Pooled Monitoring Initiative's Restoration Research Program

A novel approach that pools funding to support research answering our key restoration questions in the Chesapeake Bay

Sadie Drescher, Vice President of Programs for Restoration
Chesapeake Bay Trust

Pooled Monitoring Initiative is a way to answer key restoration questions

Reason for the program:

- Stream restoration practices were stalled
- Funders, contractors, and regulators came together to figure out why this happened
- 2013 – Chesapeake Bay Trust, state agencies (e.g., MD DNR, MDE, MDOT SHA), federal agencies (e.g., EPA), municipalities, practitioners, and others met to discuss this
- Realized there were very big, important questions that were valid
- Answers could not be found with site specific monitoring, permit monitoring, etc.
- Needed rigorous scientific efforts to start to tackle these questions

How the program started:

- MD DNR, US EPA CBPO, and the Trust pooled funding to offer first Restoration Research Award Program
- Request for Proposals (RFP) contained the top questions from earlier meeting/discussions

Pooled Monitoring Initiative - Science answers key restoration questions

- Desire to support the best, most cost-effective practices at the most optimal sites, but differences of opinion sometimes exist, and questions about the performance and function of some of these practices persist
- Funders pool resources to answer restoration questions posed by regulatory community & practitioners
  - **Partnerships and collaborations** – we are all a part of this effort!
- Increase power, objectiveness, and ability to know what works
- Bring science back to those that can use it for their work

Lauren McPhillips PI: MS student Alex Brown working on mesocosm to answer research question about deicers (about to be on the job market for stormwater-related positions in the DC area!)

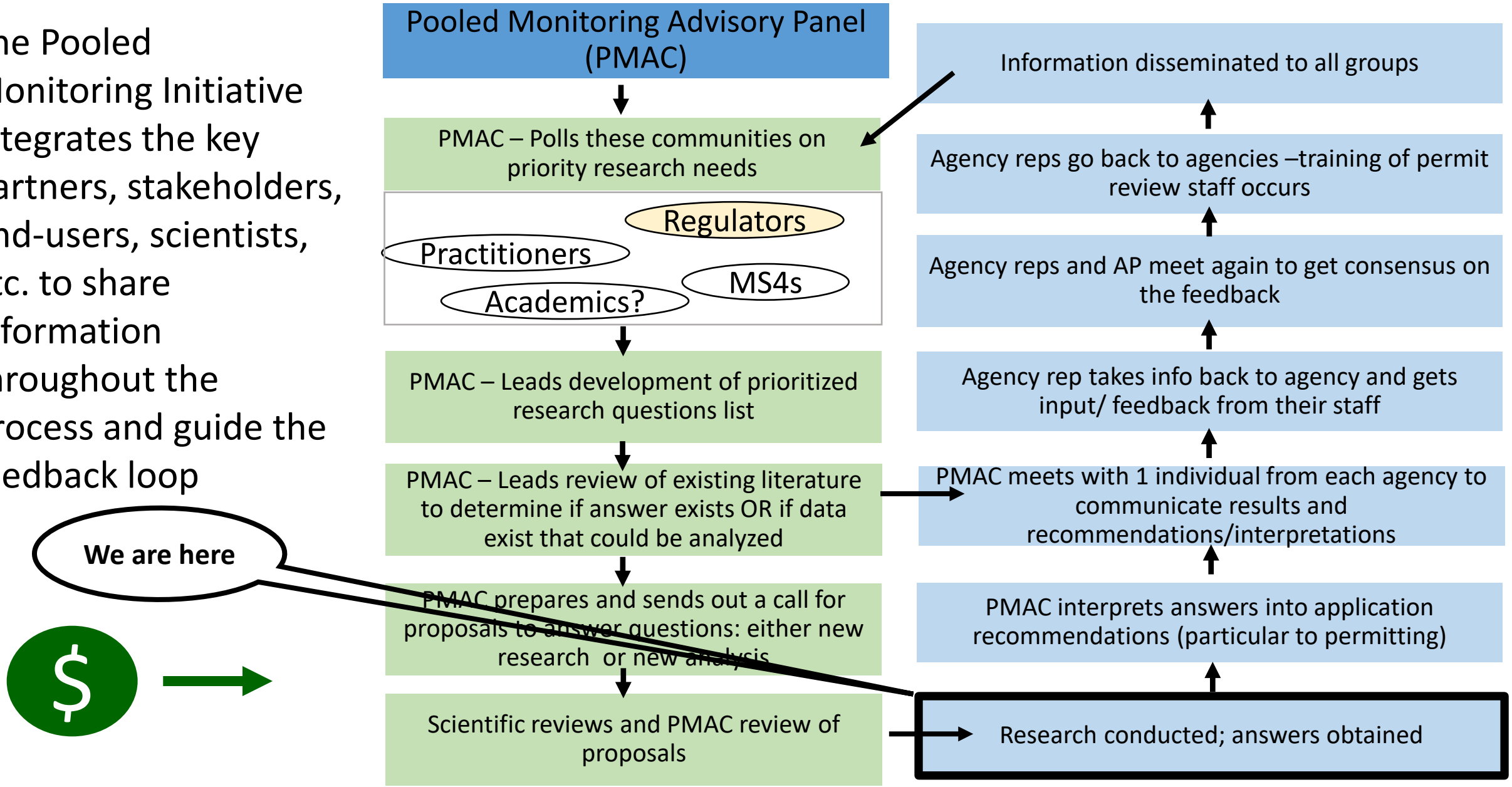
Research is for:

- BMP Effectiveness
- Watershed Restoration Assessment
- Biological Community Restoration
- Climate Change
- Pollutants of Emerging Concern
- Restoration trade-offs
- New items each year TBD by the Pooled Monitoring Advisory Committee

Landing page https://cbtrust.org/grants/restoration-research/

Process is Inclusive and Transparent

The Pooled Monitoring Initiative integrates the key partners, stakeholders, end-users, scientists, etc. to share information throughout the process and guide the feedback loop



Restoration Research Award Program

- Supported 43 projects since FY 15 at >$8M
- Guided by the Pooled Monitoring Advisory Committee
- Uses scientific reviewers across the world to vet applications
- Runs all applications through a “management review”
- Projects are managed as firm fixed price contracts
- Questions are cycled off/on the RFP each year
- All awards, progress, and program products are online at: https://cbtrust.org/grants/restoration-research/

Claire Welty (UMBC) quantifying the cumulative effects of stream restoration and environmental site design on nitrate loads in nested urban watersheds using a high-frequency sensor network(Baltimore County, MD)
Final report here and publication here

University of Maryland

Influence of historic and current land use practices on PCB contamination of soils and stormwater sediments in the Chesapeake Bay watershed

Key Restoration Question: This research study will address **RFP Question 5b**: 'Pollutants of Emerging Concern'. Specifically, we will address the **question i)**: are there significant differences of polychlorinated biphenyls (PCBs) across different land use types including industry types and eras of development? Also, based on information collected, we will provide input towards addressing **question 5b ii)**: 'What are the removal capabilities of different stormwater management designs on reducing toxic contaminant loads?' with focus on **part b):** 'comparisons of effectiveness of different innovative techniques at reducing PCBs and other toxins". Our project focuses on PCB contaminated sites of Curtis Bay, in the Patapsco River Watershed, but the approach will be extended to other locations throughout Maryland, primarily in Prince George's County to cover different land uses, eras of development, and household income where appropriate. Historical land uses records will be combined with soil and sediment sampling and analysis to answer question (i), by understanding the co-relation between the land use characteristics and the PCB contamination of the soils and roadway sediments. Knowing PCB concentrations in soils and sediments can allow estimates of potential PCB load reductions from removals in various types of stormwater BMPs and to allow targeting of areas to address sources of the greatest expected PCB stormwater loads.

