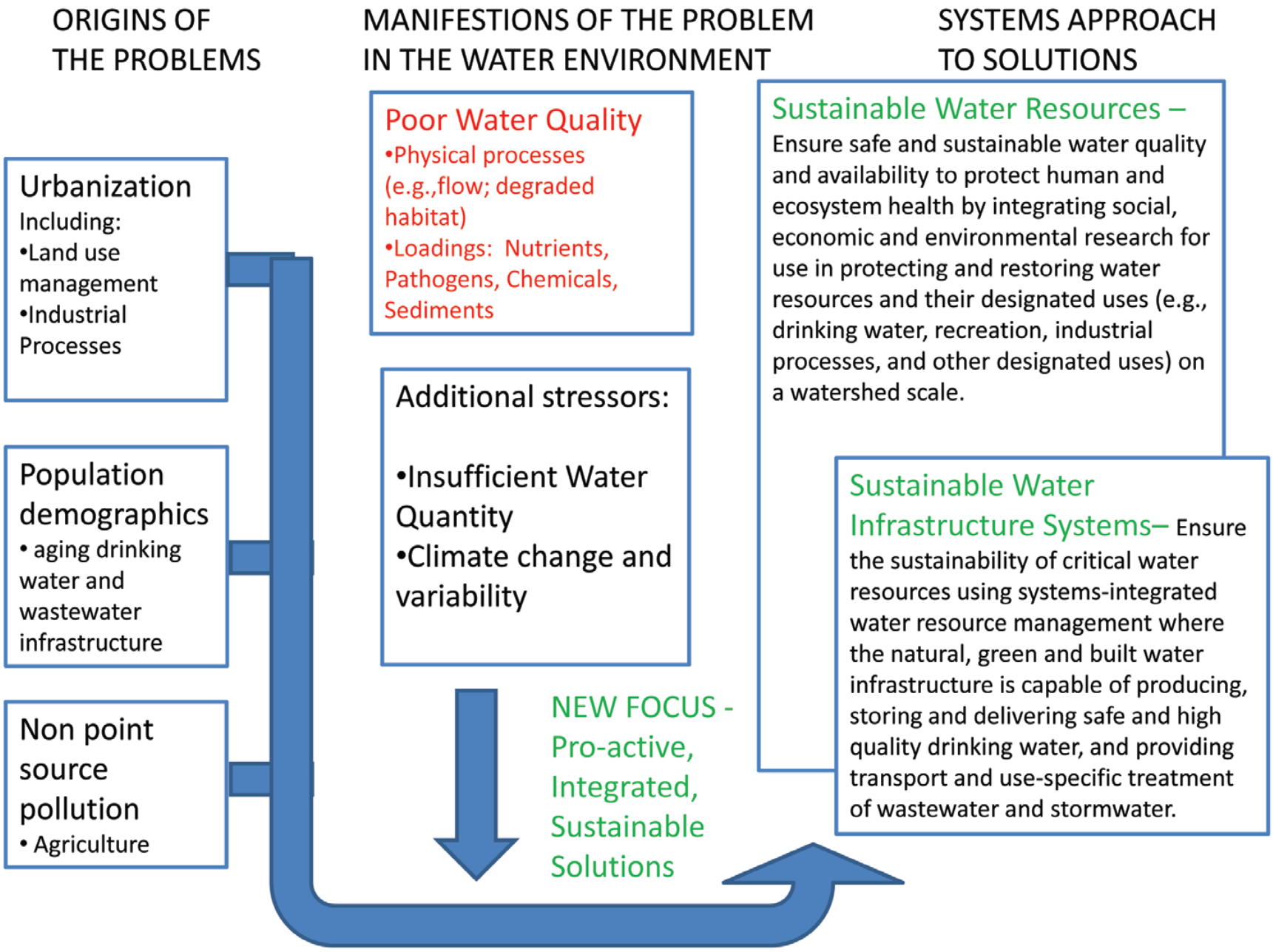
SSWR PROGRESS

- Developed Strategic Research Action Plan (StRAP)

http://yosemite.epa.gov/sab/sabproduct.nsf/0/E9FAA4240E000BED85257A16005FFB06/$File/Safe%20and%20Sustainable%20Water%20Resources%20EPA%20Research%20Plan.pdf

w/Program and Region managers and scientists within EPA, other federal research organizations and external stakeholders

- Implemented research program based on StRAP
- 2 Themes, 7 Science Questions, 21 Projects
- Hired a permanent NPD for SSWR
- Research is underway!


ORIGINS OF THE PROBLEMS
MANIFESTIONS OF THE PROBLEM IN THE WATER ENVIRONMENT
SYSTEMS APPROACH TO SOLUTIONS
Urbanization
Including:
•Land use management
•Industrial Processes
Population demographics
• aging drinking water and wastewater infrastructure
Non point source pollution
• Agriculture
Poor Water Quality
•Physical processes (e.g.,flow; degraded habitat)
•Loadings: Nutrients, Pathogens, Chemicals, Sediments
Additional stressors:
•Insufficient Water Quantity
•Climate change and variability
NEW FOCUS - Pro-active, Integrated, Sustainable Solutions
Sustainable Water Resources – Ensure safe and sustainable water quality and availability to protect human and ecosystem health by integrating social, economic and environmental research for use in protecting and restoring water resources and their designated uses (e.g., drinking water, recreation, industrial processes, and other designated uses) on a watershed scale.
Sustainable Water Infrastructure Systems– Ensure the sustainability of critical water resources using systems-integrated water resource management where the natural, green and built water infrastructure is capable of producing, storing and delivering safe and high quality drinking water, and providing transport and use-specific treatment of wastewater and stormwater.

