



Office of Research and Development

## SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



**SSWR BoSC Meeting – May 27, 2021**  
**Research Area 10: Stormwater**  
**Ann Grimm, RA Coordinator**





- 💧 Stormwater management issues continue to be a challenge for many communities in the US.
- 💧 Many combined sewer systems in the Northeast, Midwest, and Pacific Northwest need innovative methods for addressing discharge issues.
- 💧 Municipal Separate Storm Sewer Systems (MS4) need new approaches for managing water quality and quantity.

Stormwater research will integrate green and gray infrastructure to minimize stormwater effects on human health and the environment and will explore ways to capture stormwater for beneficial uses.





# Water Treatment and Infrastructure

## Research Area 7

### Drinking Water/Distribution Systems

Provide essential results and tools to our customers for managing existing and future drinking water needs. Specifically, it focuses on areas of recent concern that require novel solutions.

## Research Area 8

### Per- and Polyfluoroalkyl Substances (PFAS)

Robust analytical methods for analyzing PFAS in water, solids, and tissue samples, and a centralized website for treatment and pretreatment recommendations for wastewater and reuse.

## Research Area 9

### Wastewater/Water Reuse

Guidance on new and existing treatment technologies and analytical methods for emerging contaminants and contaminant risks.

## Research Area 10

### Integrated Stormwater Management

Integrated aspects of green/gray infrastructure and stormwater flow control to help states, municipalities, and utilities reduce the number of combined sewer overflows.

## Research Area 11

### Technical Support

Provide a means for rapid response to specific, unplanned program office, state, tribe, and community research needs concerning high-priority issues.







# Stormwater Management



**This research area will provide essential results and tools to the program offices, primarily the Office of Water; states; tribes; and communities to better manage stormwater.**

## Agency Drivers

Regulatory determinations under the CWA and SDWA (current and future), National Pollution Discharge Elimination System requirements, state regulations.

## Focus

Areas of recent concern that require novel solutions:

- 💧 Combined sewer overflows
- 💧 Monitoring stormwater infrastructure effectiveness and costs
- 💧 Enhanced aquifer recharge



# Research Outputs Overview

## Output 10.1

Planning, Implementing, and  
Monitoring Stormwater  
Management Practices

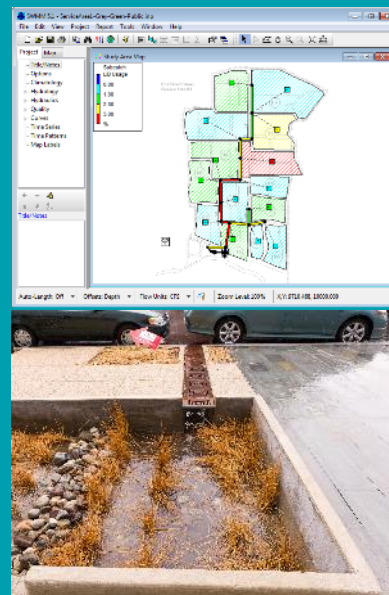
## Output 10.2

Stormwater Management as a  
Resource for Enhanced Recharge,  
Capture, and Use





Products from this work will help provide stakeholders with resources to monitor and manage stormwater, provide planners with tools for stormwater management strategies, and evaluate best practices for enhanced aquifer recharge.



- 💧 Optimization of the Stormwater Management Model (SWMM) for green/gray infrastructure planning.
- 💧 Monitoring strategies for evaluating water quantity and quality management.
- 💧 Report on best practices for stormwater capture and use through enhanced aquifer recharge and decentralized reuse.

# Stormwater Management as a Resource for Enhanced Recharge, Capture, and Use

Lead: John Johnston



## SSWR 10.2.1: Recommendations for Water System Recharge to Aquifers

**Problem:** Stormwater is often seen as a nuisance rather than a resource.

**Action:** Conduct research to explore the possible use of stormwater for enhanced aquifer recharge (EAR).

### Results (Anticipated):

- ◆ Report on the state-of-the-science for EAR best practices.
- ◆ Costs/benefits of enhanced stormwater recharge.
- ◆ Comparisons of design, performance and maintenance issues for sink holes infiltration ponds, serial dams, spreading basins and drywells.
- ◆ Application of methods to evaluate impacts of EAR on groundwater quality.
- ◆ Treatment options for stormwater for EAR.

**Expected Outcome:** Recharged aquifers by providing stakeholders with stormwater best management practices.

**Product POC:**  
Doug Beak (CESER)

### Internal Partners:

Robert Goo, Sharon Nappier, Justin Mattingly (OW),  
Newton Tedder (R1), Elizabeth Ottinger (R3)



### External Collaborators:

Chickasaw Nation, Oklahoma DEQ, Oklahoma Water Resources Board, City of Ada Oklahoma, Oklahoma State U., USGS, USDA ARS, UC Riverside, UC Davis



## SSWR 10.2.2: Recommendations for Stormwater Capture and On-Site Use

**Problem:** Communities lack data on stormwater quality including chemical and microbial pollutants and how these pollutants vary by location.