Award: $315,334 Award #20589
Timeline: 7/1/2022 to 6/30/2024

University of Maryland

Influence of historic and current land use practices on PCB contamination of soils and stormwater sediments in the Chesapeake Bay watershed

Hypothesis A: Industrial land uses and pre-1979 developments have the highest PCB contaminated soils and sediments, relative to residential land uses and post 2005 developments in the Bay watershed.

Hypothesis B. Non-legacy PCBs such as PCB-11 and PCB-52 will leach from roadway paints used in throughout the watershed. These PCB congeners will be present in the stormwater sediments and in BMP geomedia, such as bioretention soil media.

Hypothesis C. Biodegradation of PCBs will occur to some extent in stormwater BMPs. Evidence of PCB biodegradation will be different based on the land use and thereby the sources and composition of PCBs. In addition, age of the BMP (long-/short-term exposure to PCBs), redox conditions of the accumulated soil and sediment associated with PCBs and anoxic conditions may enhance anaerobic biotransformation processes of PCBs.

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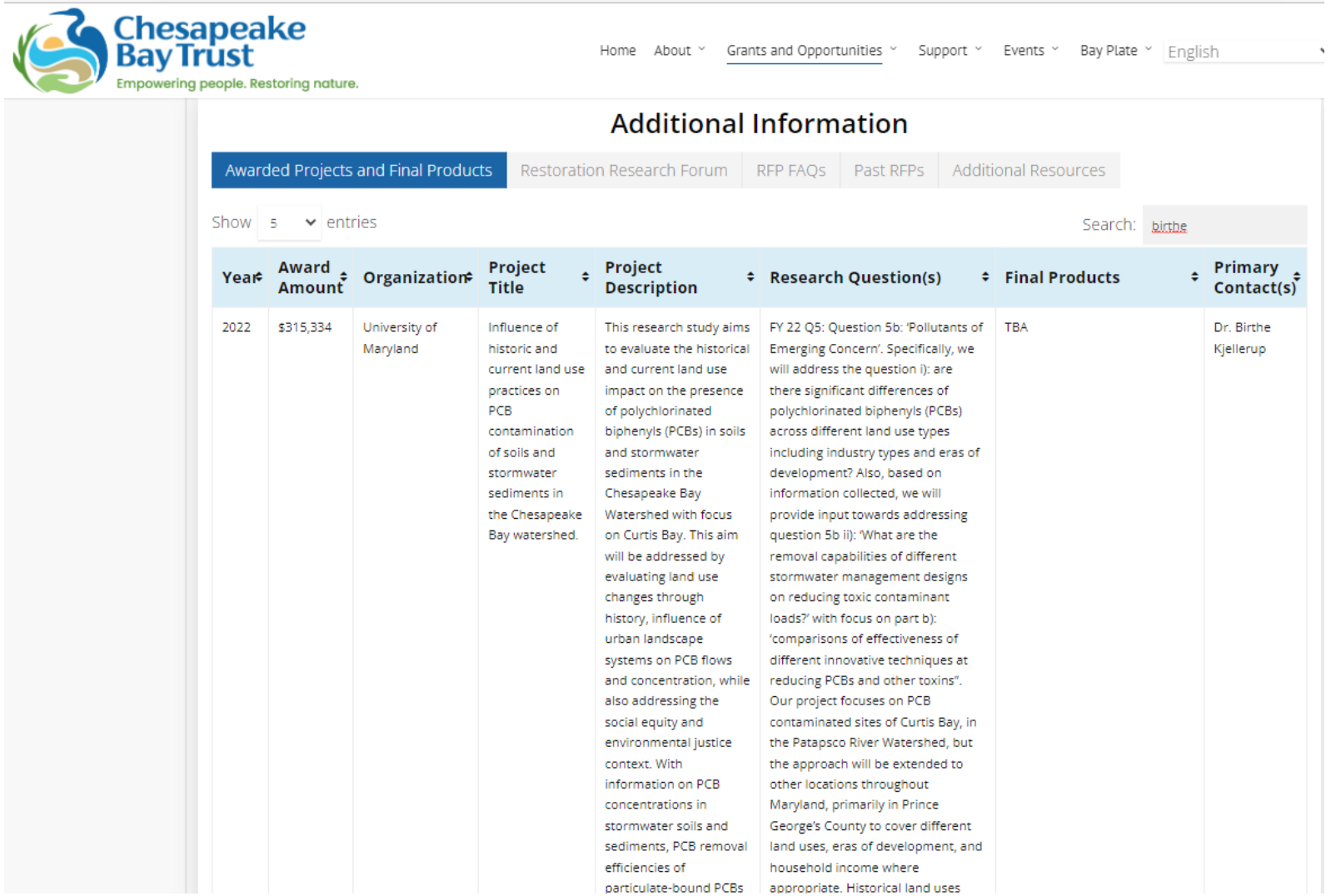
Influence of historic and current land use practices on PCB contamination of soils and stormwater sediments in the Chesapeake Bay watershed

Work Products:

- Final report and fact sheet
- Annual presentation(s) to the regulatory community
- Quality Assurance Project Plan
- Local and regional meetings
- National meetings
- Publications (1-2 peer-reviewed papers)



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Additional Information

Awarded Projects and Final Products | Restoration Research Forum | RFP FAQs | Past RFPs | Additional Resources

Show 5 entries Search: birthe

Year	Award Amount	Organization	Project Title	Project Description	Research Question(s)	Final Products	Primary Contact(s)
2022	$315,334	University of Maryland	Influence of historic and current land use practices on PCB contamination of soils and stormwater sediments in the Chesapeake Bay watershed.	This research study aims to evaluate the historical and current land use impact on the presence of polychlorinated biphenyls (PCBs) in soils and stormwater sediments in the Chesapeake Bay Watershed with focus on Curtis Bay. This aim will be addressed by evaluating land use changes through history, influence of urban landscape systems on PCB flows and concentration, while also addressing the social equity and environmental justice context. With information on PCB concentrations in stormwater soils and sediments, PCB removal efficiencies of particulate-bound PCBs	FY 22 Q5: Question 5b: 'Pollutants of Emerging Concern'. Specifically, we will address the question i): are there significant differences of polychlorinated biphenyls (PCBs) across different land use types including industry types and eras of development? Also, based on information collected, we will provide input towards addressing question 5b ii): 'What are the removal capabilities of different stormwater management designs on reducing toxic contaminant loads?' with focus on part b): 'comparisons of effectiveness of different innovative techniques at reducing PCBs and other toxins". Our project focuses on PCB contaminated sites of Curtis Bay, in the Patapsco River Watershed, but the approach will be extended to other locations throughout Maryland, primarily in Prince George's County to cover different land uses, eras of development, and household income where appropriate. Historical land uses	TBA	Dr. Birthe Kjellerup

