BOSC

BOARD OF SCIENTIFIC COUNSELORS

REPORT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY BOARD OF SCIENTIFIC COUNSELORS SAFE AND SUSTAINABLE WATER RESOURCES SUBCOMMITTEE

RESPONSES TO CHARGE QUESTIONS

BOSC Safe and Sustainable Water Resources Subcommittee

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August 24, 2021

A Federal Advisory Committee for the U.S. Environmental Protection Agency's Office of Research and Development

CONTENTS

LIST OF ACRONYMS

BMP	Best Management Practices
DBP	Disinfection byproducts
EPA	U.S. Environmental Protection Agency
LID	Low impact development
MSX	Multi-Species eXtension
NTM	Nontuberculous mycobacteria
ONPWS	Onsite Non-potable Water Systems
OPPP	Opportunistic premise plumbing pathogens
ORD	EPA's Office of Research and Development
OW	EPA's Office of Water
SCMs	Stormwater control measures
StRAP	Strategic Research Action Plan
SWMM	Storm Water Management Model
WRF	Water Research Federation

CHARGE QUESTIONS AND CONTEXT

The SSWR Subcommittee was charged with addressing a series of questions about water treatment and infrastructure, focused on Research Areas 7, 8, 9, 10, and 11. Charge questions were as follows:

> Q.1. What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its drinking-water and distribution research, and in particular on how these research activities can be comprehensively integrated to ensure safe disinfectant levels, while minimizing or eliminating exposure to lead, opportunistic pathogens, and DBPs in small treatment and distribution systems and in disadvantaged communities?
>
> Q.2. Please comment on the implementation of ORD's water reuse research, and what suggestion(s)/ recommendation(s) does the Subcommittee have regarding SSWR's water reuse research for helping to innovatively augment water supplies and improve resiliency by identifying promising alternative water sources?
>
> Q.3. 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?

The responses of the SSWR Subcommittee to the charge questions are contained in the following section.

SUBCOMMITTEE RESPONSES TO CHARGE QUESTIONS

Charge Question 1

> Q.1. What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its drinking-water and distribution research, and in particular on how these research activities can be comprehensively integrated to ensure safe disinfectant levels, while minimizing or eliminating exposure to lead, opportunistic pathogens, and DBPs in small treatment and distribution systems and in disadvantaged communities?

Narrative

The Safe Drinking Water Act is the Agency driver for this area of research, and the foci now are on lead and copper analysis and reduction, emerging microbial contaminants, disinfection byproducts (DBPs), and environmental justice. Goals include improved and new treatment strategies that states, consultants, tribes, and water system managers can use directly to reduce lead and copper levels at consumer's taps; improved better management practices (building and utilities) aimed at reducing risks associated with *Legionella* and opportunistic premise plumbing pathogens (OPPPs); more effective management of disinfectant residual and DBPs in distribution and premise plumbing systems while effectively reducing OPPPs; and the ultimate goal of providing the U.S. Environmental Protection Agency's (EPA's) Office of Water (OW), states, tribes, small systems, and underserved communities with updated information to fill research gaps impeding/preventing regulatory determinations. The goal of achieving safe disinfectant levels while minimizing health risks from these various sources of risk requires developing and applying a

comprehensive model that includes risk profiles for each of these sources, and that describes their interdependence in quantitative terms. Such a model can serve as a guide to achieving the desired degree of safety.

Strengths

- EPA's Office of Research and Development (ORD) presented a portfolio of cutting edge, focused research on DBPs, pathogens, and heavy metals, that is timely and relevant.
- The team is both using and developing highly effective models to understand fate, transport, and transformation of chemicals of concern in drinking water.
- The subcommittee commends ORD research for collaborating closely and integrating the technology with small businesses. The subcommittee believes there is excellent communication and collaboration among different groups, such as among modelers, chemists, and risk assessment scientists.

