

**U.S. Environmental Protection Agency Board of Scientific Counselors**

**Safe and Sustainable Water Resources Subcommittee**

**Virtual Meeting Summary**

**December 1-2, December 14, 2021, and January 13, 2022**

**Dates and Times:** December 1, 2021, 12:00 to 5:00 p.m.; December 2, 2021, 12:00 to 5:00 p.m.; December 14, 2021, 11:00 a.m. to 2:00 p.m.; January 13, 2022, 11:00 a.m. to 2:00 p.m. Eastern Time

**Location:** Virtual

**Executive Summary**

On December 1-2 and December 14, 2021, and January 13, 2022, the Environmental Protection Agency's (EPA's) Board of Scientific Counselors (BOSC) Safe and Sustainable Water Resources (SSWR) Subcommittee (further referred to here as the Subcommittee) convened in virtual meetings. The goals of the two-day meeting and subsequent teleconferences were to discuss the Office of Research and Development's (ORD) SSWR Research Program's research areas and charge questions. The virtual meeting format allowed for presentations, open dialogue, program feedback, Subcommittee deliberations and questions, and EPA responses to questions.

Day 1 consisted of opening remarks and introductions, presentations on Research Area 5 and Research Area 6, and BOSC Subcommittee discussion on charge questions. Day 2 consisted of an overview of Research Area 4, BOSC Subcommittee discussions on Charge Question 3, and charge question breakout groups. Day 3 and 4 consisted of charge question breakout groups and charge question report-outs.

**Wednesday, December 1, 2021**

Dr. Joseph Rodricks, Chair, Safe and Sustainable Water Resources Subcommittee, thanked the Subcommittee members for their participation. He outlined the charge question assignments and workgroups. Dr. Rodricks introduced Dr. Chris Frey, Deputy Assistant Administrator for Science Policy, Office of Research and Development.

Dr. Frey thanked the Subcommittee for their input and feedback and emphasized the importance BOSC Subcommittee members hold in providing external expert scientific advice. He recognized SSWR scientists and researchers that will present later in the meeting. Dr. Frey emphasized that the SSWR program and ORD are looking for guidance to build on the topic of human and ecological impacts of HABs and nutrients pollution. Dr. Frey described the StRAP for 2022-2026 is in the early stages of development and recognized EPA's BOSC substantial role in shaping the current plan.

**Safe and Sustainable Water Resources Research Program Overview and Charge Questions**

Dr. Suzanne van Drunick, National Program Director, SSWR Research Program, provided an overview of the three research areas that will be covered during the meeting. Research Area 4 is focused on assessment and management of Harmful Algal Blooms (HABs). Research Area 5

covers the science to support nutrient-related water quality goals, and Research Area 6 is focused on nutrient reduction strategies and assessment. Dr. van Drunick described the three charge questions.

## **Nutrients and Harmful Algal Blooms**

Dr. Anne Rea, Senior Science Advisor, Nutrients and Harmful Algal Blooms Topic Lead, Sustainable and Healthy Communities Research Program, introduced the nutrients and HABs research topic, which aims to comprehensively address nutrient issues and HABs. Dr. Rea described the work in Research Area 5 as research to determine nutrient-related impacts in watersheds and water bodies across various scales, support water quality management goals, and quantify ecosystem response and recovery rates. She noted that Research Area 6 has three broad components of nutrient reduction strategies, including application of state of the science, effectiveness evaluation, and whole system integrated management and engagement. Dr. Rea emphasized that the Subcommittee meetings are an opportunity for the EPA BOSC and SSWR program to learn about the current research efforts and how the research is designed to address the needs of EPA and the public.

## **Research Area 5: Science to Support Nutrient-Related Water Quality Goals**

### ***Overview of Research Area 5: Science to Support Nutrient-Related Water Quality Goals: Research Highlights***

Dr. Heather Golden, Research Physical Scientist, Center for Environmental Measurement and Modeling (CEMM) provided an overview of Research Area 5. She emphasized the nutrient pollution problem has consequences for human health, environmental health, and the economy. Dr. Golden described the goal of Research Area 5 and the three corresponding outputs as thematic subareas. She discussed the general research approaches, including monitoring, sediment profiles, laboratory analysis, remote sensing, and modeling. Dr. Golden described the three research outputs and subsequent example research products within each subarea.