Keep up with awards and progress at: https://cbtrust.org/grants/restoration-research/

Evaluating impacts of freshwater salinization syndrome on mobilization of nutrients and metals from stormwater best management practices

Sujay Kaushal, Joseph Galella, Jenna Reimer, William Nguyen, Walter Boger, Alexis Yaculak, and Kelsey Wood

University of Maryland, Department of Geology & Earth System Science Interdisciplinary Center

Slide from Pooled Monitoring forum; presentation available here

Key Questions

- What are critical thresholds in concentrations of different road salt ions (Na^{+}, Ca^{2+}, Mg^{2+}) which can mobilize nutrients and metals to surface waters across varying stormwater BMPs?

- What are the concentrations and loads of different road salt ions and associated metals and nutrients in nearby stream outfalls before, during, and after deicing events

Slide from Pooled Monitoring forum; presentation available here

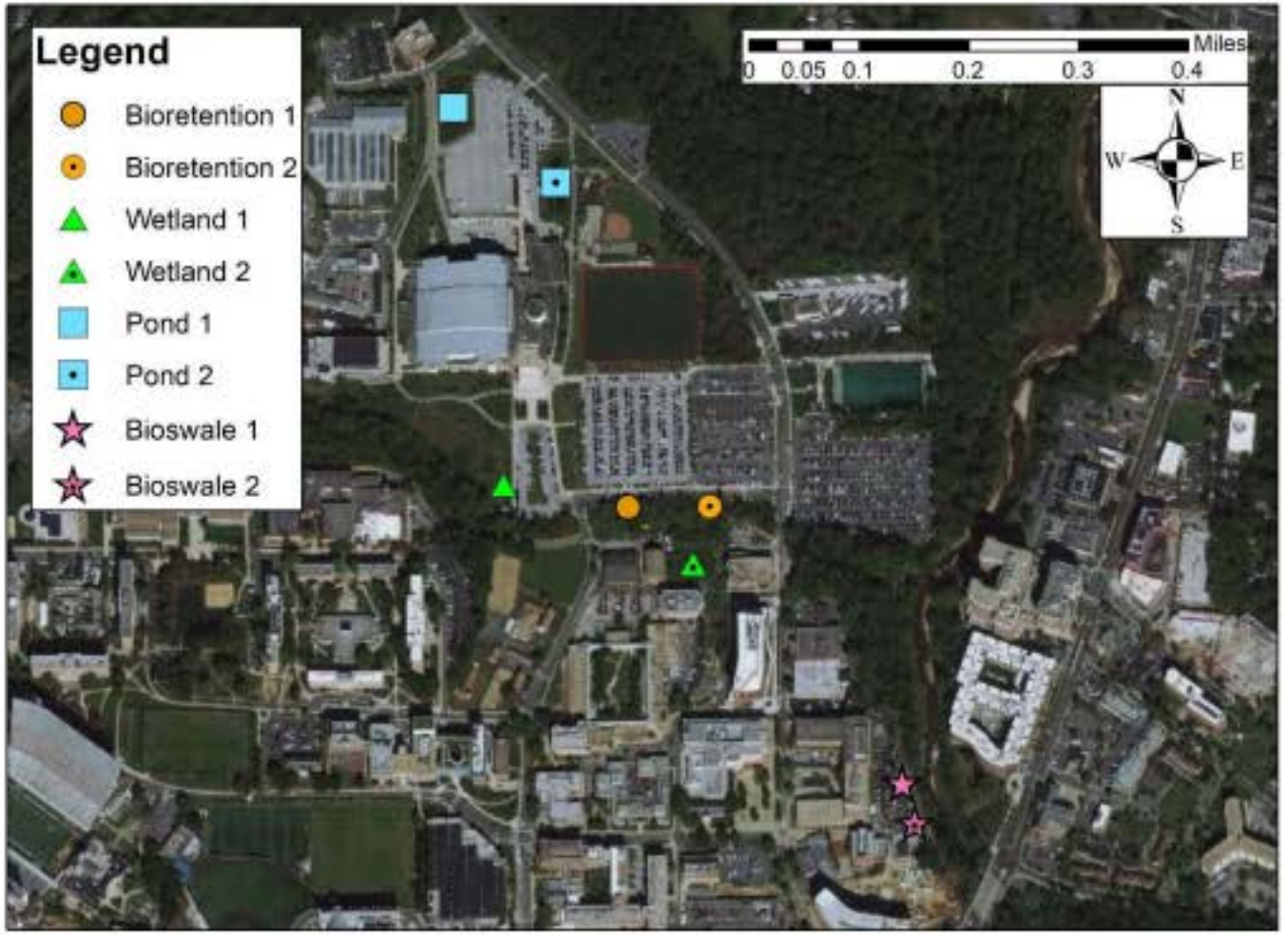
Experimental Design & Examples of Study Sites

Bioretention #1

Bioswale #1

Bioretention #2

Bioswale #2



In addition, stream restoration/floodplain reconnection sites

Slide from Pooled Monitoring forum; presentation available here

Courtesy Joseph Galella

Collect sediment and water from stormwater management feature

Add salts (NaCl, $CaCl_2$, & $MgCl_2$) at varying concentrations and incubate on shaking table for 24 hours

Analyze for major and trace elements, organic / inorganic carbon and nitrogen

Courtesy Joseph Galella

Slide from Pooled Monitoring forum; presentation available here

BMPs and stream restorations are removing salts, but mobilization and the salt ion impact the resulting "chemical cocktail" (see final report here)

Summary

- Significant retention of salt ions in stormwater sediments
- Release of elements depends on type of deicer ion and site
- Large winter peaks – which ions are retained *vs.* released?
- Developing new practical monitoring approaches using proxies

Management Implications

- Stormwater sediments/soils can have very high potential to enhance ion retention and ion exchange
- Reducing winter NaCl inputs can lead to rapid and year long recovery in some ions
- Water quality monitoring approaches using inexpensive proxies such as specific conductance can help predict concentrations of multiple ions and metals

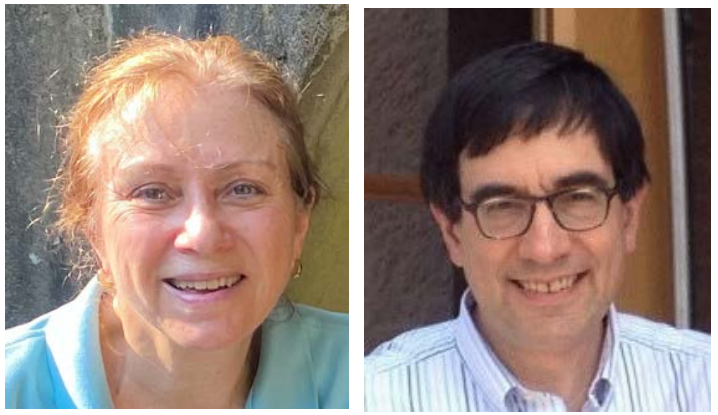
Slide adapted from Pooled Monitoring forum; presentation available here