Suggestions

- Although *Legionella* is part of the research agenda, other opportunistic pathogens do not appear to be, such as nontuberculous mycobacteria (NTMs) and Pseudomonas. There has been great improvement over last 10 years, but still a poor understanding of how it gets into small systems, storage tanks, and greater distribution systems. More research is needed into the effects of temperature, water quality, disinfectant, and growth over time. Lastly, several approaches supporting specific building water management strategies to control *Legionella* have been developed. However, current science lacks evidence identifying whether these approaches actually work. The subcommittee suggests increased research efforts to establish which specific building water management strategies effectively control Legionella.
- Increased attention should be given to research on the poorly understood health risks (toxicities and human exposure profiles) of some of the non-regulated DBPs.
- The desirable goal of reducing or preventing DBP formation requires researching the factors governing their creation and methods to control their influences.
- Continue research on lead forms and transformations in water, with emphasis on removing it and working with research teams to create effective filtration.
- Copper should have been mentioned in the charge question. In addition, other metals might need additional research such as arsenic or chromium.
- We heard about industry partnerships for technical development, and how successful these relationships are. However, we feel EPA should further prioritize and support these relationships, along with excellent and increased support for the small business grant program.
- The subcommittee suggests conducting further research on specific anthropogenic chemicals (e.g., pharmaceuticals and personal care products). The subcommittee believes development of the research plan requires systematic reviews and evidence mapping of existing literature that takes into account co-occurrence patterns, concentration levels, and health endpoints, with data from an increased number of sites.
- Residential structures and commercial buildings have unique plumbing characteristics. The subcommittee suggests research teams develop risk models describing likely lead or microorganism exposures, based on specific premise plumbing characteristics. Such models could help inform homeowners and building managers to make wise choices regarding plumbing materials and filtration devices for optimum health and well-being.
- The subcommittee believes EPA needs to focus on understanding the differential research needs of disadvantaged communities and the different water quality threats to different communities.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 1.1: Focus on developing a risk-based model integrating research findings on disinfectants, pathogens, and DBP risks, and, if relevant, on lead-related risks. This would involve optimizing and integrating existing models of individual components and would also show how changes in the risk of one component would affect the risks of the others. For example, EPA must optimize models of DBP formation (both regulated and unregulated) enabling the models to communicate with other models such as health risk models, especially for unregulated DBPs. Having the model created, even if it cannot yet be executed, would be a great tool for further research and data gap identification.

Recommendation 1.2: Focus on developing a more user friendly EPANET-MSX (Multi-Species eXtension) model that would include built-in DBP and disinfection models so users can apply them easily. EPANET is a tool used to address hydraulic issues (like mixing in storage tanks and residence time), and also fate and transport issues (for disinfectants, DBPs, natural organic matter, etc.). However, there is a need to make its application as simple as possible, especially for small systems. EPA should integrate these models with risk information in a decision support tool to better meet the needs of small systems and disadvantaged communities. Such a tool could easily highlight the risks of DBPs along with the benefits and costs of different strategies to reduce/prevent DBP formation.

Charge Question 2

> Q.2. Please comment on the implementation of ORD's water reuse research, and what suggestion(s)/ recommendation(s) does the Subcommittee have regarding SSWR's water reuse research for helping to innovatively augment water supplies and improve resiliency by identifying promising alternative water sources?

Narrative

ORD has chosen to bypass the largest reuse source, treated municipal wastewater, and focus their research on alternative reuse water sources. The subcommittee endorses this direction as municipal wastewater reuse research is saturated and EPA's investment there would not have a large impact on the field's direction. In contrast, ORD has correctly identified a dearth of research regarding several alternative sources, for which EPA's effort are potentially impactful.

However, the research plan could be improved by providing a more comprehensive vision for how the data ORD generates will help EPA prioritize a range of alternative sources. In absence of that integration, the agency is left with disjointed research on a range of chemical removal and pathogen disinfection processes.

Strengths

- Addresses a need. The country has water deficiencies in a variety of regions across the country and developing new sustainable sources will benefit society. Even in areas where water is not in short supply, having a portfolio of alternatives adds to the nation's water security.
- The research on alternative disinfection and treatment strategies for chemical and microbial contaminants will add to our knowledge base.
- They have a clear idea of how this research will enhance EPA's Water Reuse Action Plan.
- They are well-integrated with other research entities in this field, particularly the Water Research Federation (WRF) and Integration with WRF and the National Blue Ribbon Commission on Onsite Non-potable Water Systems (ONPWS).

Suggestions

- As part of developing an integration strategy, ORD should continue four parallel/integrative activities: (1) Identify the volume potential for each reuse strategy, (2) Assess the unique chemical and biological contaminant characteristics of each water type, (3) Determine the chemical/biological treatment challenges for each of these types of water, and (4) Calculate the costs associated with those treatment technologies. Collectively, those activities will allow to better focus the national water reuse strategic plan.
- There will be several parts of the activities above where the information is presently unavailable and not being worked on by others. Those information needs form the basis for future research directions.
- An additional factor that EPA might consider is the energy cost of each of the potential reuse strategies. Besides providing the basis for lessening the national carbon footprint as part of a reuse strategy, there are particular areas where low-energy, low-cost treatment technologies would be particularly valuable, such as in agricultural settings and proven strategies around subsurface flow wetland treatment utilized in Europe.

