18th Annual EPA Drinking Water Workshop: Small Systems Challenges and Solutions

Virtual Workshop

August 30 – September 2, 2021

Sponsored by U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD) and Office of Water (OW) in partnership with the Association of State Drinking Water Administrators (ASDWA)

Additional Information and Registration

Pre-Workshop Events

Monday, August 30, 2021	
11:00 am – 3:30 pm ET	IN-DEPTH TRAINING SESSIONS (T1-T4) **Treatment, Monitoring, Modeling, and Distribution Systems**
11:00 am – 3:00 pm ET	**Session T1: Corrosion** This session will cover the fundamentals of lead and copper release including corrosion, the role of particles, and metal solubility relationships in drinking water. Distribution system assessment approaches, including water sampling strategies and pipe scale analyses, will also be addressed. Lastly, corrosion control strategies and corrosion control assessment tools will be presented. Cases study data will be used to illustrate important messages where appropriate. *Trainers: Darren Lytle, Simoni Triantafyllidou, Michael Schock, Stephen Harmon, Mike DeSantis, and Jennifer Tully, and Christina Devine (ORISE Fellow), EPA-ORD*
11:00 am – 3:00 pm ET	**Session T2: Introduction to EPANET and Example Applications** This session will be structed as two parts: Part 1 will provide an overview and introduction to EPANET and Part 2 will provide four example EPANET applications that participants can follow to get familiar with and use EPANET. The four applications will be in the form of exercises and will include (1) building an EPANET model, (2) performing a hydraulic simulation using demand dependent and pressure dependent demands, (3) performing a water age analysis, and (4) performing a water quality chlorine analysis. *Trainers: Robert Janke, Feng Shang, Jonathan Burkhardt, Terranna Haxton, and Benjamen Burkhart (ORAU Contractor), EPA-ORD*
11:00 am – 1:00 pm ET	**Session T3: Sanitary Surveys—Treatment** This session will provide information for state and federal public water system oversight personnel on evaluating water treatment processes as part of sanitary surveys or technical assistance for public water systems. Presenters will be experienced field staff from multiple agencies. *Trainers: Michael Finn, EPA-OW; Evan Hofeld, Oregon Health Authority; Eugene Leung, California Water Resources Control Board (California EPA); Chad Fischer, California Water Resources Control Board (California EPA); and Johnny Mendez, Alaska Department of Environmental Conservation*
1:30 pm – 3:30 pm ET	**Session T4: Managing Legacy Manganese in Your Distribution System** This session will help small utilities identify problems related to legacy manganese (Mn) and manage their impacts. Training goals: (1) appreciation of regulatory, public health, and aesthetic issues associated with legacy Mn; (2) identify important characteristics of legacy Mn; (3) observe a demonstration of lab techniques that can be used to measure total and dissolved Mn; (4) understand how a utility developed a distribution system monitoring program for legacy Mn; and (5) be familiar with the demonstrated effectiveness of techniques for trying to remove legacy Mn. *Trainers: Philip Brandhuber, BWQ&T; Melinda Friedman, Confluence Engineering Group; and Laura Meteer, Regional Municipality of York, Ontario*
3:30 pm ET	Adjourn