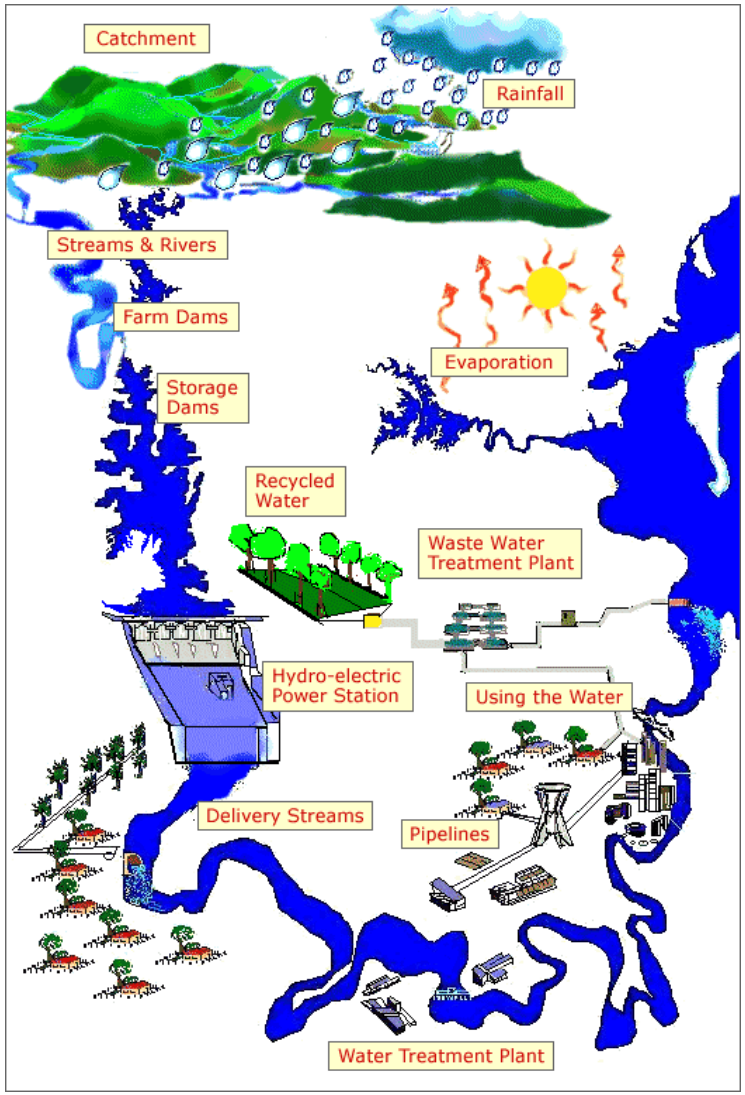
SSWR Research Program

Theme 1: *Sustainable Water Resources*

Ensure safe and sustainable water quality and availability to protect human and ecosystem health. Determine the condition of water resources for protection and restoration. Improve management by using a whole watershed perspective.

Theme 2: *Sustainable Water Infrastructure Systems*

Ensure the sustainability of critical water infrastructure to produce, store and deliver safe and high-quality drinking water, and to provide transport and use-specific treatment of wastewater and stormwater.



SSWR's 7 Program Questions/Topics Across 2 Themes

Q1: What factors are most significant and effective in ensuring the sustainability and integrity of water resources?

Q2: What approaches are most effective in minimizing the environmental impacts of naturally-occurring and anthropogenic contaminants and different land use practices (e.g., energy production, mineral extraction and injection activities, agriculture, urbanization) leading to the sustainability of surface and subsurface water resources?

Q3: What are the impacts of climate variability and changing human demographics as stressors on water quality and availability in freshwater, estuarine and coastal aquatic ecosystems? (overarching stressors distributed throughout SSWR research)

Q4: What are the most effective and sustainable approaches for maintaining and improving the natural and engineered water system in a manner that effectively protects the quantity and quality of water?

Q5: How can the Agency effectively manage water infrastructure to produce safe and sustainable water resources from source to drinking water tap to receiving waters?

Q6: What effective systems-based approaches can be used to identify and manage causes of degraded water resources to promote protection and recovery?

Q7: What technical and highly-targeted research activities are needed to support Program and Region Offices?

Key FY12 Products

- ✓ **Q1 National Coastal Condition Assessment**
- Q2 Investigation into techniques to specifically detect viable organisms
- ✓ **Q2 Update of EPA Method 525.2 (Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry). Update includes 13 chemicals from CCL3.**
- ❖ **Q2 Progress Report on Potential Impacts of Hydraulic Fracturing on Drinking Water Resources**
- Q2 Report on determining depth of colonization of sea grasses in Florida estuaries for application to numeric nutrient criteria development
- Q2 Report on determining the dissolved oxygen requirements of Florida-resident salt water species, with application to development of marine water quality criteria for dissolved oxygen
- ❖ **Q2 State of epidemiological research on mountaintop mining**
- Q5 Use of biological treatment for ammonia control
- Q5 Develop water treatment, residuals management, and monitoring technologies for drinking water and wastewater systems
- ❖ **Q7 Assessment of potential mining impacts on Bristol Bay, AK**
- Q7 Characterize conditions by which nitrosamines occur when chlorination is used in drinking water treatment; and evaluate treatment options for controlling nitrosamine levels to lower levels as a function of source water quality and existing treatment conditions
- ❖ **Q7 Waters of the United States Technical Support Document "**Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence"
- ✓ **Q7 PAH from parking lot runoff.**
- Q7 Total Coliform Rule-microbial sample temperature
- Q7 Storm Water Calculator - Based on SWMM, a site-based storm water calculator was developed per request of OW, as part of Storm Water Rule efforts.
- ✓ **Q7 Community-wide Health Status and Trends: Real-time Monitoring and Epidemiology Using Sewage Chemical-Information (ORD Innovation Project)**

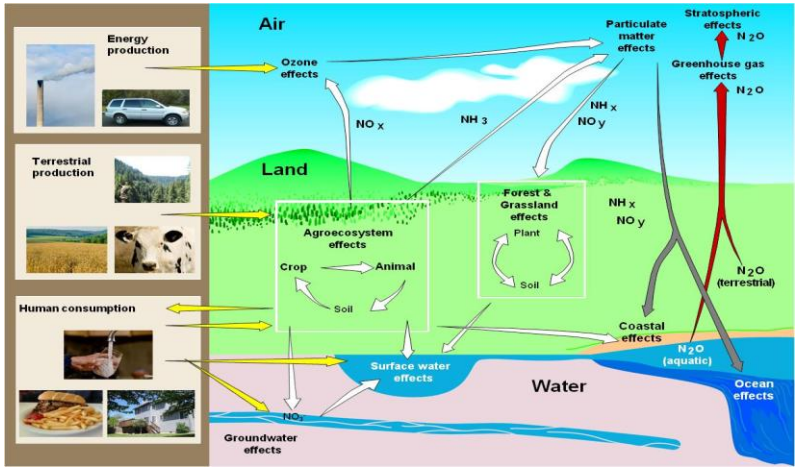
Expected Products: 36 in FY12 and 63 in FY13

Major Research Effort Completed: Recreational Water Quality Criteria

- Beach Act of 2000 Required EPA to conduct studies to:
  - Assess potential risks from pathogen exposure.
  - Develop appropriate and effective indicators for improving detection in a timely manner of the presence of pathogens.
  - Develop appropriate, accurate, expeditious, and cost-effective methods (including predictive models) for detecting, in a timely manner, the presence of pathogens.
- Required EPA to publish new or revised criteria by Oct. 2005 based on these studies, and review every 5 years
- EPA failed to meet the deadlines, and litigation resulted in a Consent Decree and Settlement Agreement (2008)
- Research completed by Dec. 15 2010 with intensive collaboration between ORD and OW involving ~15 products.
- Updated or revised criteria needs to be signed by Administrator by Oct. 15, 2012, per Consent Decree