### ***Research Focused on Novel Methods to Assess Nutrient Indicators***

Dr. Cheryl Brown, Research Oceanographer, Center for Public Health and Environmental Assessment (CPHEA) outlined the issue, approach, result, and subsequent research of ORD's research on novel methods to assess nutrient impacts and indicators. She identified primary agency drivers of their work being the Clean Water Act (CWA) and Nutrient Scientific Technical Exchange Partnership & Support (N-STEPS) program. Dr. Brown noted efforts in developing deoxyribonucleic acid (DNA) metabarcoding of nutrient indicator biota, which would improve temporal monitoring of changing nutrient conditions. She emphasized partnerships throughout their work, including Tillamook Estuaries, EPA, OW, Office of Wetlands, the Oregon Department of Environmental Quality, Great Lakes National Program Office, and various EPA regions, among others. In addition, Dr. Brown underscored the status of each of the research efforts and future directions for the research methods discussed.

### ***Research Focused on Vulnerability and Recovery From Excess Nutrients***

Dr. Kate Schofield, Ecologist, CPHEA, presented research focused on vulnerability to and recovery from excess nutrients, where vulnerability and recovery are the two key areas examined. She discussed how some of the projects examine factors making freshwater and estuary systems more susceptible to excess nutrients and related stressors, and how national nutrient inventories and modeling approaches track nutrient sources across the Great Lakes and terrestrial-marine boundaries. Dr. Schofield emphasized other current projects study how aquatic systems recover from eutrophication once nutrient loads begin to decline. She identified lead researchers, partners, and future directions of the current research efforts.

### **Board of Scientific Counselors Discussion of Charge Question 1**

Dr. Steve Weisberg read Charge Question 1. The Subcommittee engaged in discussion, with topics including the implementation approach, specific endpoints used for indicators, the relationship between the nutrient concentration and the endpoints, assessing endpoint criteria, and if certain endpoints are of greater importance.

### **Research Area 6: Nutrient Reduction Strategies and Assessment**

Dr. Ann Rea introduced Research Area 6 and introduced the first speaker, Dr. Yongping Yuan.

#### ***Overview of Research Area 6: Nutrient Reduction Strategies and Assessment: research Highlights***

Dr. Yongping Yuan, Hydrologist, CEMM, presented an overview of EPA nutrient reduction strategies and assessments, including the products that will allow customers to plan, implement, and track the effectiveness of nutrient reduction strategies at multiple spatial and temporal scales. This includes watersheds drained to receiving waters potentially affected by nutrient-related water-quality issues.

#### ***Tools and Approaches for Implementing and tracking Nutrient Reductions***

Dr. Jana Compton, Ecologist, CPHEA, reviewed EPA tools for tracking nutrient reductions to compare landscape nutrient inputs to United States water chemistry over time and combining that data with EPA's National Nutrient Inventory. Dr. Compton also reviewed EPA toolboxes for stable isotope indicators for nutrient pollution and use of low-cost sensors to track nutrient reduction efforts.

#### ***Best Practices for Integrated Nutrient Management Programs***

Dr. Chris Nietch, Research Ecologist, CEMM, highlighted projects that include best practices for nutrient management programs. He also emphasized projects related to research on improving nutrient reduction strategies, water quality credits and their partnerships, communication and engagement with the public, and building partner relationships. Dr. Nietch briefly reviewed the

community-driven research Partnership for Improved Nutrient Efficiency (PINE) to better understand nitrate leaching into groundwater from agricultural practices.

## **Board of Scientific Counselors Discussion of Charge Question 2**

Dr. Rodricks introduced Dr. Kate Lajtha and Dr. Elizabeth Fassman-Beck to review Charge Question 2. The Subcommittee engaged in discussion, with topics including determining best practices for current research efforts, research related to evaluating the effectiveness of nonpoint source nutrient reductions at local and large scales, how nutrient input and output relationships are modified by various factors, and research implementation. Discussion topics also included future research opportunities, stakeholder engagement and collaborations, and motivations behind current research efforts.