Evaluation of watershed-scale impacts of stormwater management facilities on thermal loads to a Maryland Class IV stream using a high-frequency sensor network

Claire Welty, Andy Miller, Mary McWilliams,
John Lagrosa, Nick Simeone
UMBC/CUERE
in partnership with
Kevin Brittingham, Baltimore County DEPS

Translation Slides
Greg Golden, Maryland DNR

June 21, 2023

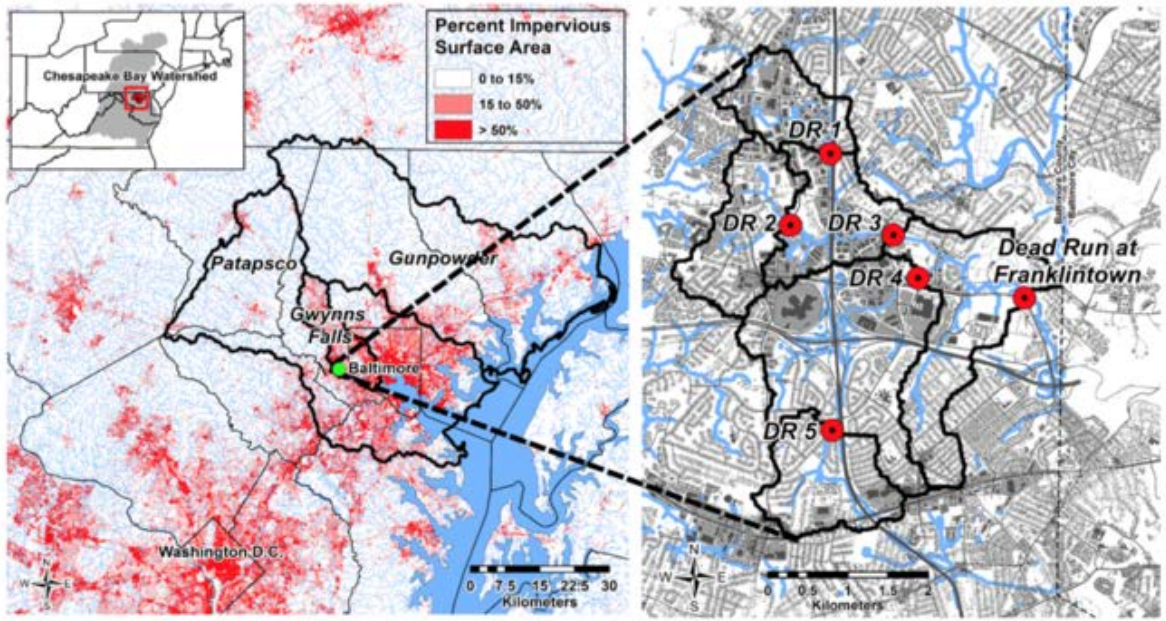


Slide from Pooled Monitoring forum; presentation available here

Research question to be addressed

What best management practice design and siting methods will reduce thermal impacts to Maryland's Use III and IV streams?

Dead Run watershed study area - Use Class IV stream network



Status update

- 6 air temperature sensors deployed Oct 2021
- 169 water temperature sensors deployed Dec 2021 – March 2022
- 35 additional water temperature sensors deployed Sept 2022/ Feb 2023
- Complete downloads of data: July/Aug 2022; Jan/Feb 2023
- Next download scheduled for Nov 2023
- Video mapping workflow completed.
- Statistical analyses to be done in the coming year.

Slide from Pooled Monitoring forum; presentation available here

Hypotheses

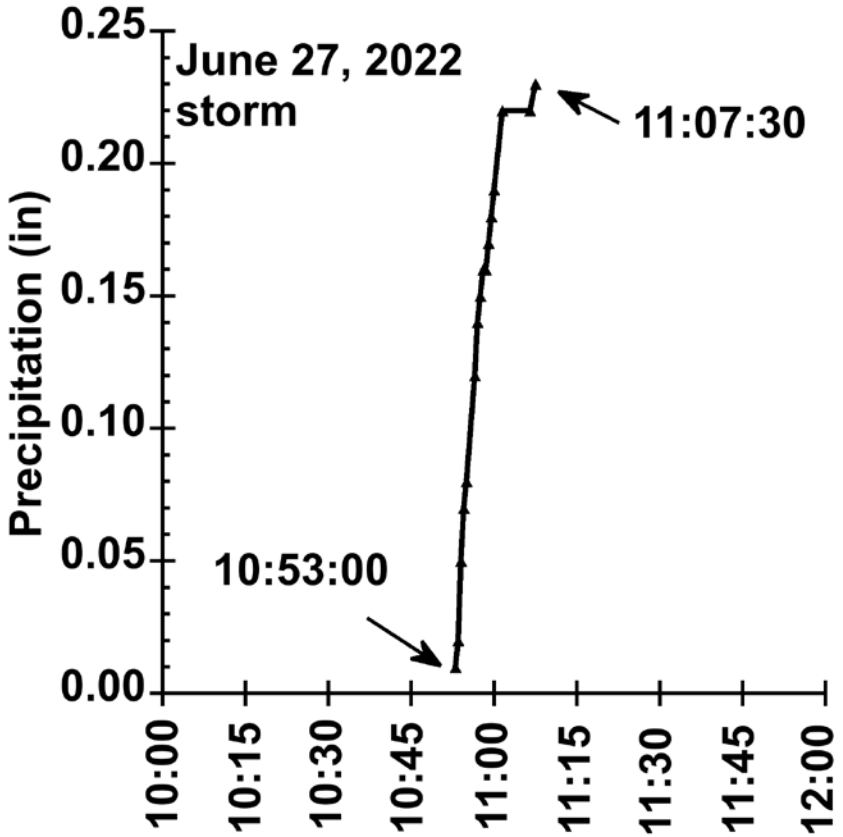
H1 High spatial- and temporal-resolution observations of stream water temperature reveal patterns of influence on thermal loading associated with land cover and stormwater management features.

H2 The thermal impact of surface stormwater facilities is comparable to that of directly-connected impervious surfaces at the watershed scale.

H3 Discharge from underground stormwater management facilities better mitigates thermal impacts to streams compared to drainage from surface stormwater facilities.

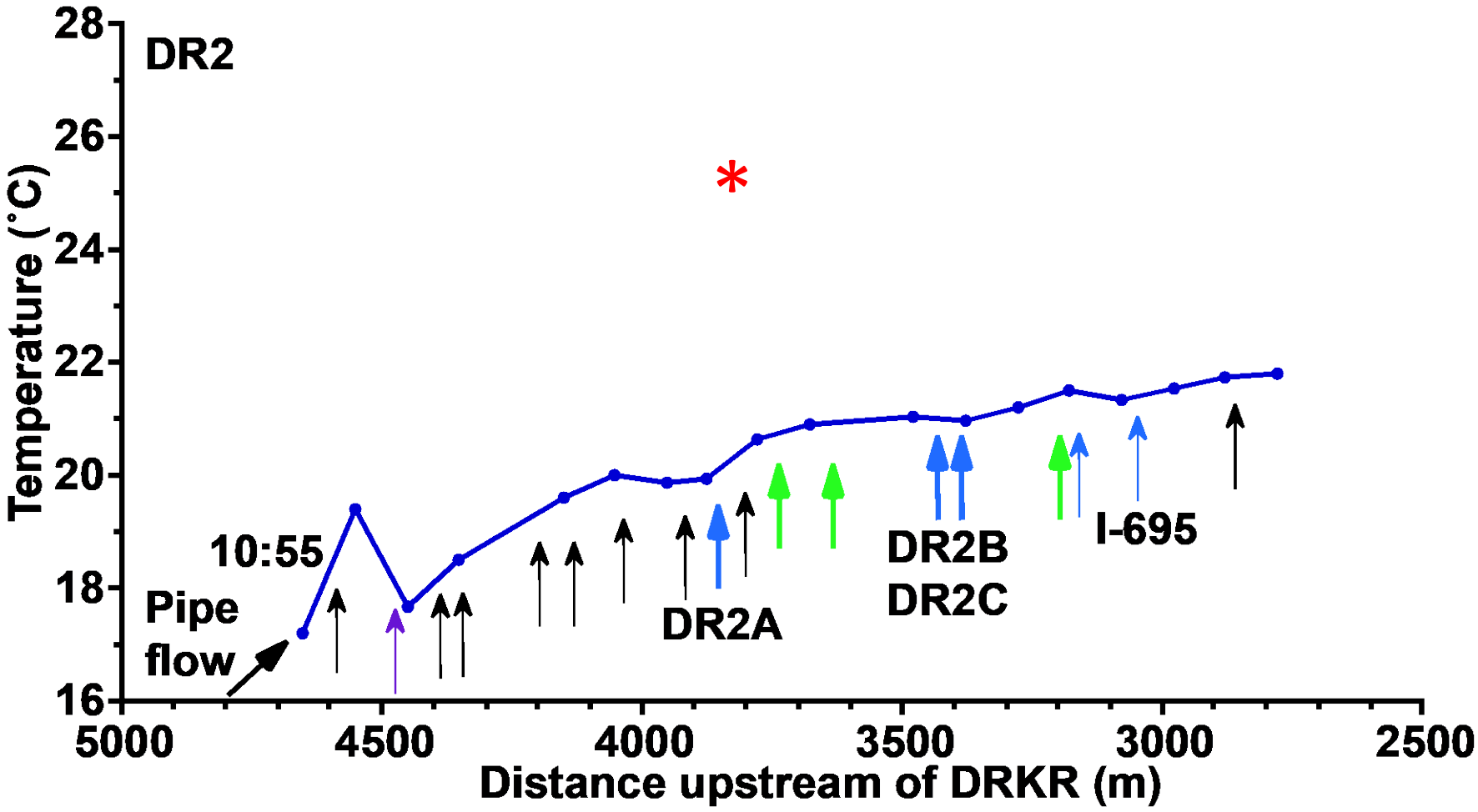
Slide from Pooled Monitoring forum; presentation available here

Example animation: June 27, 2022 storm



Slide from Pooled Monitoring forum; presentation available here

Example plots: June 27, 2022 storm



Input legend

- SWM outfall
- Tributary
- Small tributary/ drainage ditch
- Potable water pipe leakage
- Buried stream outfall (pipe flow)
- Outfall

*** Air temperature**

Slide from Pooled Monitoring forum; presentation available here

Summary

- High-density, high frequency temperature sensor network successfully deployed along 16 km of stream length.
- State-of-the-art GIS video mapping enables qualitative evaluation of stream-network thermal response to inputs from stormwater runoff.
- Example analysis points toward uncontrolled runoff contributing substantially to thermal impacts to the stream system.
- Comprehensive analysis of data across many storms and SWM facilities will be carried out next.

Slide from Pooled Monitoring forum; presentation available here

Impacts of salt loading on nutrient and metal processing in stormwater bioretention

Lauren McPhillips

Alex Brown, Bishwodeep Adhikari, Margaret Hoffman, Hong Wu, Shirley Clark

PennState

Slide from Pooled Monitoring forum; presentation available here

Research Question(s) and Hypothesis(es)

How do different levels of salt present in a BMP due to road application impact the BMP's nitrogen removal efficiency and export rates out of the BMP of pollutants such as heavy metals?

Hypotheses:

- Increased salt loading into stormwater BMPs is correlated to overall increased export or decreased removal efficiency of N and metals (Cu and Zn).
- Increased soil moisture, greater hydraulic residence times and more salt-tolerant vegetation in stormwater BMPs can moderate impacts of salt loading on N removal.

Slide from Pooled Monitoring forum; presentation available here

Approach

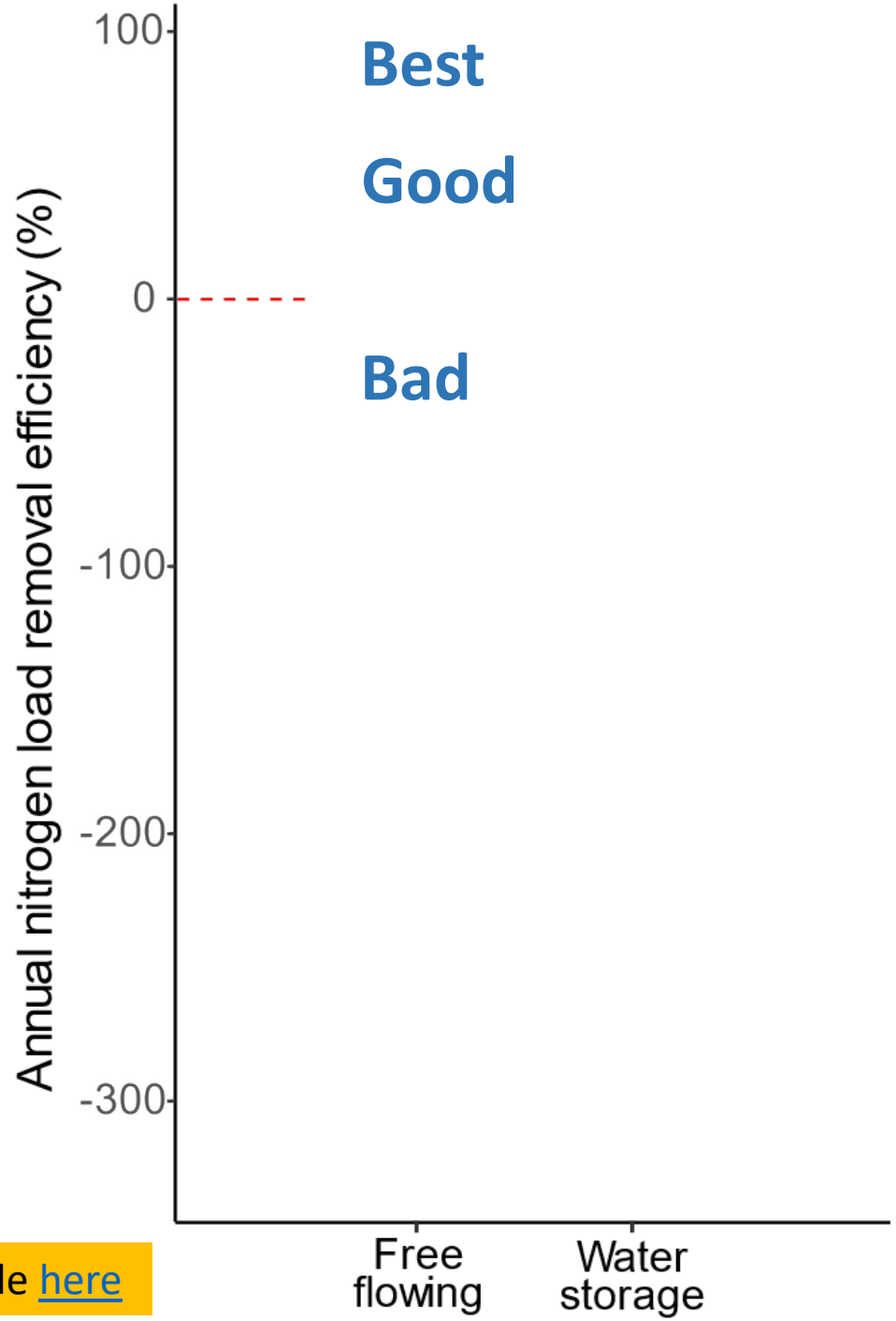
Field study w/ two basins w/ different salt loading in Lancaster, PA