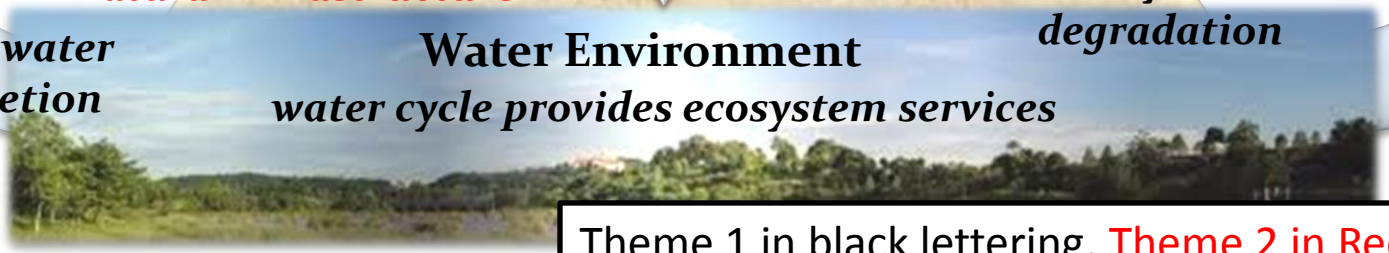
Major Research Effort Initiated: Nitrogen & Co-Pollutants

- Cross-Program research housed in SSWR to create a one-EPA perspective on sustainable nitrogen and co-pollutant management
  - Optimizes uses of nitrogen
  - Reduces environmental & health impacts
  - Maximizes benefits to society



- Currently examining research projects and tasks related to nitrogen to improve internal research integration and efficiencies

SSWR & SUSTAINABILITY
Sustainable Water Resource System



Economy

Public Health & Communities

integrated system design

products & services

water supply & demand

criteria

runoff and wastewater

best practices; extractive uses: energy, irrigation, industrial processes

recycled water recovery, storage

public health & ecological impact assessment

best practices water resource management

recreational and cultural uses

Optimize treatment technologies

Next generation infra-structure

"Green" engineered or natural infrastructure

ecosystem degradation

climate ready systems

freshwater depletion

Water Environment

water cycle provides ecosystem services

Theme 1 in black lettering, Theme 2 in Red

Sustainability: Scientific Research

- A watershed-based systems approach is needed to protect, maintain & restore the integrity of our nation's aquatic resources to ensure future sustainable water resources.

- Water is a common denominator for energy, agriculture, and resource extraction. To sustain our surface and subsurface water resources and maintain our quality of life, the impacts of the societal trade-offs must be understood now and in the future.

- Climate and changing human demographics will continue to be stressors that impact the sustainability and quality of human and aquatic life. Better information is needed by individuals, communities, and governmental agencies to adapt to the impacts of climate change and shifts in human populations.

- Sustainable approaches using natural and engineered water systems are needed to deal with stormwater management for municipalities facing consent decrees.

- Sustainable approaches are needed to ensure that our current and future water infrastructure produces safe and sustainable water resources.

- Sustainable populations will require new and innovative approaches for waste, energy and water, which will require public education, technological solutions and improved governance.

Sustainability: Economics

- Task 1.3A Socio-economic aspects of water quality trading program in the East Fork watershed from headwaters to drinking water intake.

- Task 2.1D Full cost accounting for land use and water-resources management under climate change.

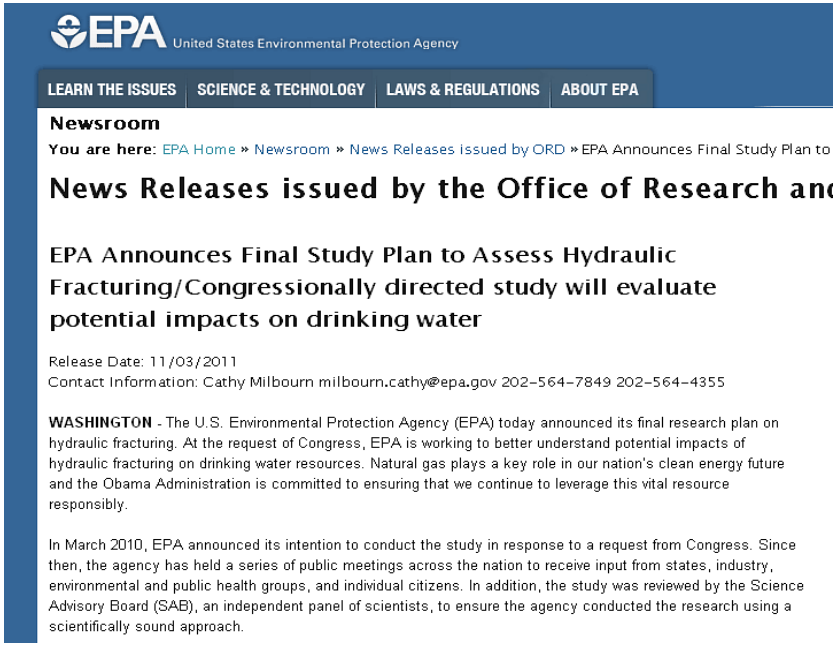
- ORISE Postdoc Position: This project will focus on assessing the economic (including ecosystem service) tradeoffs associated with N reductions achieved under scenarios involving various reduction targets and approaches . This may include assessment of market mechanisms, providing incentives to unregulated sources to meet potential reduction targets, and/or formulation of new tools for accountability related to agricultural practices. The project should leverage off existing scenarios for N reductions both within and external to EPA. The post-doc will (1) collaborate with researchers across the different ORD programs and EPA Offices, (2) contribute technical knowledge on the design of management strategies, and on the estimation of benefits and costs of those strategies.