## **Public Comment**

Mr. Tom Tracy, Designated Federal Officer, Office of Science Advisor, Policy, and Engagement, shared submitted public comments. Mr. Stephen Brown, member of the Sierra Club, asked why there has been no mention of CAFO (Concentrated Animal Feeding Operation) waste. He noted the conventional wisdom in Ohio and Michigan is the CAFO manure is spread on agricultural lands and also held in lagoons where the nutrients are leaking into the ground water. This is the major source of nutrient contamination for Lake Erie.

## **Thursday, December 2, 2021**

### **Welcome and Opening Remarks**

Dr. Suzanne van Drunick, welcomed the participants to the meeting and provided an overview of the research areas and topics that will be discussed during the meeting.

### **Research Area 4: Assessment and Management of Harmful Algal Blooms**

#### ***Research Area 4: Assessment and Management of Harmful Algal Blooms: Research Highlights***

Dr. Nick Dugan, Environmental Engineer, Center for Environmental Solutions and Emergency Response (CESER), provided an overview of HABs, including when freshwater HABs occur, the potential of cyanobacteria to produce toxins, commonly reported cyanotoxins, and routes of exposure. He identified legislative drivers of HABs research and highlighted program, region, and state needs. Dr. Dugan noted there are three research subareas: assessing adverse health outcomes from exposure to HABs, research to support managing HABs and their impacts on ambient and drinking water and developing tools to support HABs risk characterization and assessment. He stated that the health outcomes were divided into three research products. Dr. Dugan described the three research products and discussed their correlation to support HABs management. He highlighted that the research included the CyAN app as a result of collaborative

work between EPA, the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA).

### ***Research Focused on Harmful Algal Blooms Toxicity***

Dr. Elizabeth Hilborn, Epidemiologist, CPHEA, presented research focused on work addressing and informing HABs toxicity. She discussed health effects derived from their risk assessment research, the results of toxicology research, and described the acute effects of microcystic congeners using a mouse model with oral exposure and primary human hepatocytes. Dr. Hilborn emphasized cyanobacteria effects, commonly toxin rash and skin irritation, on human skin tissue as dermal exposure. She discussed the toxicity of aerosolized cyanotoxins and described acute and chronic toxicity tests on aquatic organisms. Dr. Hilborn continued to discuss science reporting on adverse observed effects. She underscored how ambient HABs are mixtures, containing multiple cyanobacteria, other phytoplankton, and other algae and are other potentially harmful aquatic organisms, ranging from viruses to protozoa. She stated EPA has collaborated with the Centers for Disease Control and Prevention (CDC) on its OneHealth Harmful Algal Blooms system to characterize HAB events and resultant human and animal illness. Dr. Hilborn outlined the many uncertainties about routes of exposure to cyanobacteria toxins and their work to develop methods to identify where blooms are more likely to be toxic. She further discussed investigative efforts into *Microcystis aeruginosa* in ambient waters.

### ***Research Focused on Predictive Capability and Future Forecasting***

Dr. Blake Schaeffer, Research Physical Scientist, CESER, discussed building capacity to forecast cyanobacteria HABs (cyanoHABs). He highlighted that EPA provides recommendations for cyanotoxin concentrations in recreational and drinking water. Dr. Schaeffer discussed bloom versus non-bloom events, describing a bloom event as any event resulting in negative environmental or health consequences. Dr. Schaeffer discussed details of models to predict lake photic zone temperature, novel methods DNA and ribonucleic acid (RNA) sequenced-based characterization and functional analysis, use of high-frequency sonde to model risks in inland reservoirs, and Ohio River risk characterization for bloom forecasting and persistence.

### **Board of Scientific Counselors Discussion of Charge Question 3**

The Subcommittee engaged in discussions and posed questions regarding Charge Question 3, including topics such as StRAP implementation, acquiring compounds for testing, focusing human observation studies on underserved or disadvantaged communities, and challenges posed by PFAS research.