18th Annual EPA Drinking Water Workshop: Small Systems Challenges and Solutions

Virtual Workshop

August 30 – September 2, 2021

Agenda

Tuesday, August 31, 2021		
11:00 am – 12:00 pm ET	SESSION 1 – OPENING PLENARY *Moderator: Alan Roberson, ASDWA*	
11:00 am	**Welcome and Introductions** *Gregory Sayles, Director of Center for Environmental Solutions and Emergency Response, EPA-ORD*	
11:05 am	**Keynote Speakers** *Christopher Frey, Deputy Assistant Administrator for Science Policy, EPA-ORD* *Zachary Schafer, Senior Advisor to the Assistant Administrator, EPA-OW*	
11:55 am	**Workshop Review and Logistics** *Michelle Latham and Thomas Speth, EPA-ORD*	
12:00 pm ET	Break/Transition	
12:30 pm – 2:30 pm ET	SESSION 2A – MONITORING AND DISTRIBUTION I: **Pathogens** *Moderator: Laura Boczek, EPA-ORD*	SESSION 2B – SOURCE AND TREATMENT I: **Per-and Polyfluoroalkyl Substances (PFAS)** *Moderator: Thomas Speth, EPA-ORD*
12:30 pm	**Prevention and Control of Legionnaires' Disease in the Aftermath of a Severe Outbreak: Lessons Learned** *William Rhoads, Eawag*	**PFAS in Minnesota** *Karla Peterson, Minnesota Department of Health*
1:00 pm	**Differences in the Inactivation of *Legionella Pneumophila* Serogroups Using Ultraviolet-C (UV-C) LED Technology in Drinking Water** *Helen Buse, EPA-ORD*	**Designing a Small System PFAS Occurrence Study - Lessons Learned** *Courtney Davis and Matthew Morse, New York State Department of Health*
1:30 pm	**Using Economic Optimization to Derive Site-Specific Treatment Objectives** *Dave Tamblyn, First Nations Health Authority*	**Collaborative Pilot-Scale Evaluation of Granular Activated Carbon (GAC) and Ion Exchange Medias for Removal of PFAS from Groundwater** *Adam Redding, Calgon Carbon Corporation*
2:00 pm	Panel Q&A	Panel Q&A
2:30 pm	Break/Transition	
3:30 pm – 5:30 pm ET	SESSION 3A – MONITORING AND DISTRIBUTION II: **Corrosion and Lead** *Moderator: Darren Lytle, EPA-ORD*	SESSION 3B – SOURCE AND TREATMENT II: **Source Water Quality and Quantity** *Moderator: Alan Roberson, ASDWA*
3:30 pm	**Lead in Drinking Water in Schools and Childcare Facilities: The Massachusetts Experience** *Michael Celona and Jessica Sibirski, Massachusetts Department of Environmental Protection*	**DWMAPS: A Tool for Source Water Protection** *Terrell Tiendrebeogo and Daniela Rossi, EPA-OW*
4:00 pm	**Experiences with Michigan's New Lead and Copper Rule** *Brandon Onan, Michigan Department of Environment, Great Lakes, and Energy*	**Managing Harmful Algal Blooms Based on Total Maximum Daily Load Models** *Jonathan Leiman, Maryland Department of the Environment*
4:30 pm	**Corrosion Control Evaluation Considerations with Change in Source and Treatment** *Ashley Voskuhl, Ohio EPA*	**Eyes in the Sky Monitor Cyanobacterial Blooms at Source Waters** *Megan Coffer, EPA-ORD*
5:00 pm	Panel Q&A	Panel Q&A
5:30 pm ET	Adjourn	