**Action:** Characterize stormwater constituents as it flows through different environments (e.g., urban, rural) to apply risk-based assessments for reuse.

### Results (Anticipated):

- 💧 Evaluation of stormwater pathogen concentrations in urban and rural settings.
- 💧 Data on chemical pollutants in stormwater and potential impacts for reuse and EAR.
- 💧 Develop risk-based frameworks for decentralized stormwater use.

**Expected Outcome:** Provide communities with results and best practices for implementing stormwater capture and use.



### Product POC:

John Johnston (CEMM)

### Internal Partners:

Robert Goo, John Ravenscroft, Rachel Urban, Sharon Nappier, Amina Pollard (OW); Newton Tedder (R1); Elizabeth Ottinger (R3)



## SSWR 10.2.3: Modeling and Monitoring the Influence of Stormwater on Groundwater Quality and Aquifer Recharge

**Problem:** Data is lacking on potential stormwater effects on groundwater resources.

**Action:** Conduct research on subsurface interactions with stormwater. Evaluate the fate and transport of contaminants in stormwater and those present in the subsurface.

**Results:** Data from monitoring networks in different geological and climatological settings for evaluating contaminant behavior:

- 💧 Mixing infiltrate water with groundwater can cause groundwater changes; concentration of traditional stormwater contaminants did not pose a concern.
- 💧 Dilution of the groundwater could change the drinking water source chemistry and impact water treatment. Possible risk.
- 💧 Reverse ion exchange. Increased sodium loading on the fine-grained particles in the vadose zone could lead to clogging diminish infiltration and water movement.
- 💧 Solubility and mobility of barium affected by the concentrations of chloride. Enhanced mobility of some metals could be potentially problematic when chloride salts are applied as de-icing agents.
  - Development of models to evaluate stormwater best management practices for aquifer recharge.

**Expected Outcome:** Provide communities with information on contaminant movement and potential threats, or lack thereof, to groundwater resources.



### Product POC:

Doug Beak (CESER)

### Internal Partners:

Dawn Taylor (R4); Christopher Taylor (R7); David Albright, Matthew Small, Leslie Greenberg (R9); Robert Elleman (R10)

### External Collaborators:

DoD, Army Corp of Engineers, Louisville and Jefferson County MSD, City of Yakima, County of Yakima, UC Riverside, USDA ARS, U. Arizona, USGS, California Water Science Center





## Research Output 10.1

# Planning, Implementing, and Monitoring Stormwater Management Practices

Lead: Matt Hopton





# SSWR 10.1.1: Recommendations for Planning, Monitoring, and Managing Stormwater

**Problem:** EPA Regional and Program Office (PO) partners, states, tribes, and municipalities need better approaches for evaluating stormwater management options prior to installation.

**Action:** Develop modeling and cost/benefit tools for comparing and evaluating management options for managing stormwater quality and quantity. Provide monitoring solutions for evaluating management strategies.

## Results (Anticipated):

- 💧 Cost/benefit tool (CLASIC) developed by WRF through STAR Grant.
- 💧 Report on the application of SWMM and other models (e.g., Visualizing Ecosystem Land Management Assessments, National Stormwater Calculator) to simulate green/gray infrastructure.
- 💧 Tools to design stormwater control approaches (e.g., size and cost-effectiveness).
- 💧 Integration of sensing technologies, communications, digital data tools, and machine learning for planning.
- 💧 Monitoring and tracking pollutants (e.g., road salt, pathogens).

**Expected Outcome:** Improved stormwater management in CSO and MS4 systems by providing management options and monitoring solutions to Regional/Program Office, state and tribal partners.

## Product POC:

Paul Mayer (CPHEA)

## Internal Partners:

Jamie Piziali, Sharon Nappier, Robert Goo, Rachael Urban, Jenny Molloy (OW); Newton Tedder (R1); Elizabeth Ottinger (R3); Regina Poeske (R3); Matt Small (R9); Angela Adams (R10); Lewis Linker (CBPO)

## External Collaborators:

Department of Energy & Environment; WRF; Seattle; U of W Center for Urban Waters; Riverside County Flood Control and Water Conservation District; Southern CA Coastal Water Research Project; USGS; DOE; U of MN; NEORSD; City of Fairfield, Ohio; Urbanalta, Inc.; OKI Water Science Center; University of MD; Joseph Cotruvo and Associates; Essential Environmental and Engineering Systems





## SSWR 10.1.2: Recommendations for Stormwater Management Implementation and Performance

**Problem:** Stakeholders lack information on existing green infrastructure (GI) including efficacy, costs/benefits, and fate/transport of contaminants through GI.

**Action:** Conduct research on monitoring gray/green infrastructure and identifying best management practices that combine GI and gray infrastructure to minimize CSO events.

### Results (Anticipated):

- ◆ Summary document/website on models, tools, and best-management practices using green/gray infrastructure to eliminate urban CSOs.
- ◆ Development and validation of integrated infrastructure models with temperature/precipitation models.
- ◆ Evaluation of nitrogen fate and transport in urban stormwater.
- ◆ Report on practical methods for watershed management and community involvement for practical stormwater management implementation.

**Expected Outcome:** Reduced CSO events by providing stakeholders with tools for monitoring and optimizing stormwater management approaches.



### Product POC:

Ariamalar Selvakumar (CESER)

### Internal Partners:

Matt King, Stephanie Santell, Smiti Nepal (OW); Micah Bennett, Sydney Wiess, Danielle Green (R5); Veronica Fasselt (R4)

### External Collaborators:

USGS; DOE; WI Department of Natural Resources; FL State University; FL Escambia County, Environmental Management Division; Northeast OH Regional Sewer District; University of MN; Great Plains Institute; Monroe and Vernon County Conservationist; Village of Viola



## SSWR 10.1.3: Decision-Support Tools for Cost-Effective Community and Watershed-Scale Integrated Planning, Including Stormwater, Wastewater, Drinking Water Management, and Land-Use Conservation

**Problem:** Stormwater, wastewater, drinking water resource, and land use management are often stove-piped and not coordinated at the watershed scale, leading to higher costs and unintended consequences. Tools were not previously available to support EPA's integrated water management program.

**Action:** Develop tools for cost-effective integrated water management, including not only wastewater + stormwater, but also drinking water and land conservation.

### Results:

- 💧 EPA ORD has released multiple versions of the Watershed Management Optimization Support Tool (WMOST) with user guides, theoretical documentation, case studies, and training material.
- 💧 Optimization is now provided for both water quantity (water supply, flooding) and water quality (water quality standards, TMDL loads) goals.
- 💧 Dollar value of associated benefits and cobenefits of green infrastructure can be quantified with the new Benefits Module.

**Outcome:** Stakeholders have tools to find cost-effective solutions involving integrated water management at the small watershed scale (HUC12-HUC10). MDE has been trained in use of WMOST.

### Product POC:

Naomi Detenbeck (CEMM)

### Internal Partners:

Chau Vu (R1), Regina Poeske (R3),  
Christopher Taylor (R7)



### External Collaborators:

MD Department of the Environment,  
Southeastern Regional Planning &  
Economic Development District,  
Resilient Taunton Watershed  
Network, KS Department of Health  
and Environment







## Charge Question 3

Stormwater management approaches can decrease stormwater runoff to wastewater treatment systems (combined sewer systems) and stream discharges (municipal separate storm sewer systems). Consequences from combined sewer systems frequently affect lower-income areas in urban settings. These effects may be exacerbated in areas subjected to increased intensity, duration, and frequency of extreme precipitation events.

*In addition to evaluating ORD's stormwater research activities, what suggestion(s)/recommendation(s) does the Subcommittee have to improve the utility of these research activities to provide integrated decision-support tools for stormwater management in disadvantaged communities?*





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- ◆ Hoover, F.A., J.I. Price, and M.E. Hopton. 2020. Examining the Effects of Green Infrastructure on Residential Sales Prices in Omaha, Nebraska. *Urban Forestry & Urban Greening* 54:126778. doi:[doi.org/10.1016/j.ufug.2020.126778](https://doi.org/10.1016/j.ufug.2020.126778)
- ◆ Brumfield et al. 2021. Metagenomic sequencing and quantitative real-time PCR for fecal pollution assessment in an urban watershed. *Frontiers in Water*, 3:626849. <https://doi.org/10.3389/frwa.2021.626849>
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## SSWR.10.1.3

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- ◆ US EPA. 2020. WMOST v3 Case Study: Cabin John Creek, Maryland. EPA/600/R-19/185.
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- ◆ Detenbeck, N., R. Sullivan, and A. Piscopo. 2019. Watershed Management Optimization Support Tool (WMOST) v3.01 Training Webinar Series
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- ◆ Detenbeck, N., A. Lee, A. Piscopo, T. Stagnitta, J. White, A. Brown, and M. ten Brink, 2018. User-Friendly Decision Support for Integrated Water Management: EPA's Watershed Management Optimization Support Tool. Proceedings, International Environmental Modeling and Software Society Conference, Fort Collins, CO, June 24-28, 2018. (Available online at: <https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=3909&context=iemssconference> )

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