Greenhouse mesocosm study

Lead: MS student Alex Brown (who is about to be on the job market for stormwater-related positions in the DC area!)

Slide from Pooled Monitoring forum; presentation available here

Interpreting results

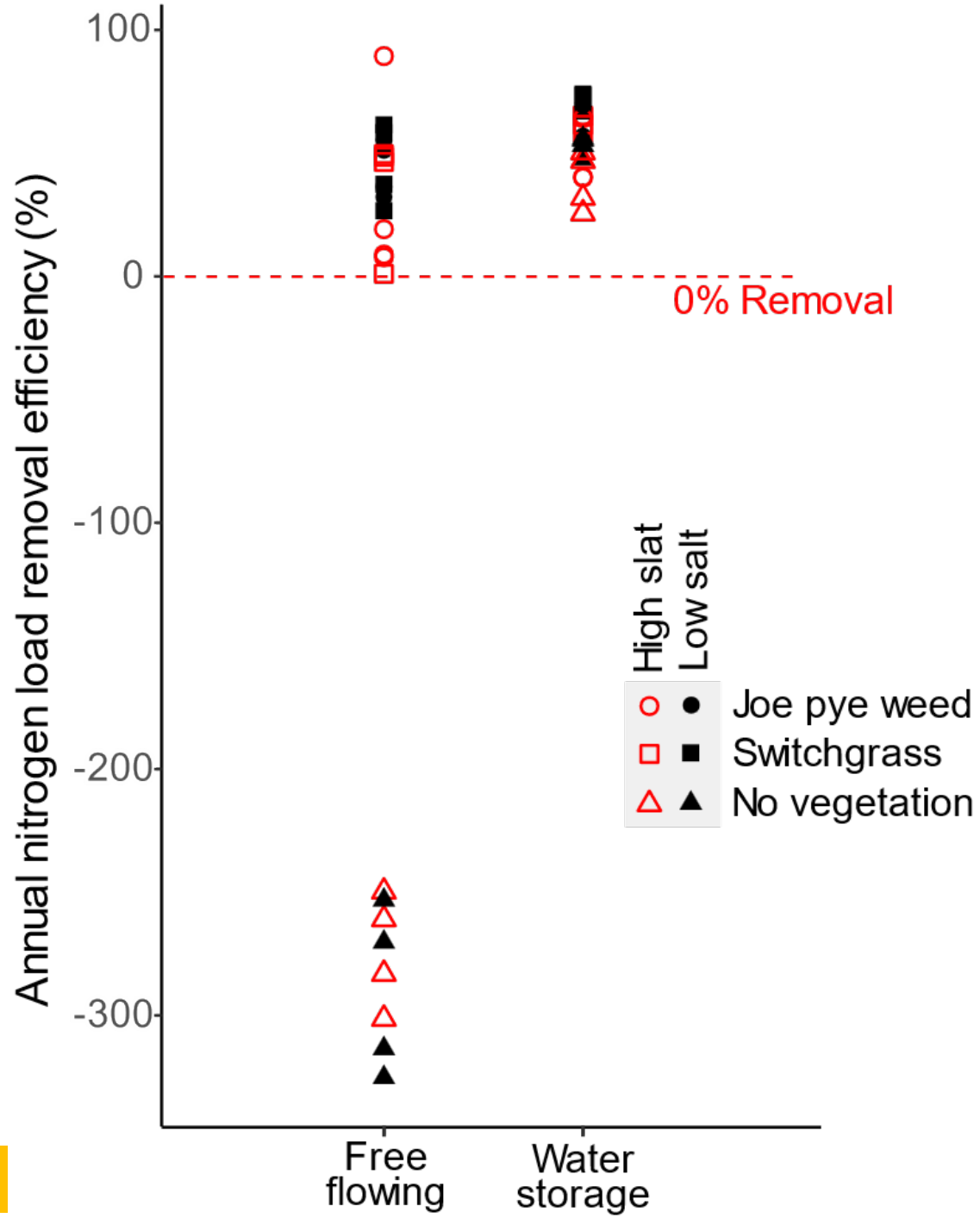


Slide from Pooled Monitoring forum; presentation available here

Nitrogen leaches in non-vegetated, free-draining bioretention

Internal water storage universally improves N retention

Salt load does not appear to impact N retention overall

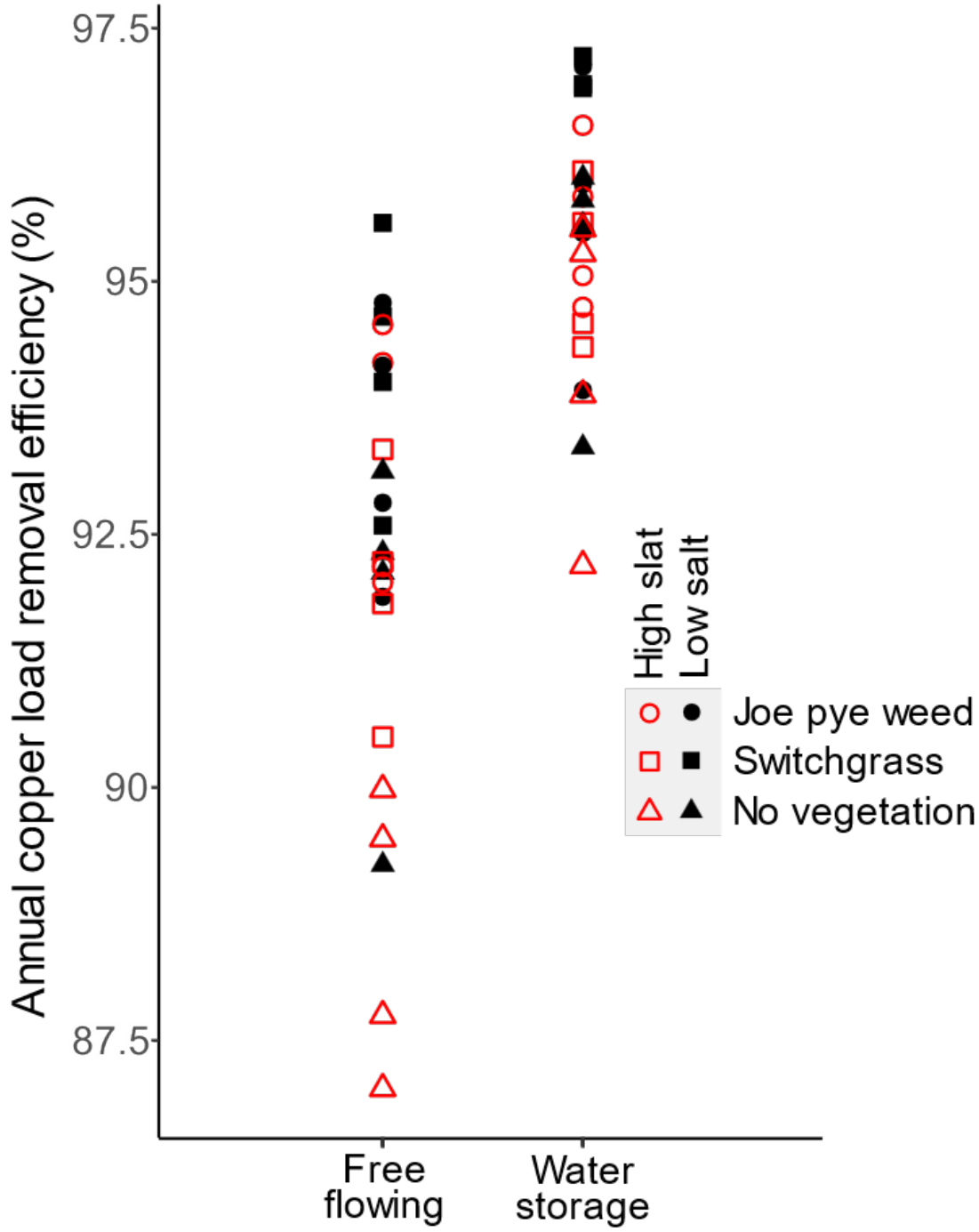


Slide from Pooled Monitoring forum; presentation available here

Copper removal is overall very good

Higher salt load slightly reduces copper removal

Internal water storage slightly improves copper removal

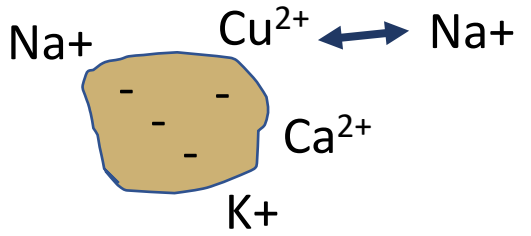


Slide from Pooled Monitoring forum; presentation available here

Summary points: *salt loading*

NaCl deicing salt negatively affects bioretention performance

More salt loading led to….

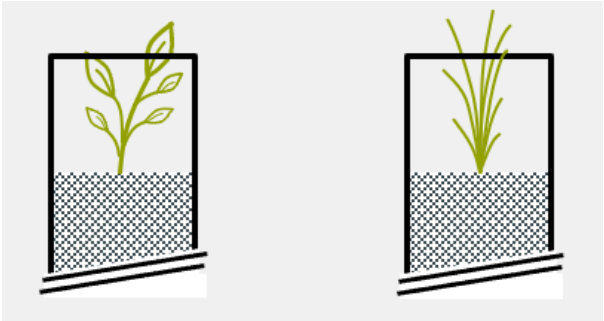


- Reduced sediment and phosphorus retention
- Episodic zinc leaching
- Plant stress & death, particularly for Joe Pye Weed

Slide from Pooled Monitoring forum; presentation available here

Summary points: *design implications*

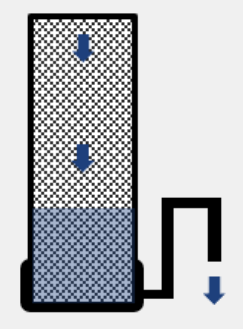
Presence of healthy plants was key for nitrogen retention



Internal water storage ….

Enhanced phosphorus and copper retention

Was essential for good nitrogen retention



Slide from Pooled Monitoring forum; presentation available here

Translation Slides

What are the take home points?
What does this mean for me?

Translation Slides by Sadie Drescher, Chesapeake Bay Trust

Slide from Pooled Monitoring forum; presentation available here

What does this mean for me?

- Salt reduction is key
- For bioretention systems:
  - Plant health is essential to the system's function (as designed)
  - Plant selection should consider natives that are also salt tolerant (e.g., coastal natives)
  - Plant success/maintenance should be monitored, e.g., replacement of dead plants
  - Internal water storage helped the system remove P, Cu, and N
  - There can be leaching from the system
- Good news is that removal occurs in the systems, so how do we optimize this is our charge

Adaptive management of BMPs is essential to maintain performance, especially where plants are relied upon for function

Slide from Pooled Monitoring forum; presentation available here

What does this mean for me?

What do I take from this if I am a practitioner:

- Consider the geographic location and future salt loading potential of the stormwater practice and adjust the plant palette to salt tolerant species, as needed
- Check plant success/health and replace dead/dying plants
- We could see clogging due to salt impacts to the soils/sediments

What do I take from this if I am a regulator:

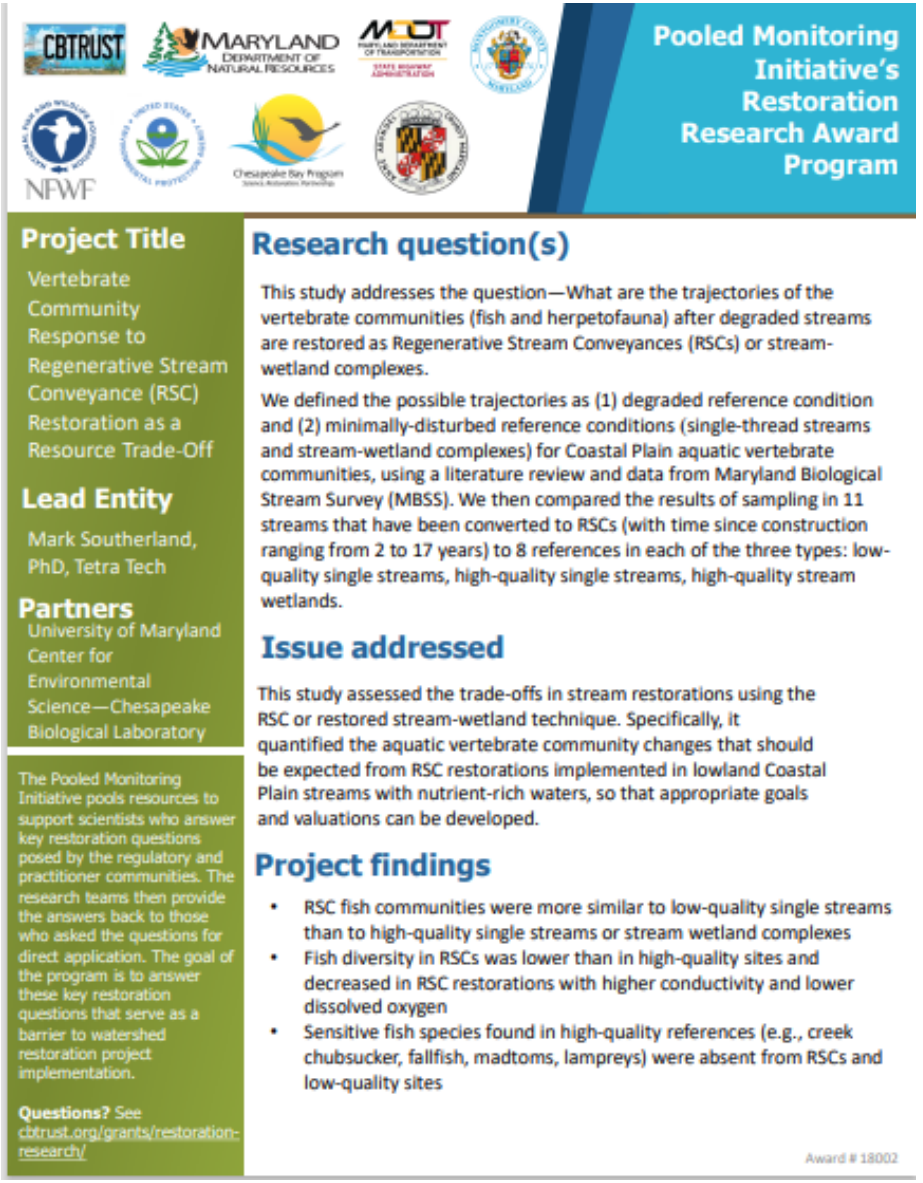
- Continue to keep an eye on salt loading to help assess and share where there are "salt success stories" – Who is doing well and how can others do the same?

For us all – There is still a lot to learn about the microbes that work in these systems

Slide from Pooled Monitoring forum; presentation available here

Communicating results

- Pooled Monitoring forum each June
- Maryland Stream Restoration hosted Pooled Monitoring researchers
- Webinars to relay results to the Pooled Monitoring Advisory Committee throughout the year
- Fact Sheets for completed projects
- Peer to Peer information sharing



Pooled Monitoring Initiative's Restoration Research Award Program

Project Title

Vertebrate Community Response to Regenerative Stream Conveyance (RSC) Restoration as a Resource Trade-Off

Lead Entity

Mark Southerland, PhD, Tetra Tech

Partners

University of Maryland Center for Environmental Science—Chesapeake Biological Laboratory

The Pooled Monitoring Initiative pools resources to support scientists who answer key restoration questions posed by the regulatory and practitioner communities. The research teams then provide the answers back to those who asked the questions for direct application. The goal of the program is to answer these key restoration questions that serve as a barrier to watershed restoration project implementation.

Questions? See cbtrust.org/grants/restoration-research/

Research question(s)

This study addresses the question—What are the trajectories of the vertebrate communities (fish and herpetofauna) after degraded streams are restored as Regenerative Stream Conveyances (RSCs) or stream-wetland complexes.

We defined the possible trajectories as (1) degraded reference condition and (2) minimally-disturbed reference conditions (single-thread streams and stream-wetland complexes) for Coastal Plain aquatic vertebrate communities, using a literature review and data from Maryland Biological Stream Survey (MBSS). We then compared the results of sampling in 11 streams that have been converted to RSCs (with time since construction ranging from 2 to 17 years) to 8 references in each of the three types: low-quality single streams, high-quality single streams, high-quality stream wetlands.

Issue addressed

This study assessed the trade-offs in stream restorations using the RSC or restored stream-wetland technique. Specifically, it quantified the aquatic vertebrate community changes that should be expected from RSC restorations implemented in lowland Coastal Plain streams with nutrient-rich waters, so that appropriate goals and valuations can be developed.

Project findings

- RSC fish communities were more similar to low-quality single streams than to high-quality single streams or stream wetland complexes
- Fish diversity in RSCs was lower than in high-quality sites and decreased in RSC restorations with higher conductivity and lower dissolved oxygen
- Sensitive fish species found in high-quality references (e.g., creek chubsucker, fallfish, madtoms, lampreys) were absent from RSCs and low-quality sites

Award # 18002

https://cbtrust.org/wp-content/uploads/18002-Tetra-Tech-Fact-Sheet.pdf

Pooled Monitoring Initiative Gains Support & Research is Valued

- Gained funding partners over the years demonstrating the value of the research program and buy-in from restoration community
- Held eight annual forums to bring together regulators, practitioners, and scientists to hear the research results
- Part of the EPA Chesapeake Bay Program Office's Stream Health Work Plan (Habitat Goal Implementation Team)
- Demonstrated buy-in from Maryland Department of the Environment who will allow permittees to "pool" resources vs. conducting site specific monitoring in new MS4 (municipal separate storm sewer system) permit

Keith Eshleman (UMCES) Plum Branch stormwater monitoring station (Ellicott City, Howard County, MD). 2022 Forum presentation here

Similar Model in Washington State

- Dept. of Ecology manages the Regional Monitoring Program to see if things are getting better, what is working, what is not working, and what is more cost effective
- Stormwater Work Group Established in 2008
- Recommended to establish a Regional Stormwater Monitoring Program in 2010 ($10.5M in first permit cycle)
  - Status and trends
  - Effectiveness studies
  - Source identification
- Permit Required Monitoring in 2013
  - Permittee either pays into the collective fund or conducts individual monitoring
  - Costs allocated by population

"Local governments in Western Washington spend hundreds of millions of dollars each year implementing the requirements of municipal stormwater National Pollutant Discharge Elimination System (NPDES) permits. How do we know if the permits are working?" Washington State Dept. of Ecology

(source: https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Stormwater-Work-Group, retrieved 10/22/19)

Pooled Monitoring Initiative expansion will answer more of our questions

- Other states, organizations, City/Counties want to pool funds to answer their "burning" questions
- Maryland MS4 permit offers a Pooled Monitoring Program option
- What other ideas do you have for the Pooled Monitoring Initiative's use of information, questions to ask, sites to monitor, expansion, etc.?

Chesapeake Bay Trust
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