### **Charge Question Breakout Group Reports**

The Subcommittee divided into three workgroups to discuss and draft responses to the charge questions. After group discussions, the Subcommittee reconvened and provided an overview of their ideas and posed questions on each charge question. Dr. Stephen Weisberg provided an overview of the discussion on Charge Question 1, stating three main challenges of the research presented. The first area is nutrient source identification, the second area is indicators and

endpoints used to determine nutrient issues, and the third area referred to linkages between nutrient concentrations and endpoint inputs. Dr. Weisberg discussed ideas and questions for Charge Question 2, including the need for a multi-pronged communication strategy and EPA's correlation between research efforts and monitoring programs. Dr. Lucinda Johnson shared the ideas and questions from Charge Question 3, including the complexity of diversity of toxins, diversity of the species delivering the toxins, and the diverse affected ecosystems. She discussed information integration, knowledge gaps, and tools for large scale bloom occurrences.

## **Tuesday, December 14, 2021**

### **Workgroups Report Out and Response to Charge Questions**

Dr. Weisberg reviewed the strengths, suggestions, and recommendations for Charge Question 1 and Charge Question 2. He noted the strengths of Charge Question 1 were the wide range of indicators, which have a good range of sensitivity, and endpoint types. The workgroup suggests more structure within research descriptions, such as a strategy document, and a need for assessment of how their works translate across geographies and small or large systems. The workgroup recommended enhancing the endpoint and nutrient concentration linkage. The workgroup suggests more structure within research descriptions, such as a strategy document, and a need for assessment of how their works translate across geographies and small or large systems.

Dr. Weisberg noted the strengths of Charge Question 2 were the holistic approach, the range of possible solutions being examined, and that ORD is tying it all back to a case study focusing beyond individual technologies. The workgroup suggests focusing more on urban stormwater, communication of a strategic study approach to scale solutions across a range of geography, and more information on tracking systems for assessing management success. The workgroup recommended that ORD create a communication strategy focused on lessons learned and target audiences.

Dr. Lucinda Johnson discussed the strengths, suggestions, and recommendations for Charge Question 3. The strengths included the current amount of HABs research and the span of work across multiple agencies (federal, state, tribal, and local governments). The suggestions from the workgroup were categorized into groups including toxicity testing, chronic exposure, and threshold determination. The workgroup recommended ensuring model development and validation captures a range of critical ecosystem types and study sites that represent different communities with special emphasis on underserved communities.

## **Thursday, January 13, 2022**

### **Workgroups Report Out and Response to Charge Question 1**

Dr. Weisberg provided a summary of the Charge Question 1 draft report. He read the Subcommittee draft strengths, suggestions, and recommendations. The strengths included research on biological indicators rather than on underlying nutrient concentrations, the range of indicators ORD has considered appropriate, and ORD's work over a large spatial range of

geographical systems. The suggestion included developing a clearer strategy for assessing how well indicators scale across systems of different sizes and geography. Dr. Weisberg read the actionable recommendations, including creating a document describing a coherent structure for ORD's nutrient research strategy, and organizing the list of projects based on the structure. Dr. Suzanne van Drunick appreciated the Subcommittee's suggestions and recommendations. She noted the strategy is something to focus on in the next strategic plan.

### **Workgroups Report Out and Response to Charge Question 2**

Dr. Weisberg provided a summary of the Charge Question 2 draft report. He read the Subcommittee draft strengths, suggestions, and recommendations. He noted ORD has effectively identified two or three factors. One of the strengths is the strategy that uses a case-study approach. Dr. Weisberg noted the three suggestions from the workgroup, including systems used as test systems not being legacy-dominated systems, to have more work on urban systems, and to establish a better connection between source identification research and BMP practices under development. The workgroup recommended having a communications strategy for communicating with managers and scientists, who can contribute to the research efforts. Dr. Suzanne van Drunick noted given resource limitations, ORD cannot have case studies and different scenarios. She asked if there is a useful priority, given the wide scope of nutrients research nationally. Dr. Weisberg noted there was no priority, if there is transferability.

### **Workgroups Report Out and Response to Charge Question 3**

Dr. Joseph Rodricks provided an overview of the Charge Question 3 draft report. He read the Subcommittee draft strengths, suggestions, and recommendations. Dr. Lucinda Johnson noted there was interest in ensuring inclusion of different community types and ecosystem types in model development and activation exercises to ensure adequate representation. Dr. Suzanne van Drunick appreciated the recommendations and noted they would be helpful for EPA moving into the next strategic plan.

## Meeting Agenda and Other Meeting Materials

The [agenda](#)<sup>1</sup>, [charge questions](#)<sup>2</sup>, and other meeting materials can be accessed at: [BOSC Safe and Sustainable Water Resources Subcommittee Meeting: December 2021 | US EPA](#).