Sustainability: Social Outreach/Science Communication by ORD Communications

Traditional, w/Office of External Affairs

Press releases

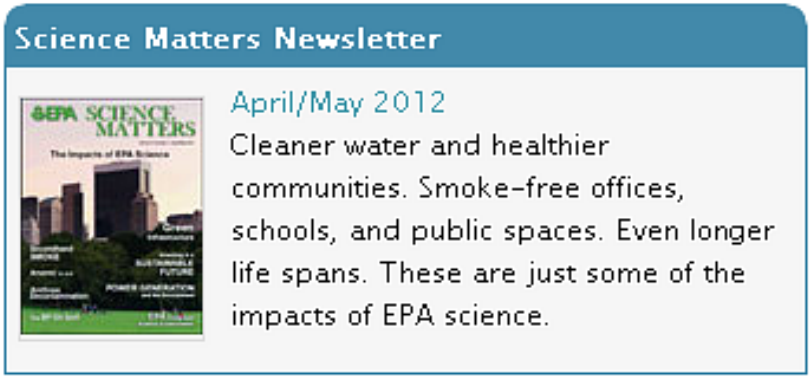
Respond to media inquiries

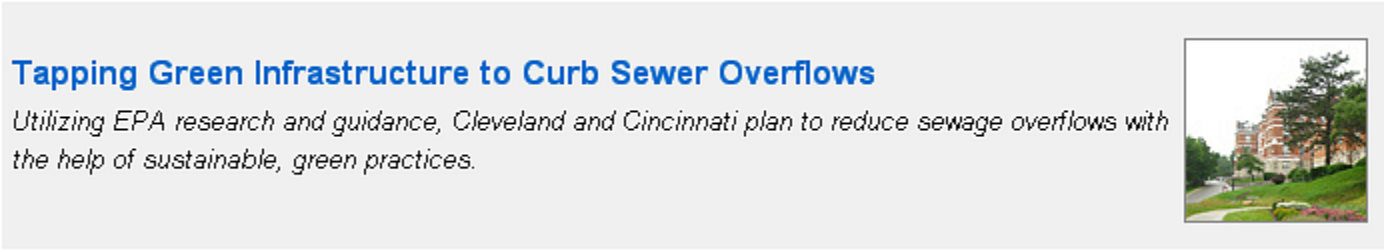


Science Matters newsletter

http://epa.gov/research/sciencematters

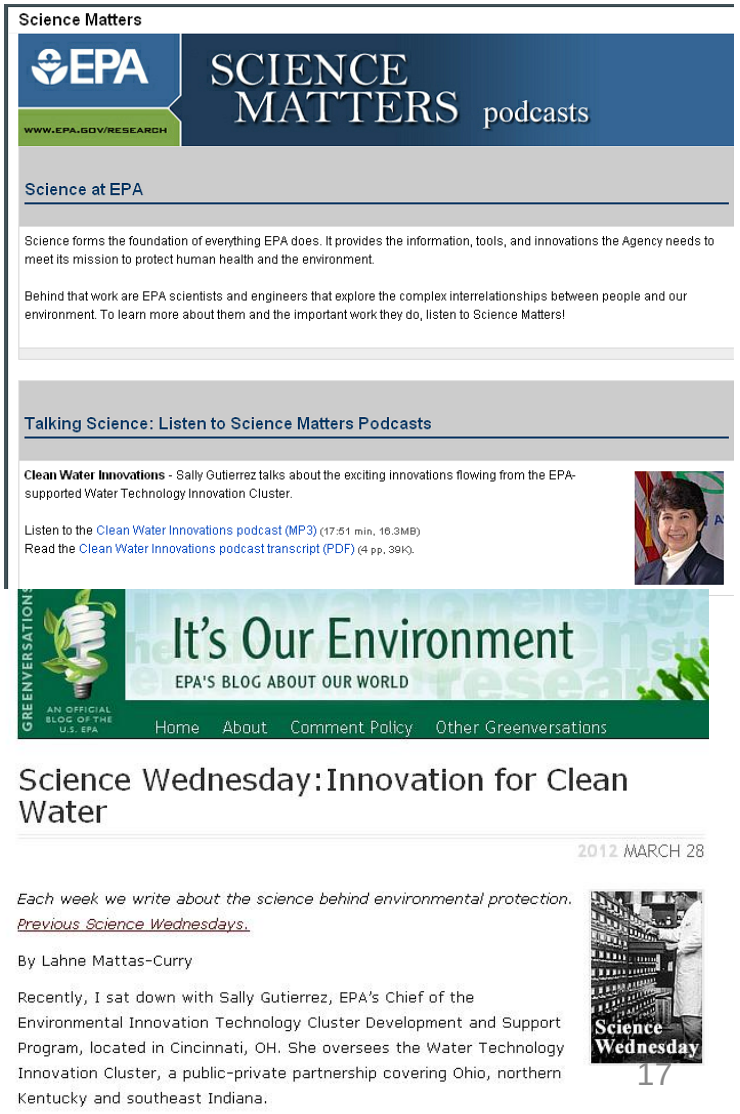
Next issue on Water Research!





Sustainability:
Social Outreach/Science Communication

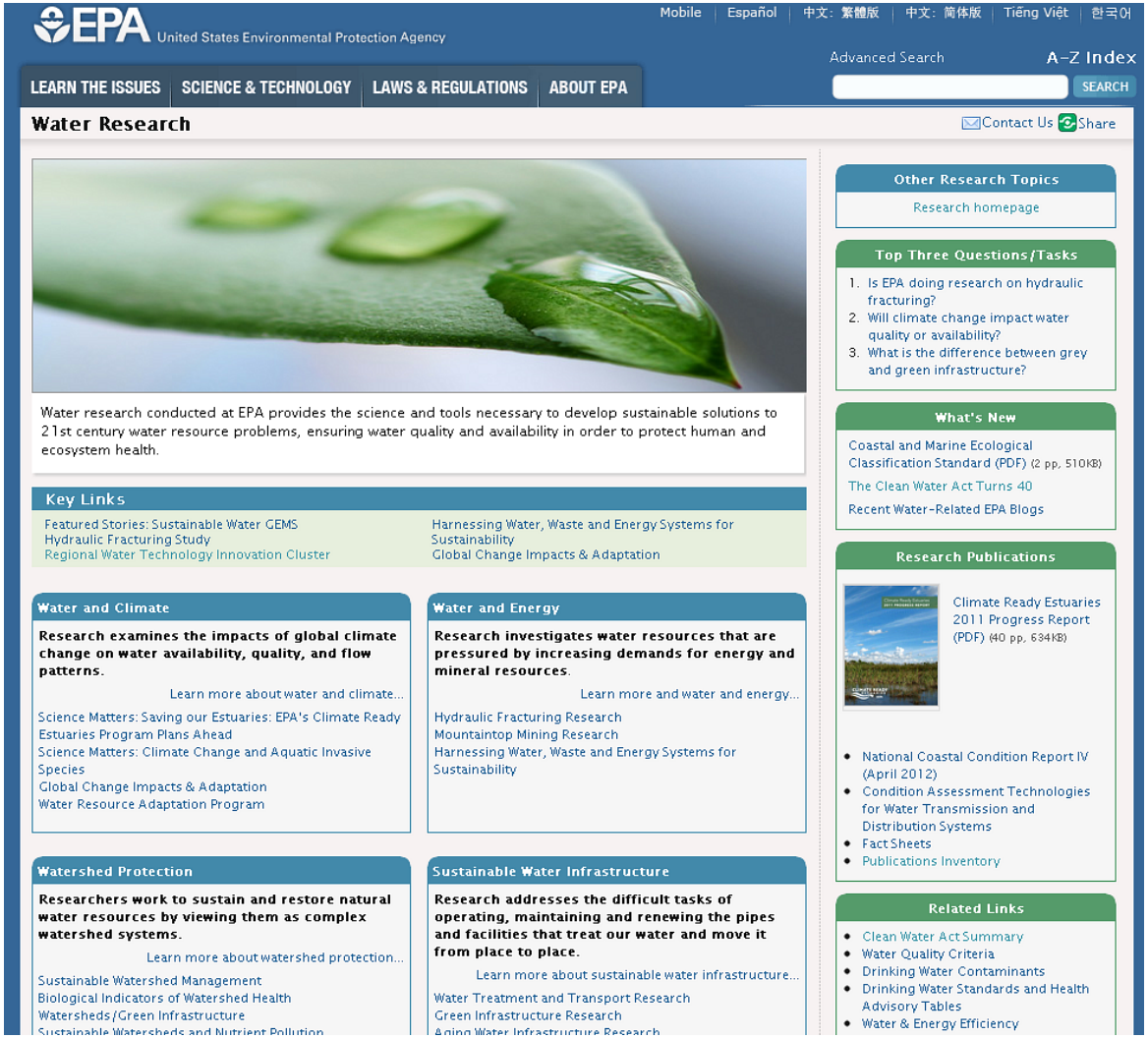
Social Media



twitter, blogs and podcasts

- @EPAResearch
- Greenversations blog http://blog.epa.gov/science
- Science Matters Podcasts