Wednesday September 1, 2021		
11:00 am – 12:30 pm ET	SESSION 4 – TECHNICAL FOCUS GROUPS I: **Breakout Group Discussions for Primacy Agencies (State/Territory/Tribal) and Federal Partners**	
Limited to primacy agency staff and federal partners	**Group A: Corrosion.** *What are the most pressing corrosion issues and how are they being addressed?* Facilitators: Darren Lytle, EPA-ORD and Ashley Voskuhl, Ohio EPA	
	Group B: Analytics and Analytical Methods. *What are the method-development priorities for emerging contaminants and method-improvement needs for regulated drinking water parameters?* Facilitators: Steve Wendelken, EPA-OW and Hunter Adams, City of Wichita (Texas)	
	Group C: Pathogens. *What are the pathogens of concern from the distribution system to premise plumbing, and what factors influence their presence?* Facilitators: Laura Boczek, EPA-ORD; Michael Finn, EPA-OW; and Wendi Wilkes, ASDWA	
	Group D: Disinfection and Disinfection Byproducts (DBPs). *What is the highest priority regulatory or non-regulatory issue for reducing exposure to DBPs?* Facilitators: Jonathan Pressman, EPA-ORD and Alan Roberson, ASDWA	
	Group E: PFAS. *How are primacy agencies and water systems addressing sampling, treatment, and public perception?* Facilitators: Thomas Speth, EPA-ORD and David Dani, Colorado Department of Public Health and Environment	
12:30 pm ET	Break/Transition	
1:00 pm – 3:00 pm ET	SESSION 5A – MONITORING AND DISTRIBUTION III: **Disinfectants and Disinfection Byproducts (DBPs)** *Moderator: Jonathan Pressman, EPA-ORD*	SESSION 5B – SOURCE AND TREATMENT III: **Equity and Underserved Communities** *Moderator: Michelle Latham, EPA-ORD*
1:00 pm	**Regulated DBP Formation and Prediction for Long Residence Times** *Anthony Kennedy, U.S. Bureau of Reclamation*	**All Rise for Safe Water: Study of Drinking Water Violations in Manufactured or Mobile Home Communities** *Liana Prudencio, EPA-OW*
1:30 pm	**DBP Compliance Assistance Training: Lessons Learned from Oklahoma Pilot** *Candy Thompson, Oklahoma Department of Environmental Quality and Matthew Alexander, EPA-OW*	**Water Equity and Safe Drinking Water Act Compliance: Evidence from California** *Maura Allaire, University of California-Irvine*
2:00 pm	**Understanding HAAs Occurrence with National Datasets of UCMR4 versus DBP ICR** *Jimmy Chen, EPA-OW*	**How the Drinking Water State Revolving Fund Can Target Funding to Disadvantaged Communities** *Kiri Anderer and Dallas Shattuck, EPA-OW*
2:30 pm	Panel Q&A	Panel Q&A
3:00 pm ET	Break/Transition	
3:30 pm – 5:30 pm ET	SESSION 6A – MONITORING AND DISTRIBUTION IV: **Resiliency and Emergency Response** *Moderator: Regan Murray, EPA-ORD*	SESSION 6B – SOURCE AND TREATMENT IV: **Contaminant Removal** *Moderator: Kevin Letterly, ASDWA*
3:30 pm	**Water Infrastructure Strategies to Support Community Resilience** *Ryan Colker, Alliance for National and Community Resilience*	**Comparing the Triple Bottom Line of Centralized Water System Improvements to Point-of-Use or Point-of-Entry (POU/POE)** *Kaycie Lane, University of Massachusetts Amherst*
4:00 pm	**Tools to Enhance Water Sector Supply Chain Resilience** *Gabrielle Minton, EPA-OW*	**Using POU for Safe Drinking Water Act Compliance: The States' Experience** *Alan Roberson, ASDWA*
4:30 pm	**Capacity Building to Extreme Weather and Climate Events in the Water Sector** *Sarah Trainor and Nathan Kettle, International Arctic Research Center-University of Alaska Fairbanks and Jean "Renee" Edwards, Louisiana State University*	**Case Studies of POU/POE for Safe Drinking Water Act Compliance** *Marc Verhougstraete, University of Arizona*
5:00 pm	Panel Q&A	Panel Q&A
5:30 pm ET	Adjourn	

Thursday, September 2, 2021		
11:00 am – 12:30 pm ET	SESSION 7 – TECHNICAL FOCUS GROUPS II: **Breakout Group Discussions for Primacy Agencies (State/Territory/Tribal) and Federal Partners**	
Limited to primacy agency staff and federal partners	**Group A: Inorganics.** *What are important regulatory and non-regulatory issues for managing inorganic contaminants (iron, manganese, arsenic, nitrate, etc.) from the source to the tap?* Facilitators: Asher Keithley, EPA-ORD and Cynthia Klevens, New Hampshire Department of Environmental Services	
	Group B: Lead Testing in Schools. *How are states/territories/tribes preparing for LCRR lead testing in schools/childcare facilities?* Facilitators: Kevin Letterly, ASDWA and Anna Schliep, Minnesota Department of Health	
	Group C: Emergency Preparedness. *What is a reasonable expectation for cybersecurity for a water system, and what is the expectation of the primacy agency in understanding their systems' cybersecurity?* