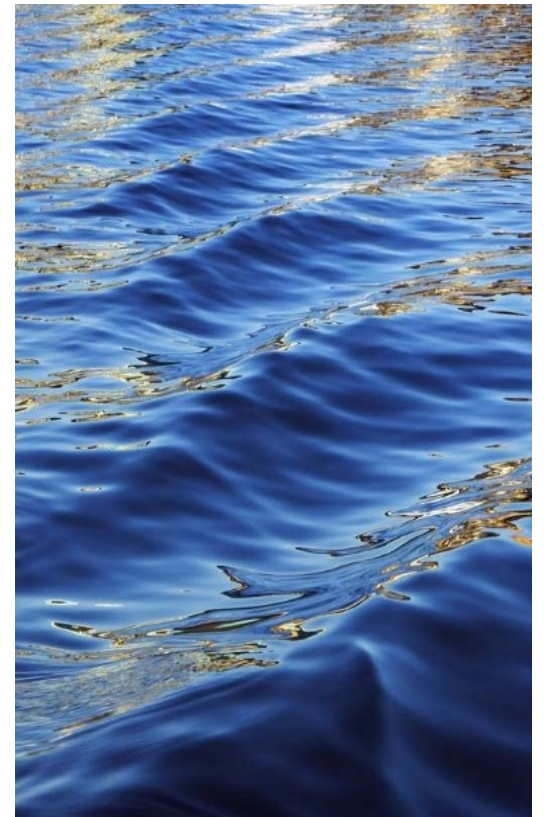


# Improving Water Reuse for a Healthier Potomac Watershed

Justin Mattingly  
Water Environment & Reuse Foundation

November 10, 2016



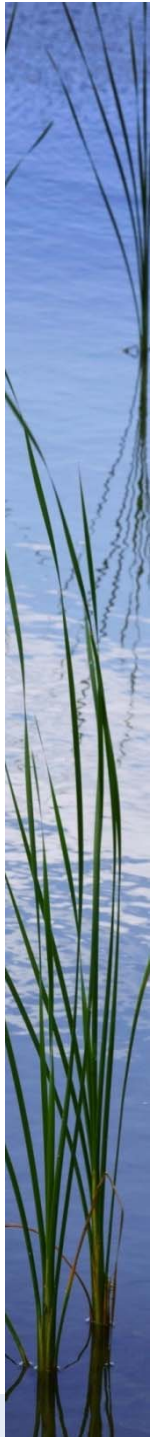
# Project Team

- Dr. Sujay Kaushal – University of Maryland
- Dr. Shuiwang Duan – University of Maryland
- Dr. Diana Aga – University at Buffalo
- Dr. Adil Godrej – Virginia Tech
- Dr. Luke Iwanowicz – U.S. Geological Service
- Dr. Erik Rosenfeldt – Hazen and Sawyer
- Dr. Sudhir Murthy – DC Water



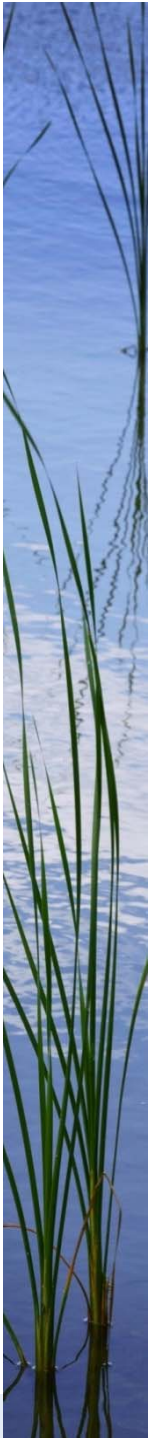
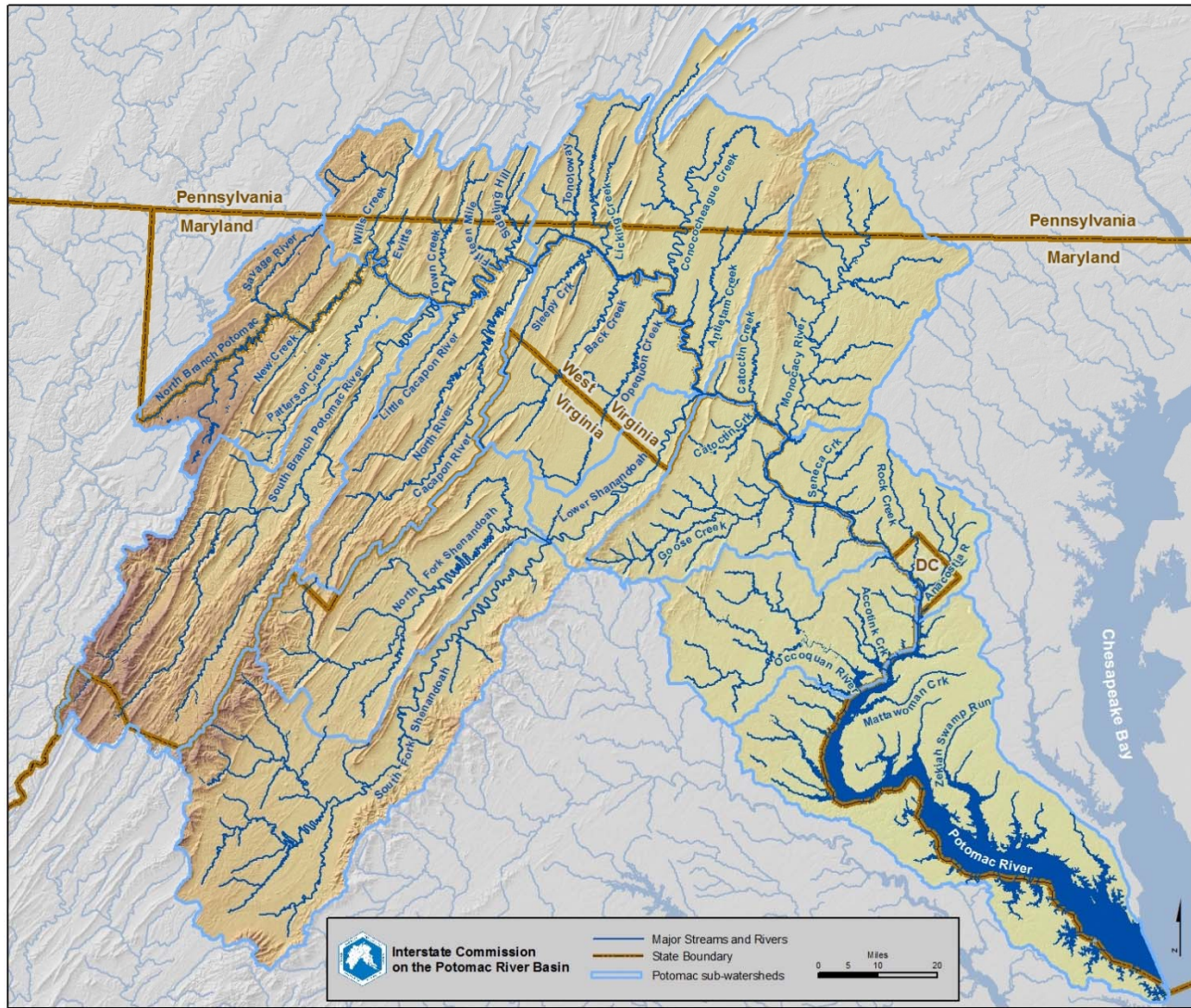
## Project Advisory Committee (PAC)

- Bob Angeliotti – Upper Occoquan Service Authority
- Dr. Rominder Suri – Temple University
- Leita Bennett – GHD
- Steven Bieber – Metropolitan Washington Council of Governments
- Dr. Susan Glassmeyer – U.S. EPA



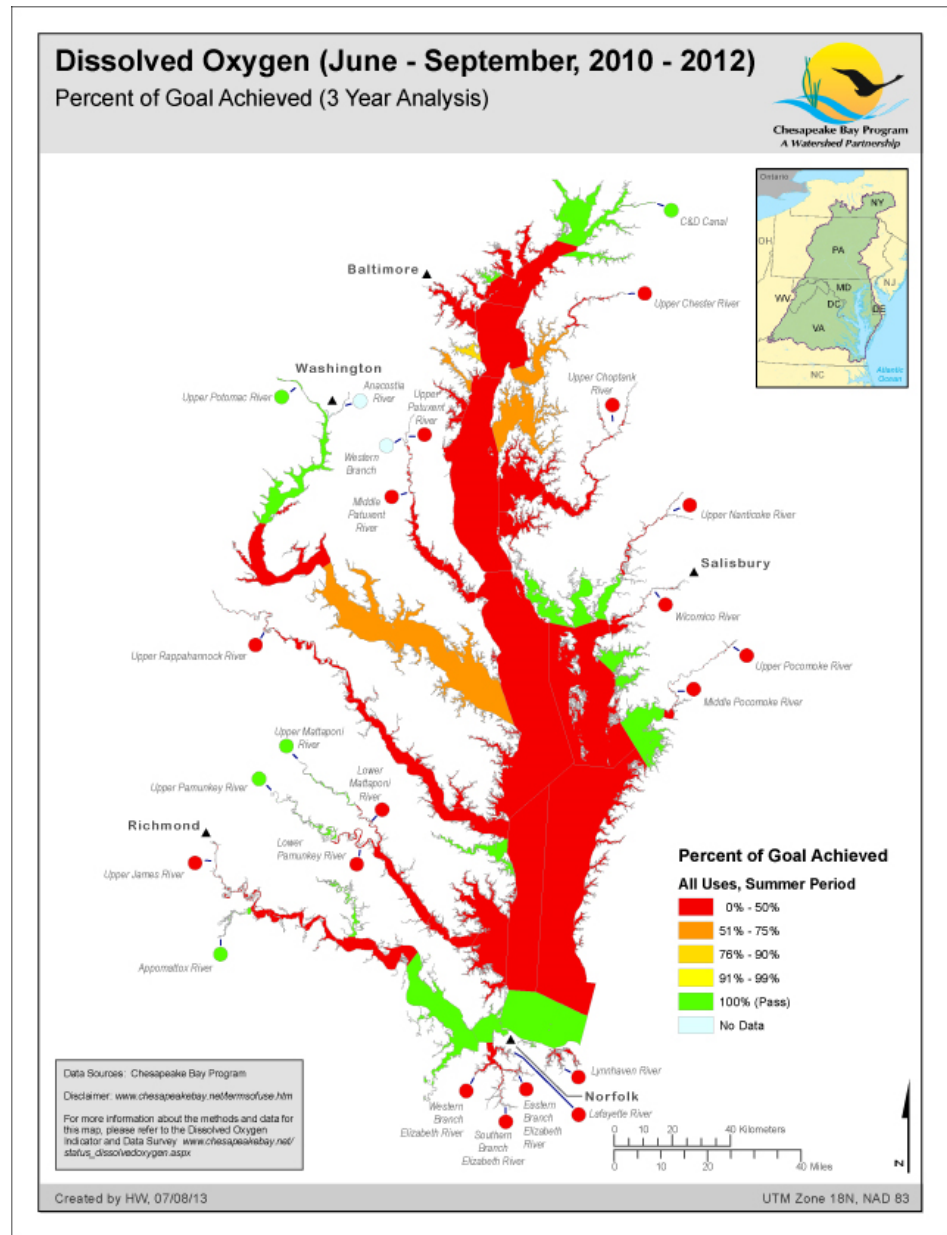


# Potomac River Watershed



# Nutrients

- Wide variety of land uses in Potomac watershed
- TMDL established in 2010 for Chesapeake Bay
- Economic value in fisheries
  - \$3.39 billion in sales
  - \$890 million in income
  - Nearly 34,000 jobs to the local economy





# Endocrine Disrupting Compounds

Speaking of Science

These fish started life as boys. Now scientists aren't sure what sex they are.

- Herbicides (e.g. atrazine)
- Biogenic hormones

Sex-change chemicals in Potomac

Potential sources

Intersex Fish Linked To Population And Agriculture In Potomac River Watershed

- Municipal wastewater

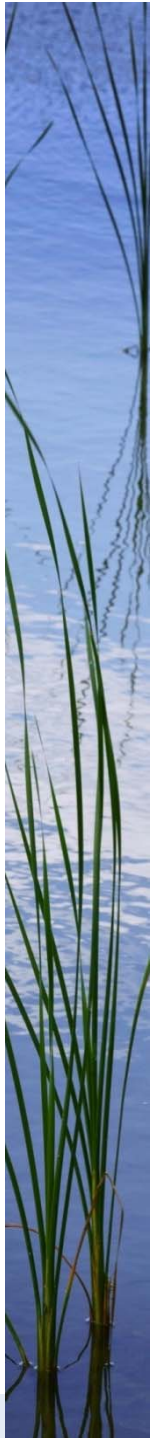
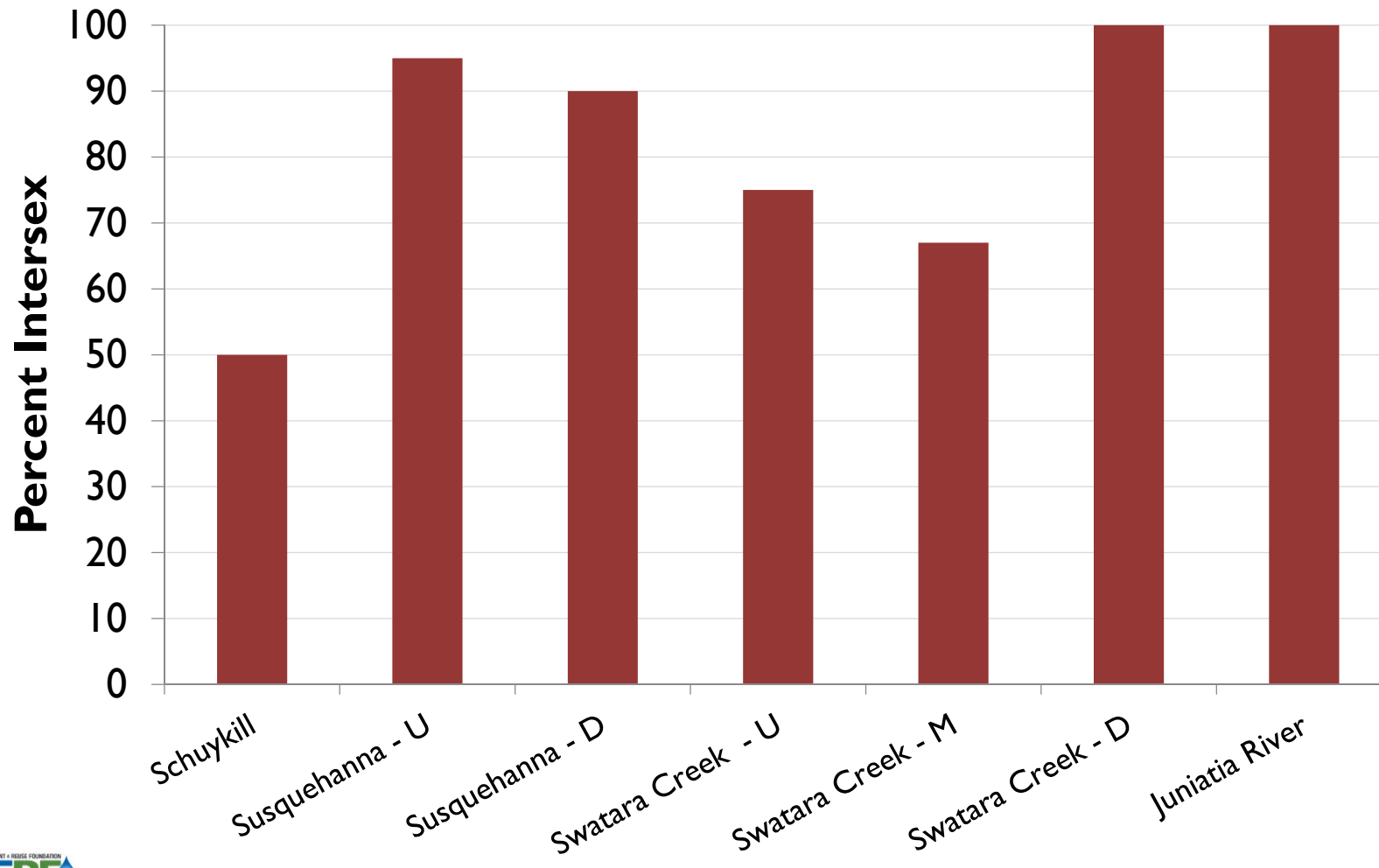
▪ Stormwater

Health & Science

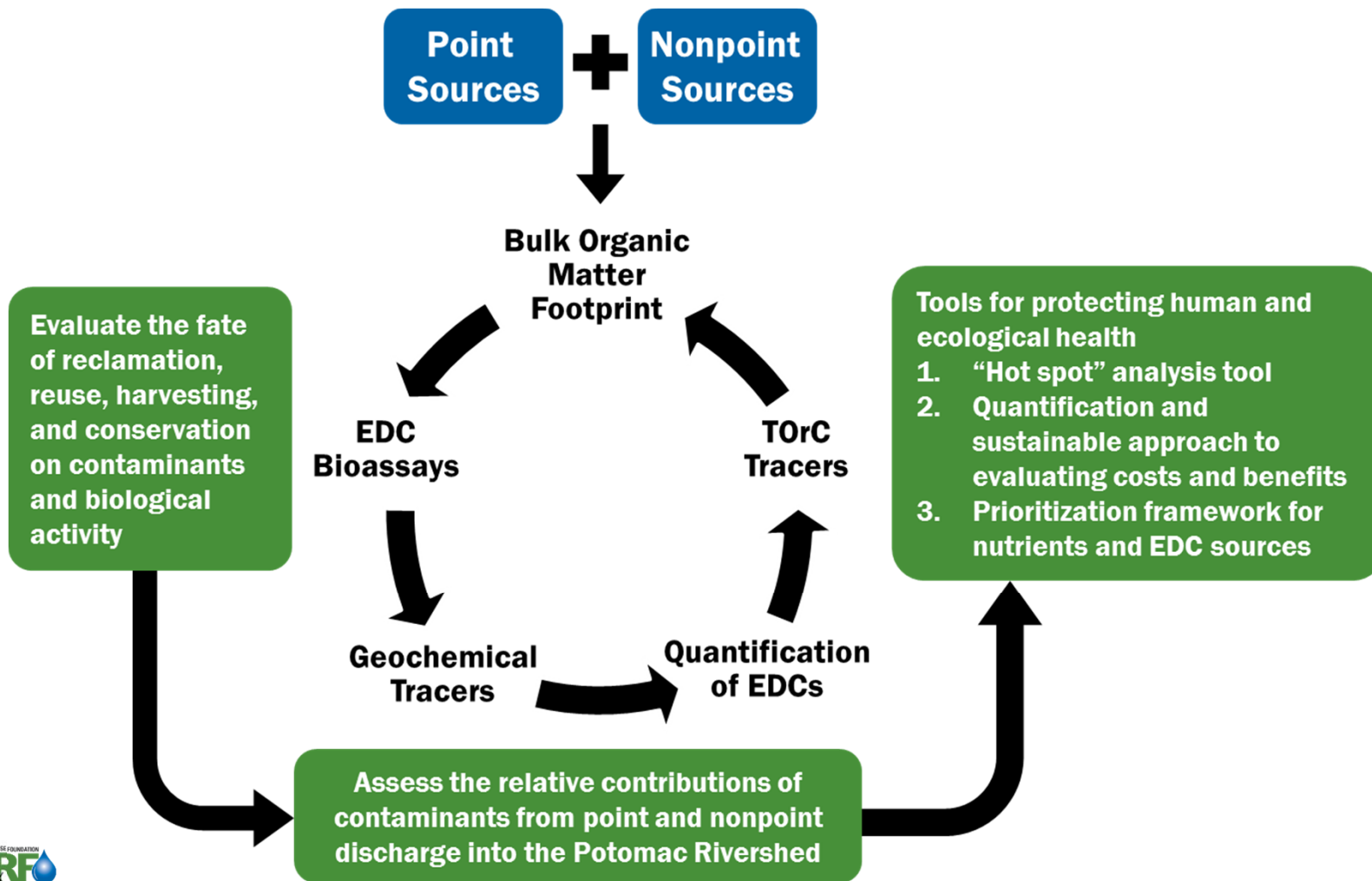
As more male bass switch sex, a strange fish story expands



# EDCs in Pennsylvania Watersheds

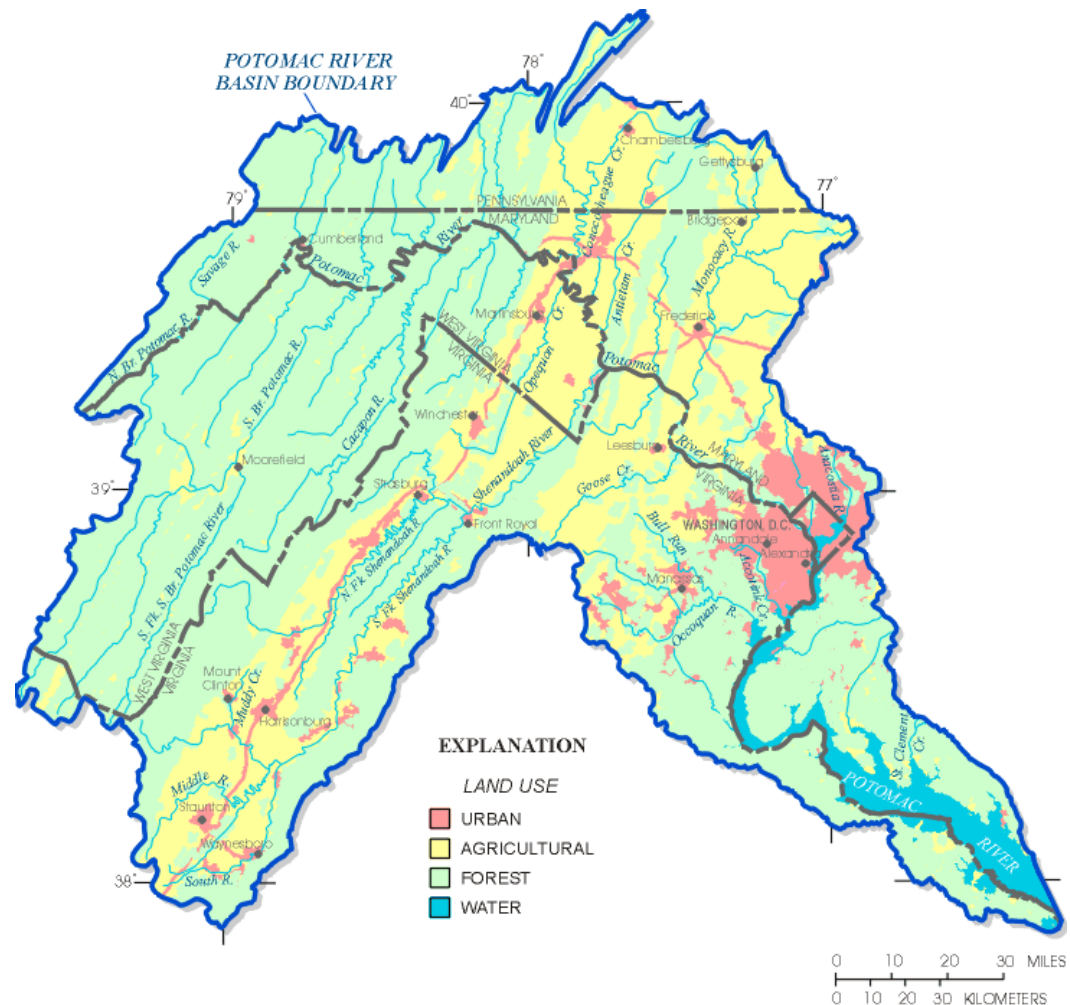


# Conceptual Model for Managing Pollutants



# Year 1 – Hot Spot Analysis

- Identify and track spatial variations in “hot spots” of EDCs, biological activity, and nutrients
- USGS and Chesapeake Bay Program sites
- Includes sites impacted by treated wastewaters, mineral fertilizers, animal manure, and atmospheric deposition

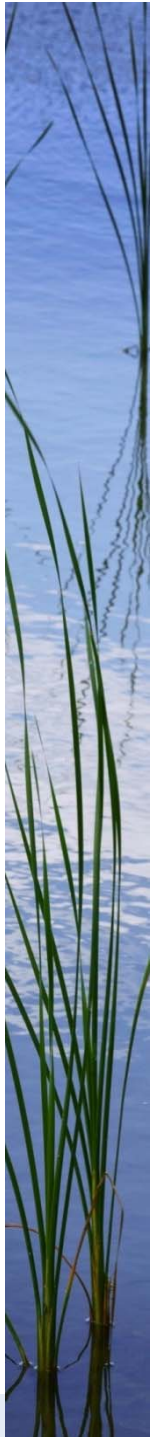




# Year 2a – Impact of current management strategies

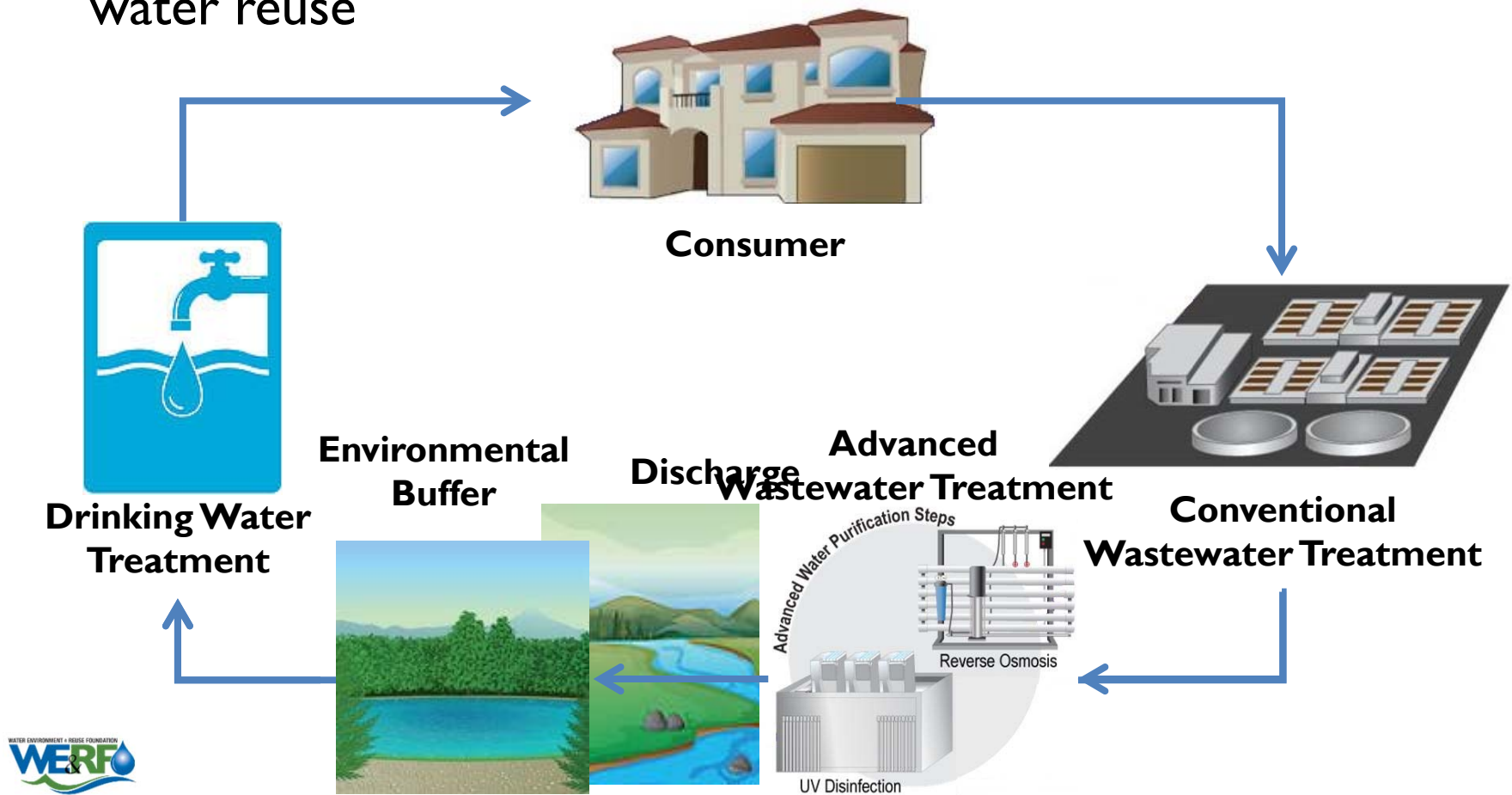
- Effects of water reuse, stormwater harvesting, and management practices
- Sites to be chosen in coordination with PAC based on the results of Year I

Advanced reclamation	Conventional reclamation
Stormwater reuse	Unmanaged stormwater
Managed agriculture (e.g. riparian buffers)	Unmanaged agriculture



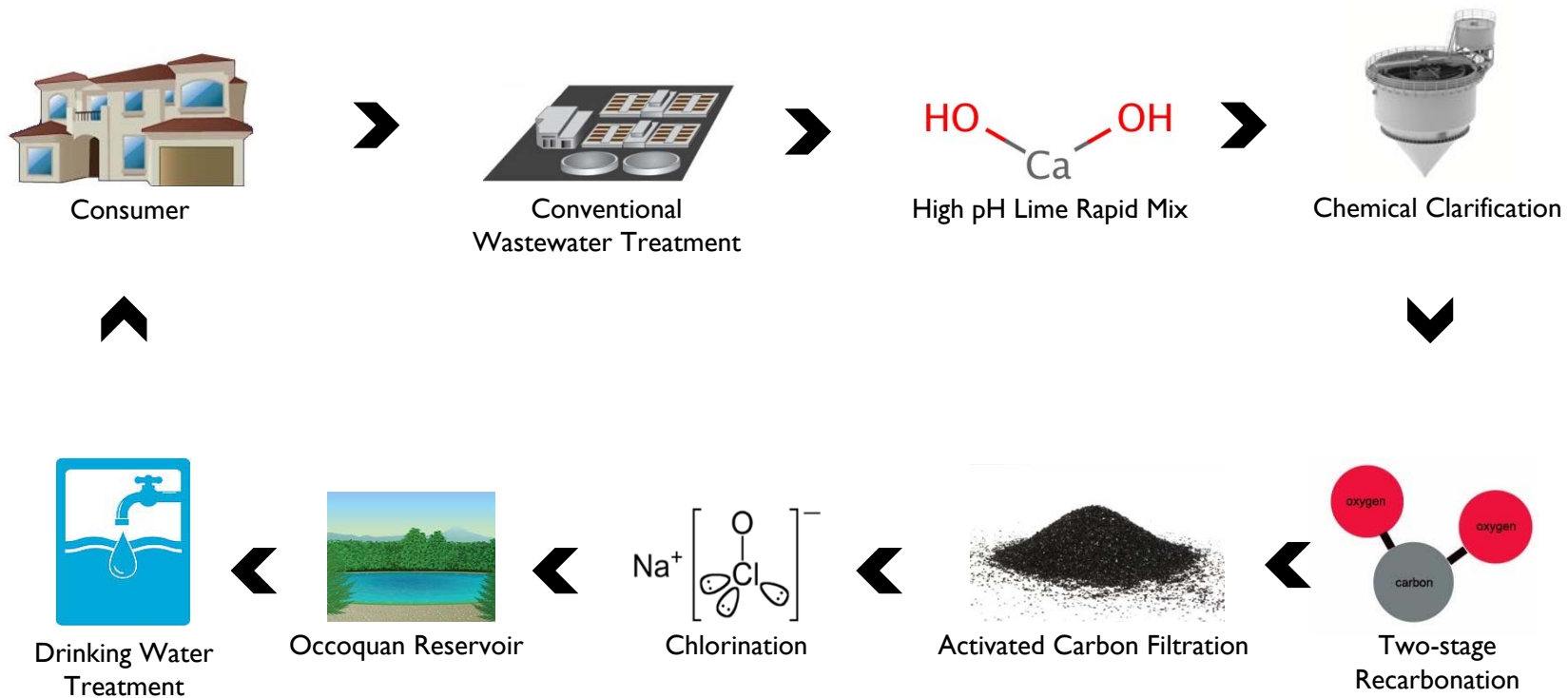
# Year 2b – Impact of planned potable reuse

Pilot-level studies on the impact of planned and unplanned water reuse



# Upper Occoquan Service Authority

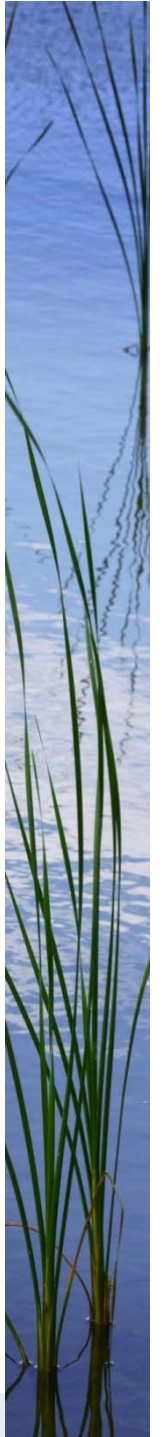
Planned indirect potable reuse since 1978



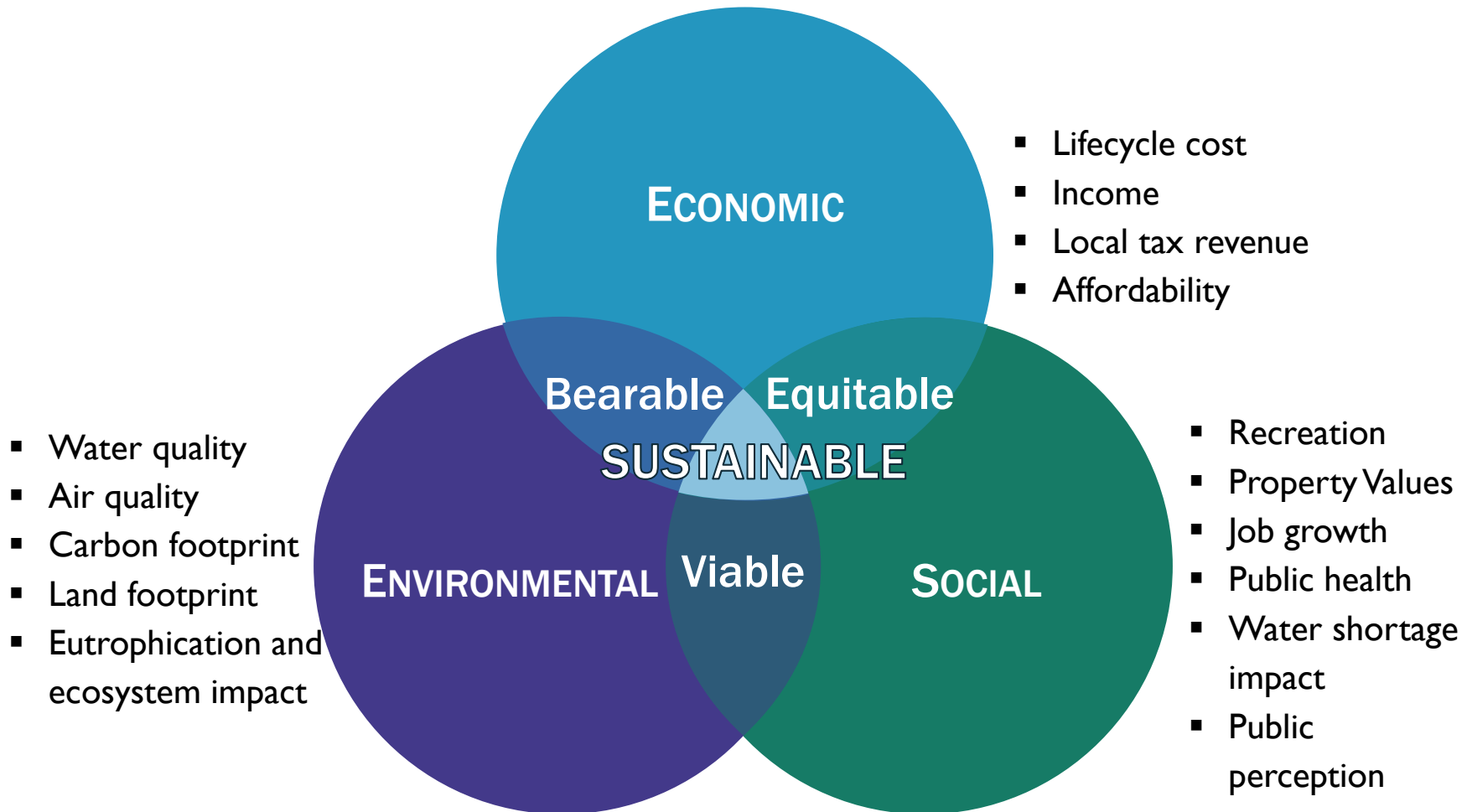


## Year 3 – Cost-benefit analysis

- Incorporate economic and societal factors
- Framework with three components
  1. EDC and nutrient sources – seasonal and spatial variability
  2. Proportion of EDC and nutrient sources along 10 sections of the Potomac
  3. Effectiveness of management strategies
- Output of potential EDC and nutrient reduction in the Potomac River watershed

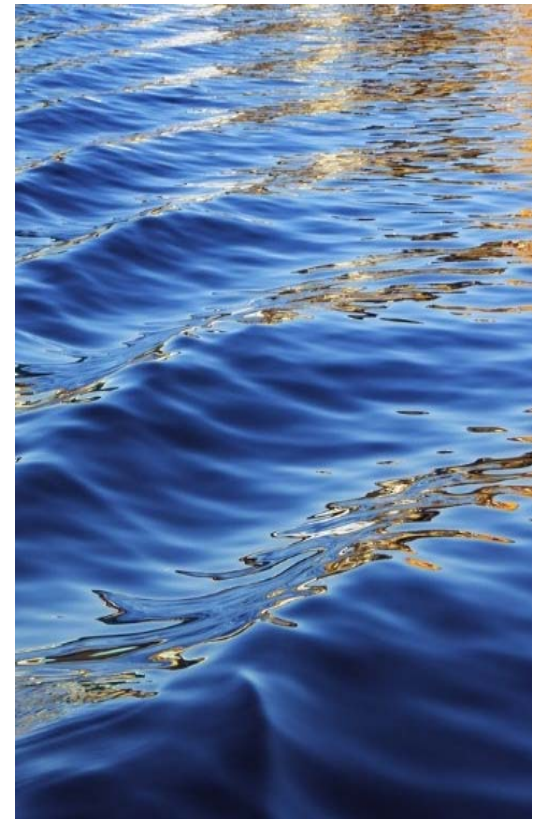


# Triple-Bottom Line Approach



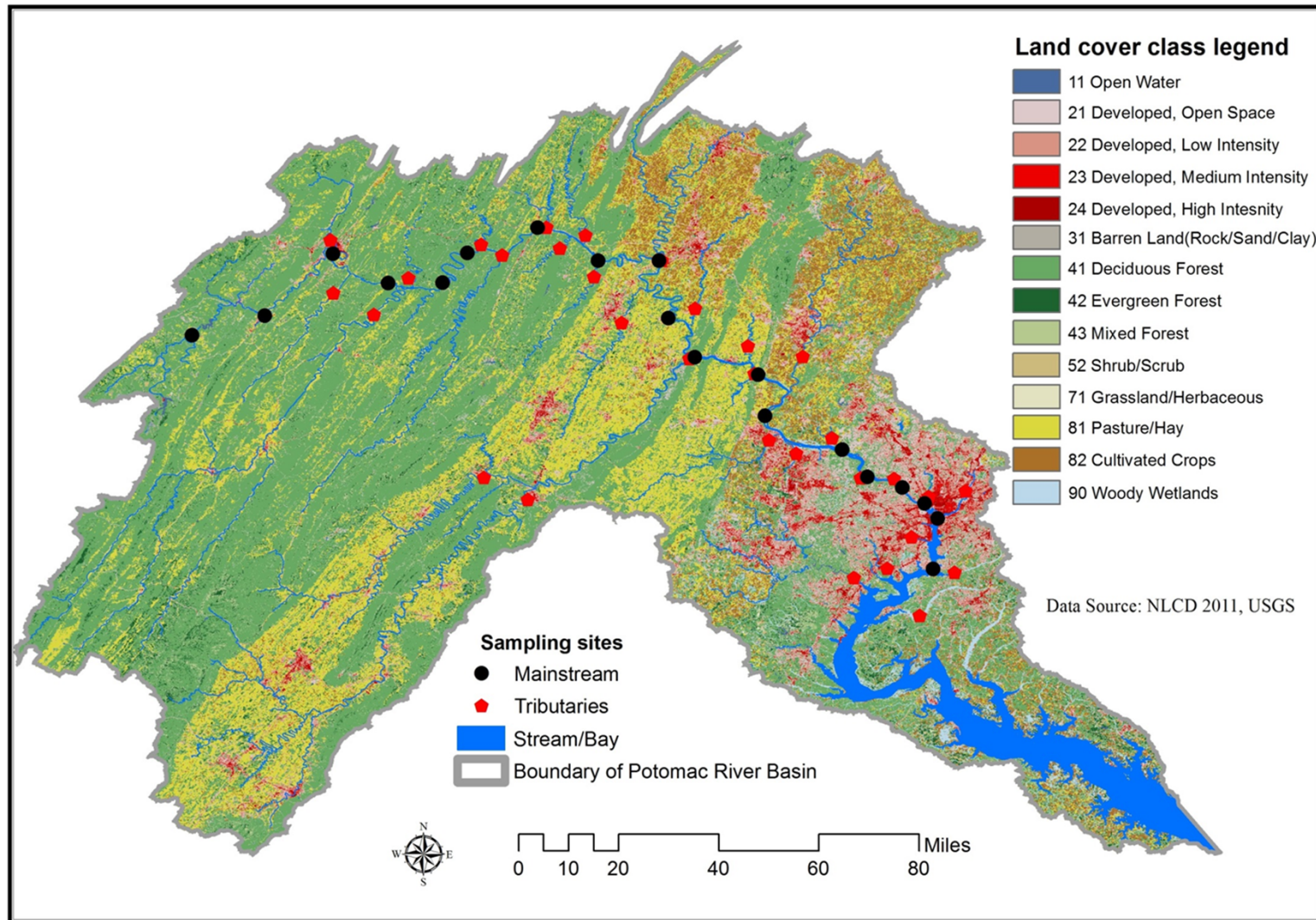


# Sampling Sites and Preliminary Results





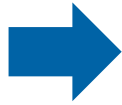
# Sampling sites in August – 19 main stem and 31 headwater sub-watershed sites



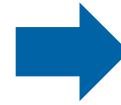
# Sampling the Land Use Gradient



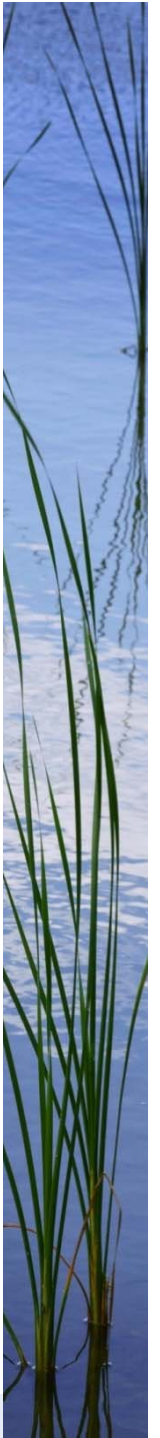
Upper Potomac: **Forest**



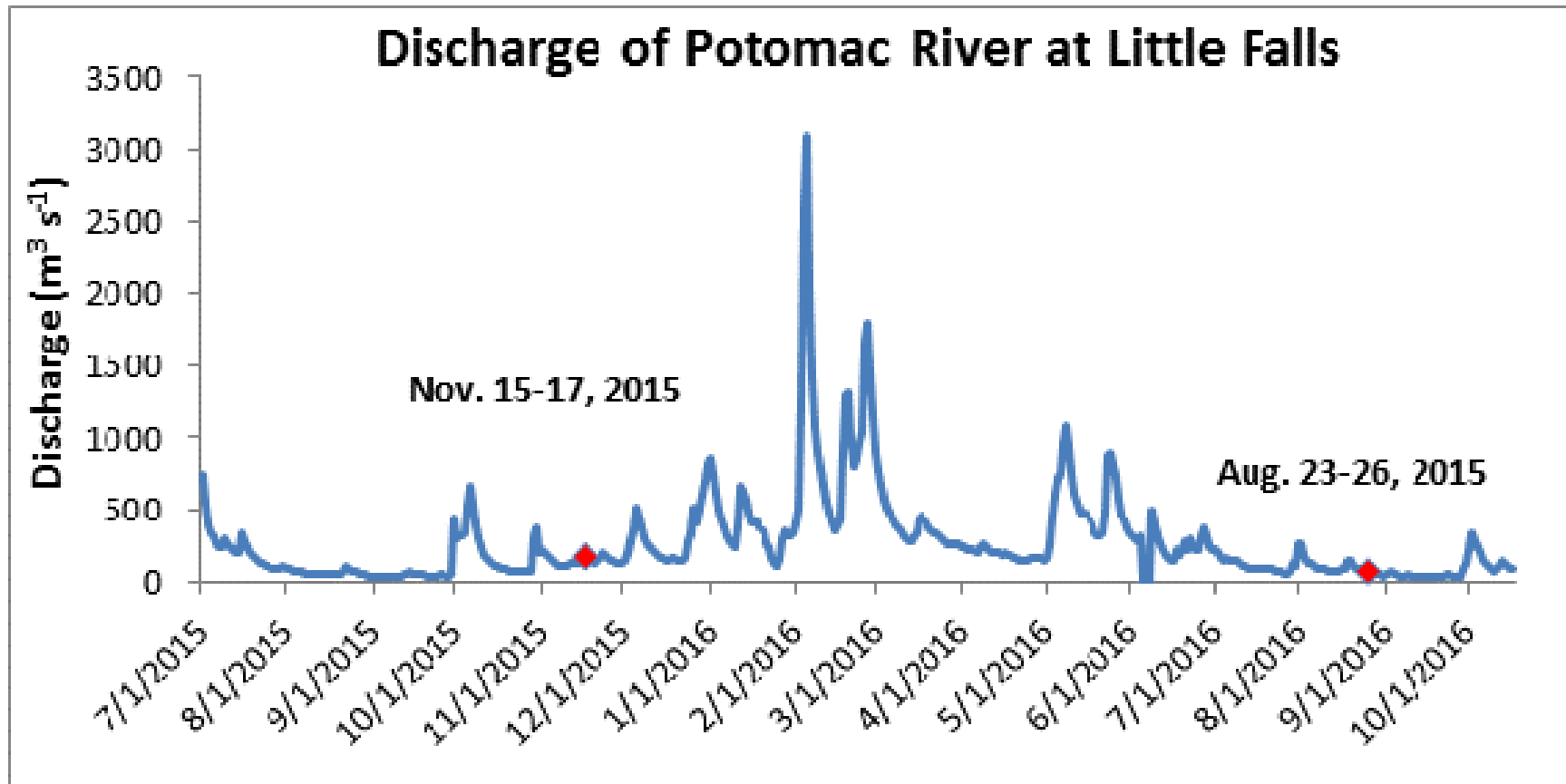
Middle Potomac: **Agriculture**



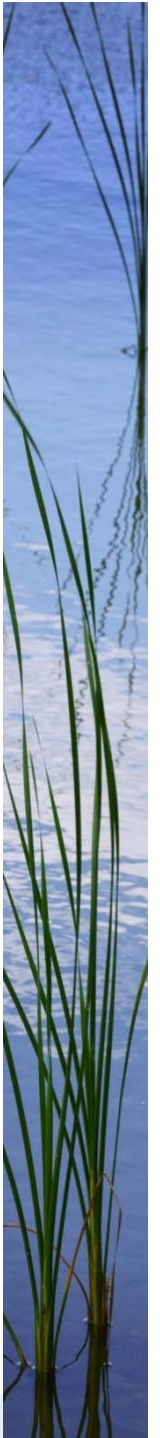
Lower Potomac: **Urban**



# Hot Spot Sampling at Baseflow

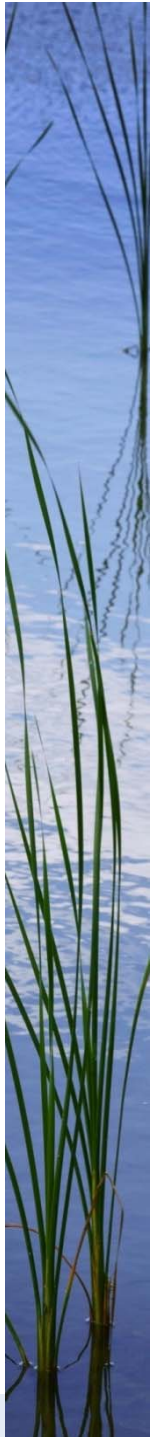
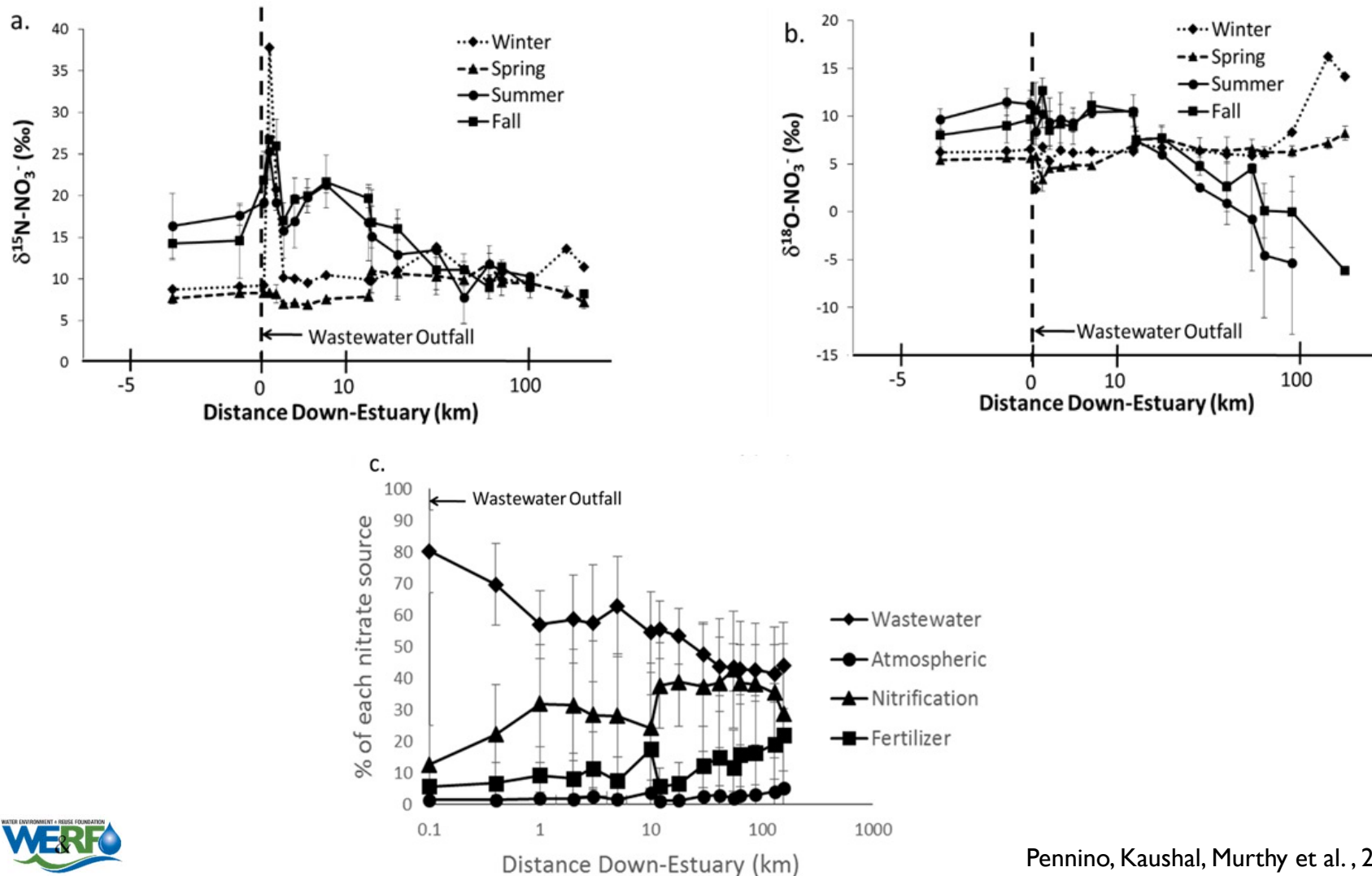


Fall 2015 (middle flow) and Summer 2016 (base flow)





# Tracking Nitrogen Sources Along the Potomac River



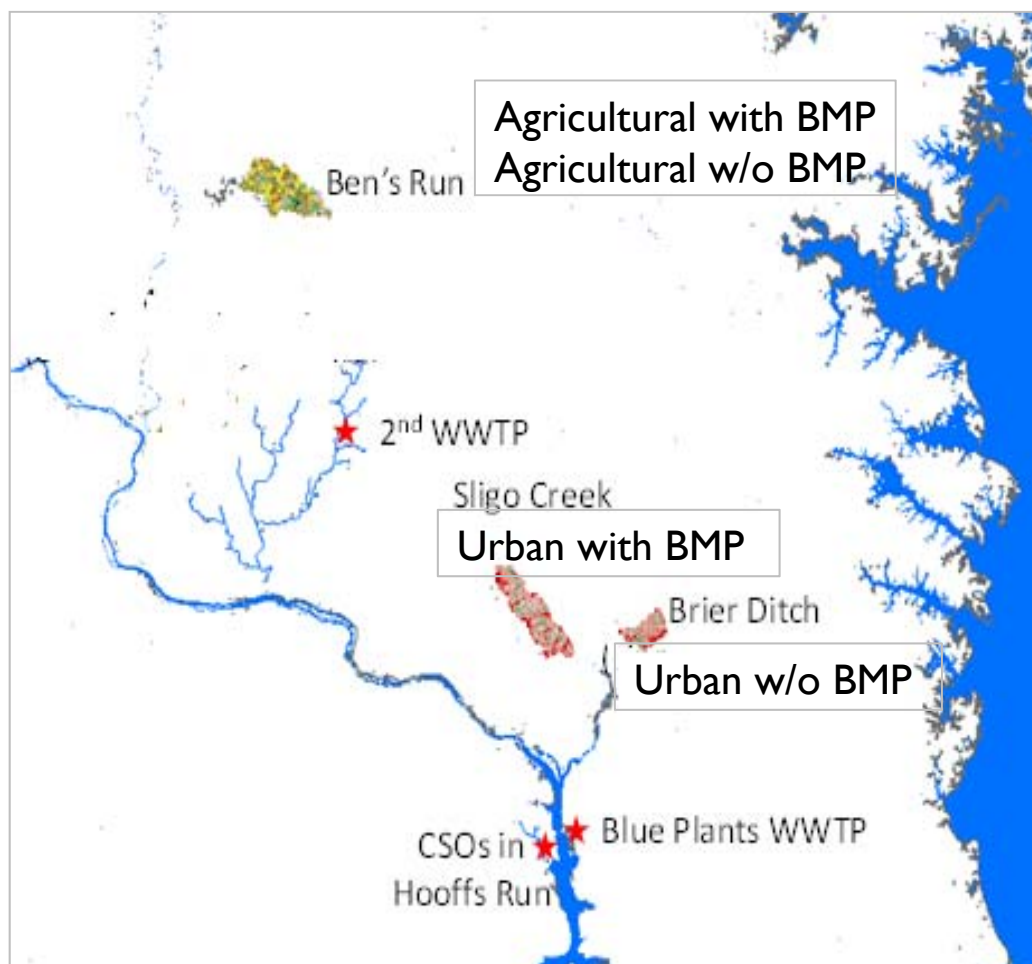
# Evaluating Sources and Management of Nitrogen and EDCs

## ► Paired streams

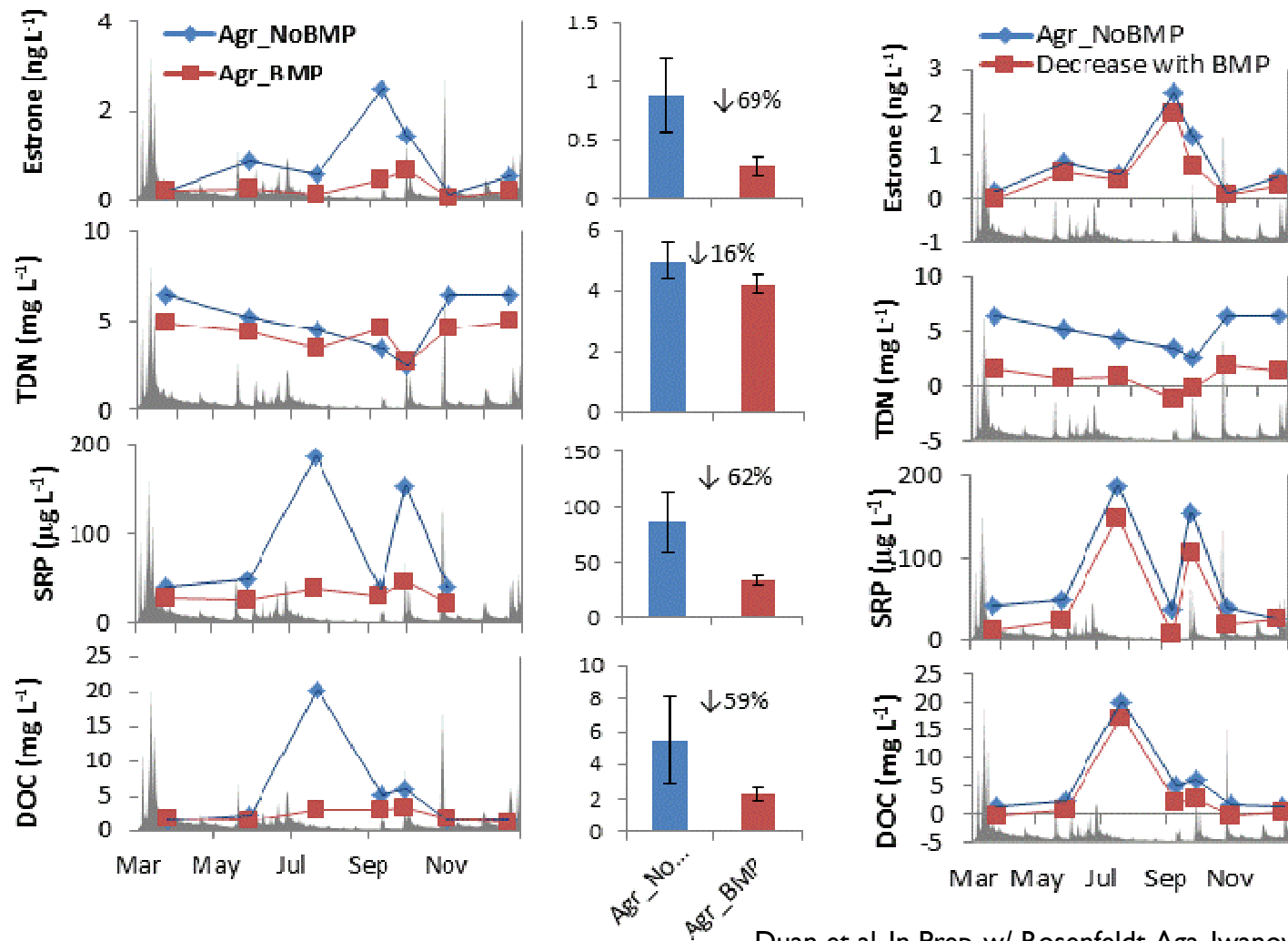
↕ **Agricultural w/o BMP**  
↕ **Agricultural with BMP**

↕ **Urban w/o BMP**  
↕ **Urban with BMP**

**Efficiencies of stormwater  
BMPs = w/o BMP - with BMP**



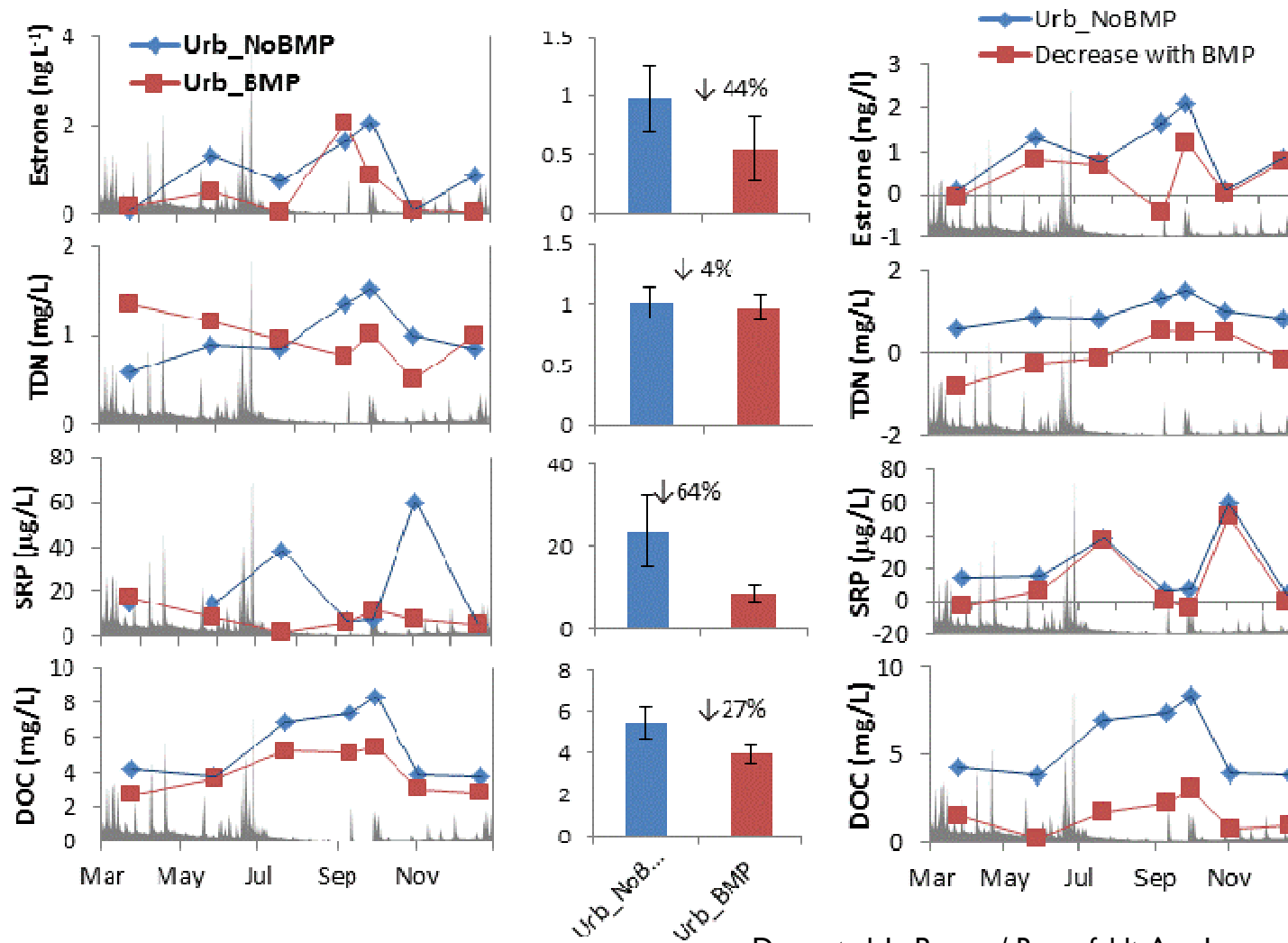
# Agricultural BMPs reduce Estrogen, N, P, or C inputs



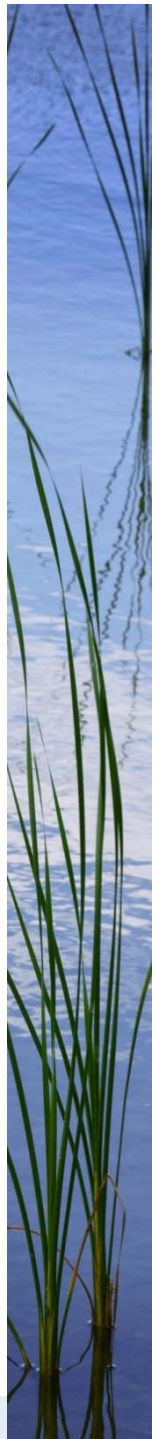
Duan et al. In Prep. w/ Rosenfeldt, Aga, Iwanowicz, Kaushal



# Urban BMPs reduce Estrogen, P or C inputs



Duan et al. In Prep. w/ Rosenfeldt, Aga, Iwanowicz, Kaushal



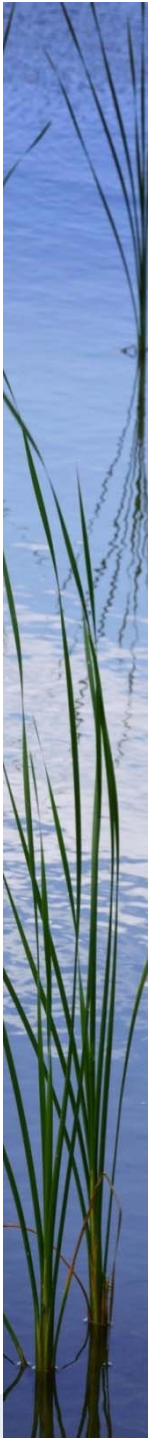
# Next Steps

## Continuing Isotopic analyses

- Nitrate isotopes for N source
- Fluorescence scan for carbon source
- Carbon and nitrogen data for particulate sources

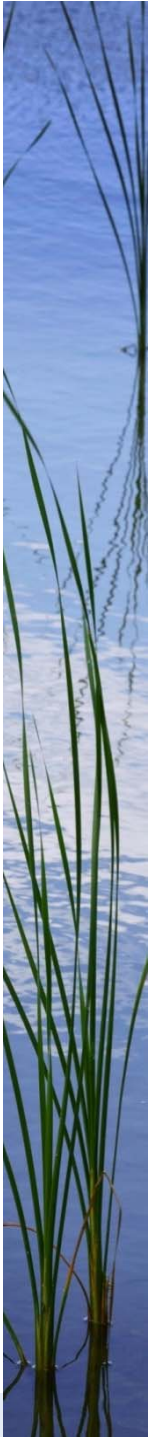
Analyzing EDC chemicals and reactivity

Continue seasonal sampling of hot spots

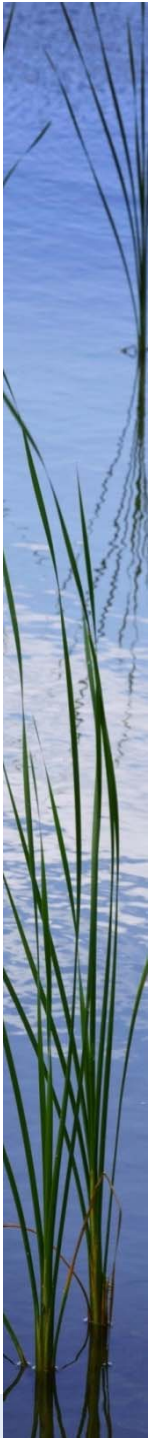
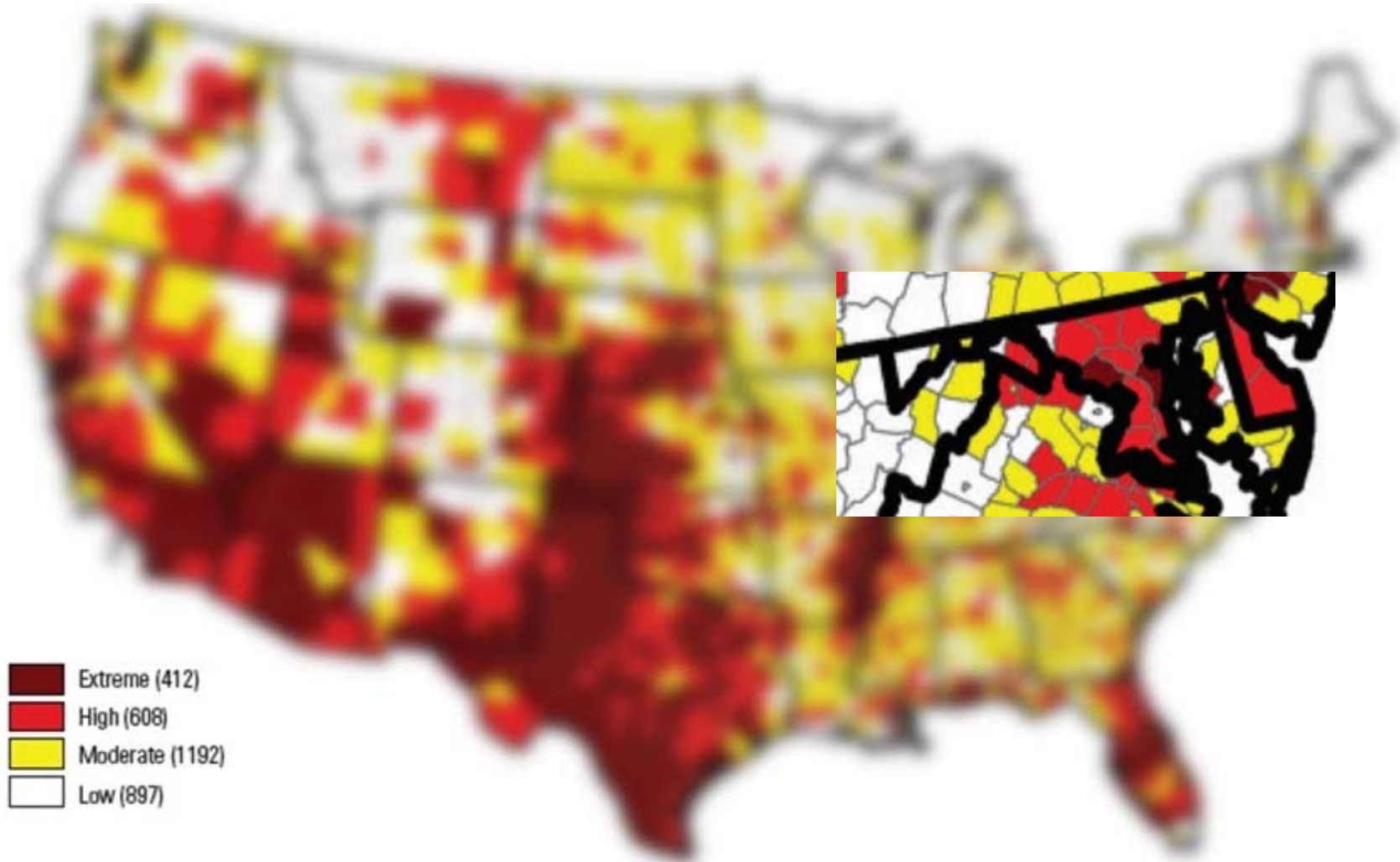


# New Drivers for Water Reuse

- Mid-Atlantic region not considered water stressed
- Impacts from nutrients and EDCs
- Water Reuse = strategy for controlling nutrients and EDCs



# New Drivers for Water Reuse







Thank You!

Justin Mattingly

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