## Meeting Participants

### BOSC Safe and Sustainable Water Resources Subcommittee Members:

Joseph Rodricks, *Chair*  
Robert Blanz, *Vice Chair*  
Scott Ahlstrom\*  
Jerad Bales\*  
Steve Carr\*  
Shahid Chaudhry\*  
David Cole  
Joel Ducoste  
Elizabeth Fassman-Beck  
Fred Hitzhusen  
Lucinda Johnson, *BOSC Executive Committee Vice Chair*  
Kate Lajtha  
Michelle Lorah\*  
John Lowenthal  
Tim Verslycke\*  
Stephen Weisberg  
John White

*\* did not attend any meetings*

**EPA Designated Federal Officer (DFO):** *Tom Tracy, Office of Science Advisor, Policy, and Engagement*

### EPA Presenters:

Cheryl Brown, *Office of Research and Development, Center for Public Health and Environmental Assessment*  
Jana Compton, *Office of Research and Development, Center for Public Health and Environmental Assessment*  
Nick Dugan, *Office of Research and Development, Center for Environmental Solutions and Emergency Response*  
Christopher Frey, *Deputy Assistant Administrator for Science Policy, Office of Research and Development Assistant Administrator Nominee*  
Heather Golden, *Office of Research and Development, Center for Environmental Measurement and Modeling*



Elizabeth Hilborn, *Office of Research and Development, Center for Public Health and Environmental Assessment*  
Christopher Nietch, *Office of Research and Development, Center for Environmental Measurement and Modeling*  
Anne Rea, *Senior Science Advisor for Nutrients*  
Blake Schaeffer, *Office of Research and Development, Center for Environmental Measurement and Modeling*  
Kate Schofield, *Office of Research and Development, Center for Public Health and Environmental Assessment*  
Suzanne van Drunick, *National Program Director, Safe and Sustainable Water Resources Research Program*  
Joe Williams, *Principal Associate National Program Director, Safe and Sustainable Water Resources Research Program*  
Yongping Yuan, *Office of Research and Development, Center for Environmental Measurement and Modeling*

**Other EPA Attendees:**

Jason Augustine	Amalia Handler	Jenny Paul
Azadeh Azadapour-Keeley	Matt Herberling	Marguerite Pelletier
Hannah Boone	Elizabeth Hilborn	Amina Pollard
Warren Boothman	Donna Hill	Brenda Rashleigh
J. Renee Brooks	Jeff Hollister	Anne Rea
Cheryl Brown	Brandon Jarvis	Matthew Richards
Jim Carleton	Correne Jenson	Vicki Richardson
Eliodora Chamberlain	Whitney King	Caroline Ridley
Giancarlo Cicchetti	Karen Kleier Schrantz	Bruce Rodan
Jana Compton	Betty Kreakie	Mary Ross
Lesley D'Anglada	Taylor Lass	Marc Russell
Naomi Detenbeck	Michelle Latham	Robert Sabo
Nick Dugan	Jim Lazorchak	Blake Schaeffer
Katie Flahive	Jingrang Lu	Marie Schneider
Katherine Foreman	Cissy Ma	Kate Schofield
Chris Frey	Bob McKane	Stephen Shivers
George Gardenier	Janet Nestlerode	Nathan Smucker
Tim Gleason	Chris Nietch	Avery Tatters
Heather Golden	Autumn Oczkowski	Dana Thomas
Rick Greene	Edward Ohanian	Hale Thurston
Ann Grimm	Jacques Olivier	Julie Weitzman
Scot Hagerthey	Kate O'Mara	Allison Yackley
Gayle Hagler	Stephen Pacella	Yongping Yuan
James Hagy	James Pauer	Robert Zucker

**Other Attendees:**

Astrika Adams	Ciera Baird	Lara Beaven
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Stephen Brown  
Adam Carpenter  
Gloria Charland  
Steve Davies  
David Finethy

Grace Gusler  
Erma Leaphart  
Justin McGehee  
Elena Mola  
Jayme Smith

Justin Spangler  
Steve Via  
Tom Warmuth  
Linda Wilson

**Contractor Support:**

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