Recommendations

The Subcommittee offers this recommendation to support the relevant Agency priorities:

Recommendation 2.1: The research vision should further define how the various individual research projects will be integrated into a synthesis product that will inform communities that must prioritize among a range of alternative water reuse sources.

Charge Question 3

> Q.3. 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?

Narrative

Stormwater management involves a wide range of technical challenges. Based on a diverse portfolio of research activities, ORD has successfully advanced research to tackle many of these challenges. Different social, economic, and regulatory factors create regionally unique challenges to the design, operation,

performance, and maintenance of stormwater management solutions. ORD has a history of conducting successful stormwater management research with and in disadvantaged communities across the country. While technical research questions on the performance of stormwater treatment systems to achieve certain objectives (e.g., water quality improvement, hydrologic mitigation) are generally relevant regardless of where the systems are installed, research questions pertaining to the full life cycle of stormwater management solutions require community-specific considerations. For example, prior work in disadvantaged communities has yielded valuable insight into community values and perspectives on stormwater management solutions, from siting to amenity priorities. These lessons learned have often emerged as an added benefit, rather than from stated initial goals of the research projects.

A potentially unique opportunity to advance ORD's stormwater management research in disadvantaged communities is in the topic area of system maintenance. Stormwater treatment systems in disadvantaged communities suffer disproportionally from lack of long-term maintenance, thereby compromising community acceptance and, potentially performance, over time. Research opportunities arise to document how the performance of stormwater treatment systems changes over time or what specific maintenance activities are effective on maintaining runoff management. Neither of these topics are rigorously studied to date.

Maintaining focus on programmatic goals, including research within disadvantaged communities, is challenged by competing demands and potentially shifting goal posts. For example, developing critical stakeholder, non-governmental organization, and community relationships to conduct research in disadvantaged communities, and delivering robust data sets from field-based research, each require long timelines often exceeding the duration of a Strategic Research Action Plan (StRAP) or the length of an administration. The growing recognition of ancillary benefits over and above technical solutions for mitigating stormwater sometimes results in competing priorities for implementation and diverts resources from projects to advance knowledge on how to plan for and achieve water resource protection goals.

Strengths

- ORD is pursuing initiatives that make up a diverse portfolio of research. Specific program strengths include:
    - A large network of field monitoring projects across the country, including work in many disadvantaged communities.
    - Investments to enhance the Storm Water Management Model (SWMM), the most widely used tool across the world for stormwater management planning.
    - A focus on aquifer recharge, which is essential for regions of the country expected to see drier climates.
    - Timely projects on pathogens that are informed by research in non-stormwater management sectors; for example, identifying better indicators of human health risk from fecal contamination and assessment techniques.

Suggestions

- ORD's stormwater management research portfolio covers a diverse array of well-developed technical questions which contributes to the strength of the program; however, activities appear to be siloed. ORD stakeholders, including the broader public, would benefit from better articulation of how

research initiatives integrate into a cohesive overall approach to advancing stormwater management tools and technologies.

- Technical questions and approaches to data collection are regionally specific. Considerations of social and community benefits, ecosystem services, and environmental justice also need a regional approach. Consider documenting the process of developing and implementing regional research programs to synthesize into a national framework for promoting implementation of stormwater management solutions.
- Provide a more explicit explanation of how climate change impacts are being considered in the field and modeling programs. How these research questions contribute to evaluating and developing solutions for disproportionately impacted communities with failing infrastructure, which are often economically disadvantaged communities, is of particular interest.
- Contribute data from field monitoring programs to resources such as the National Stormwater Quality Database (characterizing untreated runoff/ stormwater quality) and the International Stormwater Best Management Practices (BMP) Database (for monitoring data from stormwater management technologies that may be called BMPs, stormwater control measures, or SCMs, low impact development, or LID, green infrastructure effectiveness, etc.). These freely available databases (www.bmpdatabase.org) are already supported by EPA and represent the largest repository of stormwater management monitoring data, yet the majority of existing ORD data are not yet included.
- Additional considerations from a programmatic perspective are to develop:
    - optimization tools to solve site-specific runoff problems with the type and location of stormwater management technologies.
    - appropriate metrics to interpret context-specific performance (especially with respect to receiving water goals, and translating between site-scale and regional technologies), and set operational standards over the lifecycle of the system. Metrics should be supported by standardized protocols for stormwater management monitoring.
    - design approaches to promote appropriate pollutant removal mechanisms to target specific pollutant types in stormwater, including optimizing use of novel materials.
    - investigations on issues of emerging concern as they relate to stormwater management, such as pollutants of emerging concern, climate change, road salt-related contamination, etc.
    - research projects to investigate the direct influence of specific maintenance activities on restoring or enhancing stormwater management technology performance.
    - SWMM's ability to accurately model hydrograph and pollutant transformations through stormwater management technologies (e.g., calibration and validation of the LID controls).
- Programmatic considerations for conducting stormwater management research in disadvantaged communities should include:
    - Developing integrated performance metrics and decision support tools for stormwater management systems with multiple benefits (e.g., stormwater treatment, recreation, amenity, ecosystem services).
    - Engaging with appropriate experts and local community stakeholders to develop and communicate program priorities and metrics for evaluating success.
    - Providing training for local partners to continue research after ORD has completed its scope. Continuing research is anticipated to engender community acceptance and long-term care (maintenance) of stormwater management facilities, as well as provide critically absent, industry-wide data on lifecycle performance.

Recommendations

The Subcommittee offers these recommendations to support the relevant Agency priorities:

Recommendation 3.1: Develop new sensors or tools to enable remote performance monitoring of stormwater management technologies. This would reduce challenges of physically conducting monitoring and/or where funds or professional capability are not readily-available.

Recommendation 3.2: Implement research that considers the entire lifecycle of a stormwater system (including design, installation, maintenance, and decommissioning) in disadvantaged communities. Such research should address both biophysical/technical issues as well as community capacity (social, economic) with the objective of developing a decision framework.

SUMMARY LIST OF RECOMMENDATIONS

Charge Question 1: What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its drinking-water and distribution research, and in particular on how these research activities can be comprehensively integrated to ensure safe disinfectant levels, while minimizing or eliminating exposure to lead, opportunistic pathogens, and DBPs in small treatment and distribution systems and in disadvantaged communities?

- **Recommendation 1.1:** Focus on developing a risk-based model integrating research findings on disinfectants, pathogens, and DBP risks, and, if relevant, on lead-related risks. This would involve optimizing and integrating existing models of individual components and would also show how changes in the risk of one component would affect the risks of the others. For example, EPA must optimize models of DBP formation (both regulated and unregulated) enabling the models to communicate with other models such as health risk models, especially for unregulated DBPs. Having the model created, even if it cannot yet be executed, would be a great tool for further research and data gap identification.
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- **Recommendation 1.2:** Focus on developing a more user friendly EPANET-MSX (Multi-Species eXtension) model that would include built-in DBP and disinfection models so users can apply them easily. EPANET is a tool used to address hydraulic issues (like mixing in storage tanks and residence time), and also fate and transport issues (for disinfectants, DBPs, natural organic matter, etc.). However, there is a need to make its application as simple as possible, especially for small systems. EPA should integrate these models with risk information in a decision support tool to better meet the needs of small systems and disadvantaged communities. Such a tool could easily highlight the risks of DBPs along with the benefits and costs of different strategies to reduce/prevent DBP formation.

Charge Question 2: Please comment on the implementation of ORD's water reuse research, and what suggestion(s)/ recommendation(s) does the Subcommittee have regarding SSWR's water reuse research for helping to innovatively augment water supplies and improve resiliency by identifying promising alternative water sources?

- **Recommendation 2.1:** The research vision should further define how the various individual research projects will be integrated into a synthesis product that will inform communities that must prioritize among a range of alternative water reuse sources.

Charge Question 3: 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?

- **Recommendation 3.1:** Develop new sensors or tools to enable remote performance monitoring of stormwater management technologies. This would reduce challenges of physically conducting monitoring and/or where funds or professional capability are not readily-available.
- **Recommendation 3.2:** Implement research that considers the entire lifecycle of a stormwater system (including design, installation, maintenance, and decommissioning) in disadvantaged communities. Such research should address both biophysical/technical issues as well as community capacity (social, economic) with the objective of developing a decision framework.

APPENDIX A: MEETING AGENDA

Wednesday, May 26

Time (EDT)	Topic		Presenter
11:45-12:00	Sign on and Technology Check		
12:00-12:15	Welcome and Opening Remarks		Tom Tracy (DFO) Joseph Rodricks (SSWR BoSC Chair) Robert Blanz (SSWR BoSC Vice Chair)
12:15-12:30	ORD Welcome		Jennifer Orme-Zavaleta (ORD Acting Assistant Administrator)
12:30-12:40	SSWR Overview and Charge Questions		Suzanne van Drunick (SSWR National Program Director)
12:40-1:15	ORD Center and Grants Overview		Greg Sayles (Director, CESER) Rusty Thomas (Director, CCTE) Mary Ross (Director, OSAPE)
1:15-1:25	Water Treatment and Infrastructure		Chris Impellitteri (Associate NPD, WTI Topic Lead)
1:25-4:30	Overview of Research Area 7: *Drinking Water Treatment and Distribution Systems*		Hale Thurston (ACD, CESER)
	1:30-2:00	Output 1: Resources and tools for characterizing and mitigating lead and copper release in drinking water distribution systems and premise plumbing	Darren Lytle (ORD, CESER) BoSC Q&A
	2:00-2:30	Output 2: Best practices, tools, and information for assessing and controlling pathogens and biostability in drinking water systems, managing disinfectant residuals, and minimizing DBPs	Eric Villegas (ORD, CEMM) BoSC Q&A
	2:30-3:00	Output 3: Analytical methods, occurrence, health effects, and treatment assessments to aid regulatory decision-making	Jane Ellen Simmons (ORD, CPHEA) BoSC Q&A
	3:00-3:15	Break	

Thursday, May 27

Time (EDT)	Topic		Presenter
11:15-11:30	Sign on and Technology Check		
11:30-11:40	Welcome – Day 2		Tom Tracy (DFO) Joseph Rodricks (SSWR BOSC Chair) Robert Blanz (SSWR BOSC Vice Chair)
11:40-12:00	ORD Centers Overview		Tim Watkins (Director, CEMM) Jamie Strong (Associate Center Director, CPHEA)
12:00-1:30	Overview of Research Area 9: *Wastewater and Water Reuse*		Ann Grimm (ACD, CEMM)
	12:05-1:00	Output 1: Analytical methods, exposure and effects assessment processes, and tools for wastewater and fit-for-purpose water reuse Output 2: Treatment technologies for wastewater and fit-for-purpose water reuse	Jay Garland (Associate Director, CESER)
1:00-1:30	BoSC Discussion of Charge Question 2		Joseph Rodricks (SSWR BoSC Chair) Robert Blanz (SSWR BoSC Vice Chair)
1:30-1:45	Public Comments		Tom Tracy (DFO)
1:45-2:00	Break		
2:00-3:45	Overview of Research Area 10: *Stormwater Management*		Ann Grimm (ACD, CEMM)
	2:05-2:20	Output 2: Stormwater Management as a Resource for Enhanced Recharge, Capture, and Use (Informational only – no charge question)	John Johnston (ORD, CEMM) BoSC Q&A
	2:20-2:45	Output 1: Planning, Implementing, and Monitoring Stormwater Management Practices	Matt Hopton (ORD, CESER)
2:45-3:15	BoSC Discussion of Charge Question 3		Joseph Rodricks (SSWR BoSC Chair) Robert Blanz (SSWR BoSC Vice Chair)
3:15-3:30	Break		
3:30-4:30	Charge Question Breakout Groups (Committee members will be preassigned to specific charge questions)		BoSC & ORD
4:30-5:15	Charge Question Breakout Group Reports (15 mins each report)		Charge Question Leads

Time (EDT)	Topic	Presenter
5:15-5:30	Next Steps	Joseph Rodricks (SSWR BoSC Chair) Robert Blanz (SSWR BoSC Vice Chair) Suzanne van Drunick (NPD, SSWR) Joe Williams (Principal Associate NPD, SSWR) Tom Tracy (DFO)
5:30	Adjourn	

APPENDIX B: MATERIALS

Material Provided in Advance of the Meeting

- Meeting Agenda
- Charge Questions
- Presentations
- American Water Works Association – Public Comments
- March 8, 2021 Next Steps on Implementation of Executive Order 13985
- Zoom Virtual Participation Guide

Material Provided During or After the Meeting

- All Presentations
- Zoom Recordings