Sustainability:
Social Outreach/Science Communication



New!
Water Research on the Web by research subtopic:

- Water and climate
- Water and energy
- Watershed protection
- Sustainable water infrastructure
- Chemical and microbial risk
- Nutrients management
- Health
- Tools and models

SSWR Research: Balancing Immediate Needs & Emerging Issues

StRAP emphasizes meeting near-term and longer-term OW and Regional needs

Near-term

- Product 1.1.D.1 National Coastal Condition Assessment
- Product 2.4.B.1 State of epidemiological research on mountaintop mining

Long-term

- Product 2.3.A.6 Technical synthesis of approaches for developing numeric nutrient criteria for estuarine and coastal waters: decision support tools for application at site-specific to regional scales
- Product 4.2.A.4 Develop guidance on Green Infrastructure alternatives under different environmental conditions and potential changes in precipitation extremes
- Climate change and variability

Integrated SSWR Research

❖ Within SSWR: between Theme 1 & 2

- Integration of results from Topics 1, 2, & 3 (and 4, and 5) into Project 6.1 Promoting safe and sustainable waters through integrated management of nutrients in New England
- Integration of results from 5.2.C.1, 1.1.B.3, 1.2.E.1, and 2.2A.12 to better understand invasive species impacts on sustainability
- Integration of 2.2 and 5.2 to develop better tools for grouping contaminants for regulation and removing groups of contaminants from water

❖ Across NPDs and ORD

- Cross-cutting topics (Nutrients, Climate, etc)
- **NCER/STAR**

❖ Outside ORD and Agency

- Water Innovation Technology Cluster
- Nutrient management in New England
- Net Zero

Examples:

✓ Climate change and variability
✓Nitrogen and co-pollutants

1. Contaminants as a Group
2. Net Zero
3. Model Interoperability: increase integrative solutions and reduce duplicative efforts

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Integrated Research with NCER/STAR

NCER is supporting several projects supportive of SSWR

how climate change will impact and alter the Nation's water quality, including nutrient impacts

innovative water infrastructure especially for small water treatment facilities

NCER grants related to climate change which links to ACE

- *Modeling of the Hydrochemical Response of High Elevation Watersheds to Climate Change and Atmospheric Deposition*
- *Impact of Climate Change and Variability on the Nation's Water Quality and Ecosystem State*
- *Consequences of Global Climate and Emissions Changes on U.S. Water Quality: An Integrated Modeling Assessment*

Other grants include:

- *Model simulations predicting a shift in hydrology characterized by later snowpack development, earlier spring snowmelt, greater evapotranspiration, and a slight increase in annual water yield, and resulting in acidification of soil and stream water and deterioration of water quality draining from forested watersheds*
- *Identification of global water security threats to both human society and biodiversity*
- *Improved models of the geographic distribution of atmospheric nitrogen deposition*

NCER will issue a RFA seeking projects to establish holistic and practical nutrient reduction management strategies at the National level using a systems view approach (National Priorities RFA).

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Example 1. Contaminants as a Group

- In 2010, Administrator Jackson announced a new Drinking Water Strategy for the Agency.

  Key goal of the Strategy: *"Address contaminants as groups rather than one at a time so that enhancement of drinking water protection can be achieved cost-effectively."*

- Current water practices and research do not foster sustainability (instead focus on one aspect of water use at a time). ORD's NPD programs view the water-use cycle from source water to treated drinking tap water to wastewater, and integrates investigation of human health and ecological risks from water contaminants.

- Our approach is multi-disciplinary and multi-organizational to achieve efficient assessment, treatment and regulation.

ADVANTAGES OF CONSIDERING CONTAMINANTS AS GROUPS

- Allows EPA to set regulatory limits that account for cumulative effects (e.g., greater than additive toxicity)
- Chemicals responsible for the majority of the toxicity of the group can be identified and remedial actions targeted toward these ‘worse actors’
- Green or new water engineering approaches can be considered holistically, comparing the relative toxicity of the contaminant groups chemicals that are formed or affected by current and proposed technology
- Allows determination of the chemicals in a complex mixture that are associated with health effects of concern
- Changes in toxicity can be correlated with changes in chemical composition of the group, enhancing risk management decisions
- Methods are available, and others under development, that allow for estimation of the toxicity of the group from data on chemicals comprising the group (predictive toxicity)

CONTAMINANTS AS GROUPS: APPROACHES

Project 2.2
Task A Chemical/microbial contaminant grouping for evaluating ecological/human health
Task D Integrated assessment and reduction of contaminant risks

Project 5.2 Innovation for water-treatment system efficiency and integration

Provide grouping information for chemicals and microorganisms as they relate to human and ecosystem health: research supporting measurement, exposure, effects, regulation, treatment

Leverage other ongoing studies and expertise both in U.S. and internationally

Combine traditional analytical techniques, structure/activity relationships, etc. with additional innovative research approaches

- integrate biologically-based assay methods (e.g., in vitro EDC activity assay)
- molecular assays and real-time monitoring
- wide-spectrum chemical analysis

Tools and methods to determine which contaminants or contaminant groups in complex mixtures are responsible for the majority of observed toxicity

Methods for prediction of toxicity for contaminant groups

Example 2. Net Zero

ORD has two partnerships with DoD/Army to jointly develop innovative technology solutions for regional water-resource challenges on military bases.

1. MOU signed Nov 28, 2011 by ORD and Assistant Secretary of the Army installations, Energy, and the Environment.
   a. demonstrate cutting-edge technology solutions to advance both institutions' goals for increased resource efficiency and balanced resource use
   b. work jointly to advance the development and demonstration of new applications and technologies that can be used on installations striving towards net zero water, waste and energy goals
   c. explore net-zero related technologies and approaches.

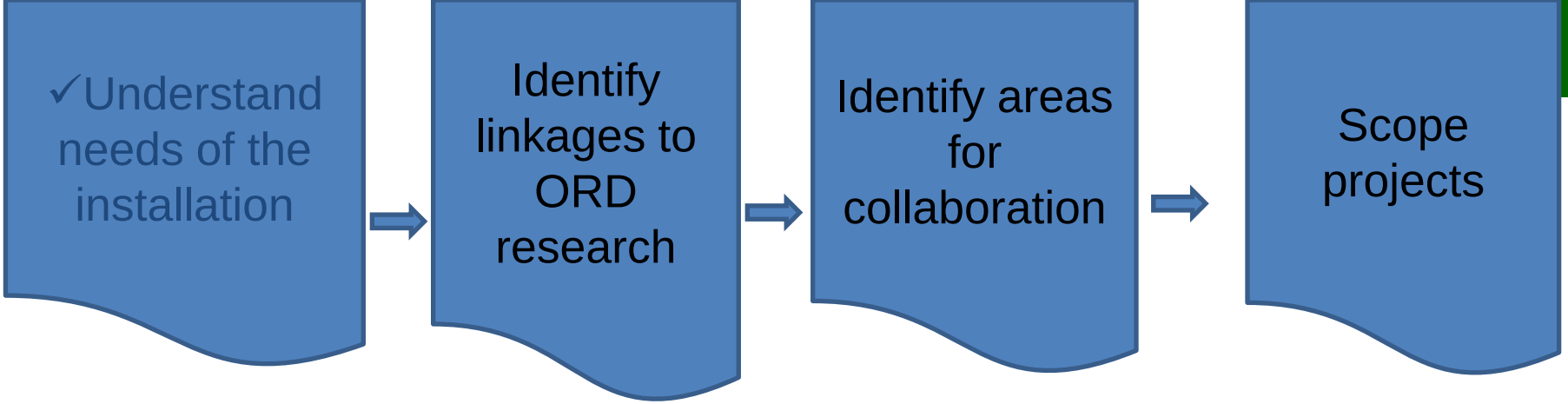
2. MOU signed Feb 7, 2012 by ORD and the Deputy Under Secretary of Defense for Installations and the Environment.
   a. complements the Army MOU
   b. expands opportunities to promote and transfer technology successes to military bases and communities
   c. leverages opportunities with DOD's SERDP and ESTCP programs

Other ongoing collaborative efforts

1. Department of Energy: Pacific Northwest National Laboratory has been conducting Water Balance Surveys on the Army installations
2. Army Corp of Engineers: responsible for managing some of the major construction projects on-post.

Initial focus is on Net Zero Water at two installations:

Fort Riley, Kansas and Joint Base Lewis-McChord(JBLM), WA



Focus Areas Identified to Date:

- Drinking Water/Wastewater Systems – water reuse opportunities, improved efficiency in treatment/distribution, energy recovery and efficiency

- Aging Infrastructure – Condition assessments, monitoring and leak detection, optimization combinations of old and new distribution lines

- Stormwater Management – Improve wet weather flows, green infrastructure, and water reuse opportunities

Innovative SSWR Research

Examples

1. Pathforward Innovation Projects (PIP)
2. Water Technology Innovation Cluster (WTIC)
3. Green Infrastructure (GI)

Example 1. Pathforward Innovation Projects

FY 12

- **Drinking Water Microbiome**: Integrating metagenomics and transcriptomics as a novel pilot approach to assess health risks and ecosystem management
- **Community-wide Health Status and Trends**: Real-time monitoring and epidemiology using sewage chemical-information mining [Daughton CG "Using sewage to gauge human health: Remote, real-time health assessment of small-area populations via human biomarkers in sewage," *Reviews of Environmental Contamination and Toxicology* (currently undergoing ORD review)]
- **Global to Genome (G2G)**: Specification of a computational platform for agency-wide, seamless data flow and computational modeling in support of health, ecological, and climate risk characterizations
- **Scaling of Ecological Patterns and Processes**: Achieving regional inference from localized observations
- **Transformational Approach to Monitoring Water Quality Sustainability of Coastal Ecosystems from Satellite Remote Sensing**

FY 13

- **Cyanobacteria Assessment Network (CyAN) for freshwater systems:** An early warning indicator for toxic blooms using the MERIS satellite
- **Development and application of genome-scale resources for fathead minnow (*Pimephales promelas)*:** A case study on the application of post-genomic analyses to identify susceptibilities to environmental stressors.
- **Innovative Approach for Biological Desalination of Seawater Using Algae**
- **The Significance of Molecular Methods in Assessing Human Health Risk from Viruses Isolated from Water**
- **Sustainability in Health Care**: Minimizing the environmental footprint of medications with prescribing guided by pharmacokinetic excretion profiles

Example 2. Water Technology Innovation Cluster

- On January 18, 2011 EPA and SBA announced the WTIC launch
- WTIC is a cluster of interconnected firms (businesses, suppliers, and service providers) and supporting institutions (local government, business chambers, universities, investors, and others) that work together to promote economic growth and technological innovation.
- Promotes economic development through the creation and attraction of jobs and investment.
- Development, demonstration and commercialization of innovative water technologies invented by the private sector or EPA with a focus on removal of multiple contaminants from drinking water and the development of small systems technologies
  **Increasing number of patents, licenses, & CRADA's with regional companies
- Demonstrations to speed the adoption of new innovative water technologies

Example 3. Green Infrastructure

Problem: Stormwater runoff has led to discharge of pollutants to receiving waters (including untreated wastewater in communities with combined sewer systems) and degradation of water quality, and stream condition leading to litigation and expensive remediation for municipalities

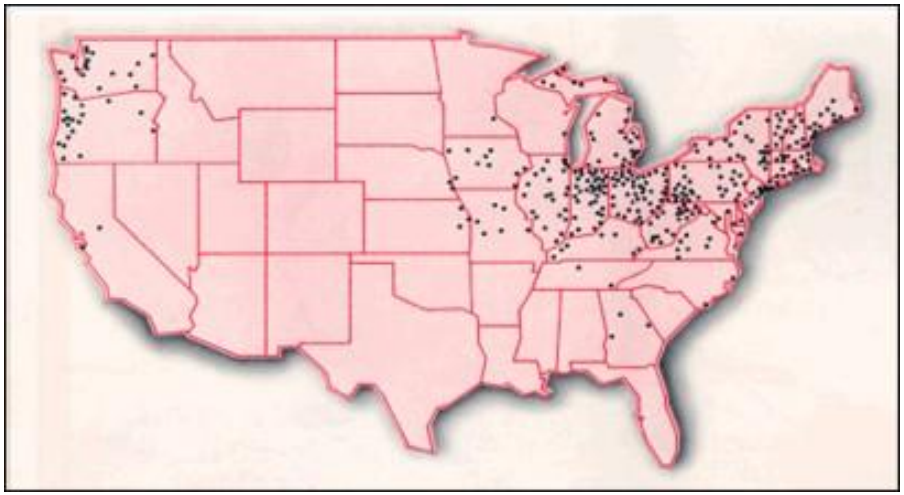
SSWR Solution: Develop effective and sustainable approaches that maintain and improve natural, green and engineered water systems

- Combined Sewer mitigation through multi-scale implementation of green infrastructure in communities (*e.g., Cleveland, Cincinnati consent decree enforcements of CSO policy, support upcoming Philadelphia CSO consent decree)*
- Green Infrastructure Best Management Practice (BMP) performance and metrics (*e.g., impact of GI BMP adoption on aquatic ecosystem health)*
- Green infrastructure modeling tools and data inventories *(e.g., Storm Water Management Model (SWMM), Green Infrastructure databases in EPA GeoPlatform)*

SSWR Partnering for products: Guidance on incorporating Green Infrastructure into Combined Sewer Overflow (CSO) consent decree enforcements (2012) - *joint OW-Regional-ORD effort*

Stormwater Management: Permitting and Enforcement

- National Pollutant Discharge Elimination System (NPDES) stormwater discharge permit required for large, medium, and small Municipal Separate Storm Sewer Systems (MS4s) and some construction and industrial activities.
- Combined storm/sewer systems release untreated wastewater when system overloaded by heavy rains and high volumes.
- Combined Sewer Systems in ~772 communities.
- Combined Sewer Overflows (CSOs) among major sources responsible for beach closings, shellfishing restrictions, and other water body impairments.
- 1994 CSO Policy requires nine minimum controls for NPDES permit and Long Term Control Plan (LTCP) for full compliance with Clean Water Act.
  - *Many municipalities are currently under or negotiating consent decree settlements for their LTCP to control of CSO*



Map of U.S. Locations with Combined Sewer Systems

Stormwater Management: Moving toward More Sustainable Solutions

- LTCP describes combined sewer systems changes to meet CSO reduction targets
- Grey infrastructure changes to increase stormwater volume capacity
  - Pipes, channeling, tunnels, high rate wastewater treatment, etc.
  - Extremely costly, can be in the $1B's
  - Ex: New York City has spent or plans to spend almost $2.9 billion to construct grey infrastructure for CSO reductions
- Integrating green infrastructure **along with** grey to keep stormwater out of system increasingly being considered as more cost effective
  - Ex: New York City's (NYC) goal to manage 10% of impervious surfaces via detention and infiltration in CSO watersheds
  - NYC estimates net public funds saving of $2.4 billion by using green infrastructure for this 10%, as opposed to additional grey infrastructure investments



EPA ORD Research to Support Integration of Green Infrastructure

- Technical Guidance integrating Green Infrastructure (GI) along with grey Infrastructure
  - *controlling the stormwater runoff as a source while also increasing capacity of sewer system)*
- Generating and Collecting Data on GI Performance, Operation & Maintenance, Costs, Socio-Economic benefits
- GI Research Information Clearinghouse
- Modeling Tools for GI and Stormwater Planning

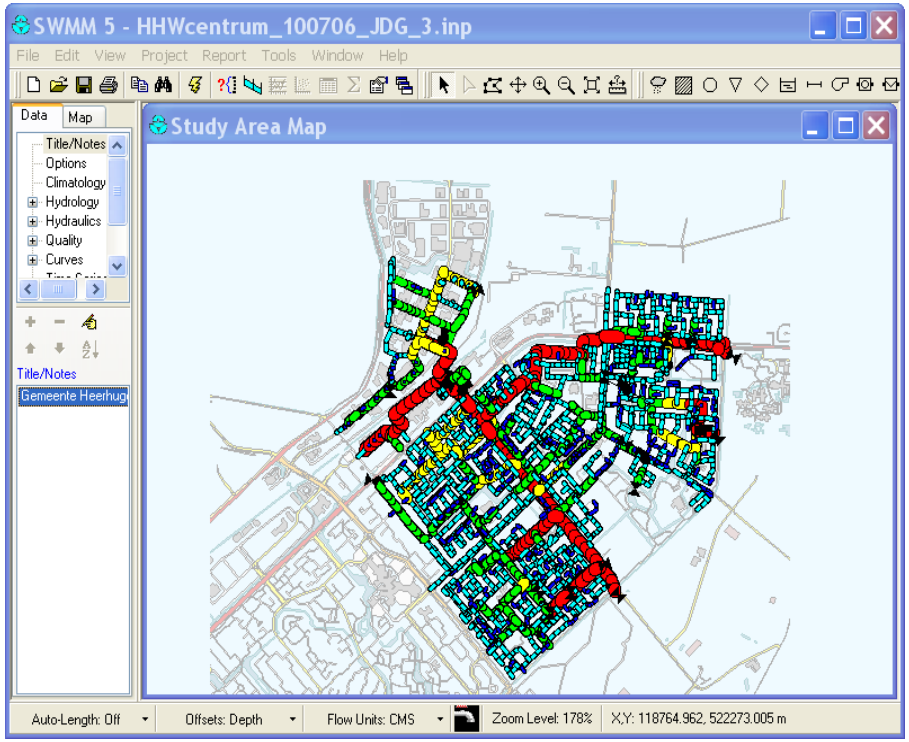
ORD Collaborations with Communities Integrating Green Infrastructure into LTCPs

Cincinnati, OH Case Study (2010 – ongoing)	• Cincinnati's consent decree for CSO control includes GI pilot demonstrations • If key GI pilots are successful in controlling stormwater targets, construction plans for a tunnel could be altered • ORD monitoring hydrology and water quality at select demonstration projects (e.g., St. Francis Apartments expansive rain gardens, Cincinnati State's permeable pavement parking lots)
Cleveland, OH Case Study (2010 – ongoing)	• ORD and Region 5 "Green Team" proposal (adopted) for integrated green-grey approach in Cleveland consent decree for CSOs • Adaptive management approach to integrate GI • Site-scale monitoring (water volume, water quality) at Cleveland GI pilots • Can adapt green-grey approach and take advantage of additional GI substitution to replace grey
Omaha, NE Case Study (2012 – ongoing)	• Omaha's consent decree for CSO control relies on grey infrastructure enhancements • Numerous GI opportunities under consideration to enhance their plan • Collaboration with ORD under development at their Minne Lusa GI pilot

Green Infrastructure Best Management Practices (BMP) Performance Monitoring

- Monitoring of GI BMPs such as permeable parking lots and rain gardens (O&M, long term performance) and stream restoration
- Field sites are located primarily in the Northeast and Midwest – Combined Sewer Systems (CSS), Green Infrastructure primarily implemented for keeping stormwater out of CSS
- Edison, NJ EPA facility: permeable parking lots, rain gardens
- Data from green infrastructure BMPs are used to inform the development and evaluation of stormwater modeling tools (e.g., Stormwater Management Model (SWMM))

Storm Water Management Model with Low Impact Development (SWMM v5)

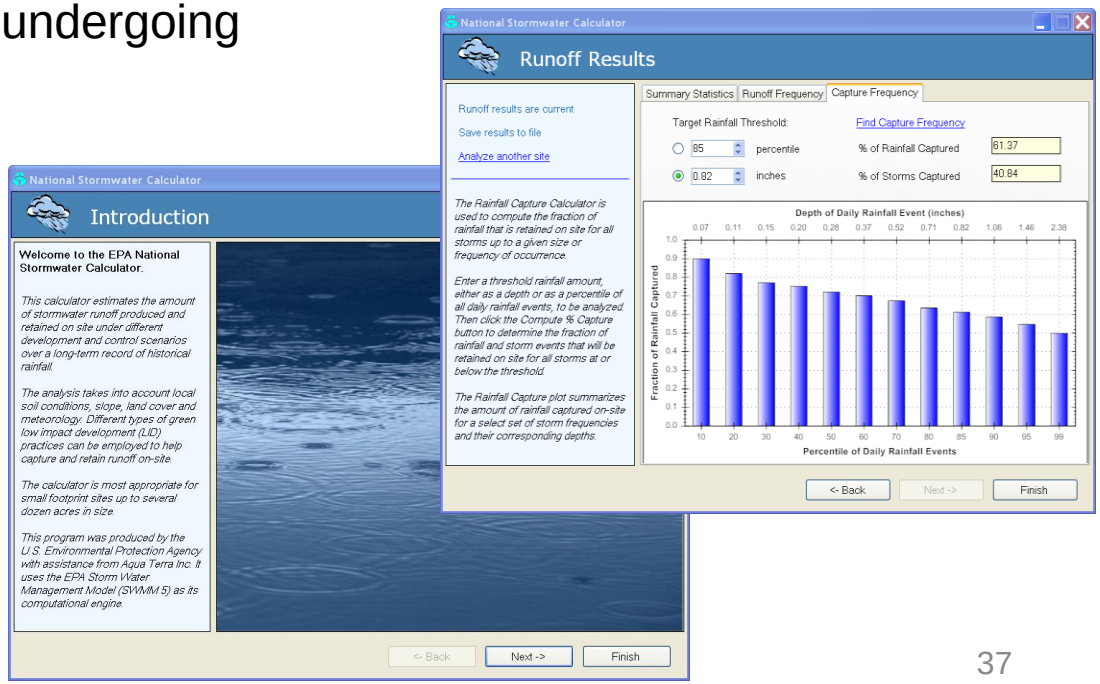


- Hydrology and hydraulics modeling (soils, landscape, buildings, pipe conveyance, treatment, overflows) to design green and grey stormwater management alternatives
- Estimates how planned stormwater management alternatives would impact stormwater runoff and Combined Sewer Overflows (CSOs)
- Publicly available tool, up to 2000 downloads of model every month
- SWMM is often used as core modeling engine by municipalities

http://www.epa.gov/nrmrl/wswrd/wq/models/swmm/

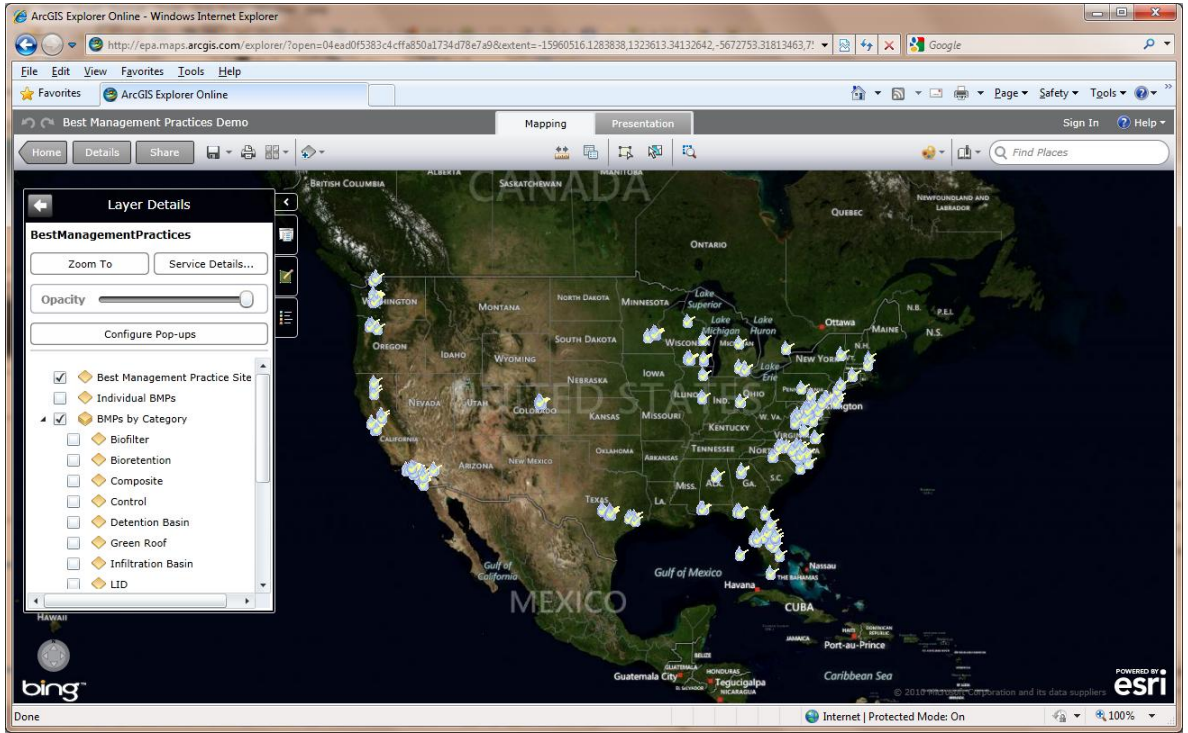
National Stormwater Calculator

- Stormwater calculator relies on SWMM model in background, easy to use.
- Developers and local planners estimate how much stormwater will run off their property (under development) with various green infrastructure/low impact development plans.
- Focus on stormwater runoff before it gets into sewer systems, unlike the larger scope and spatial scale of SWMM
- The stormwater calculator is undergoing external peer review, and will publicly available soon.



International Best Management Practices (BMP) Database and EPA GeoPlatform

- Water Environment Research Foundation (WERF) International Stormwater BMP Database information linked with USEPA GeoPlatform
- Goal to provide tools to access, query, and select GI BMPs performance data to communities with geospatial tools for searching and sorting information
- Data from EPA green infrastructure BMPs also are being incorporated into the International BMP Database and linked to the EPA GeoPlatform



SSWR Charge Questions

- ORD has integrated programmatic research with EPA Program Office input to begin developing a strategic nutrient management plan for the nation with the intent of accomplishing the SAB's recommended goal of 25% reduction of reactive nitrogen. Are there research gaps that would impede developing a strategy to accomplish the recommended 25% reduction goal? *(for example, should we be looking at green infrastructure for removing nutrients as well as for controlling storm water?)*

- To better accomplish our goal of using a variety of approaches to addressing stormwater issues, should EPA also be looking to incorporating natural infrastructure in the watershed into research on constructed green and gray infrastructure?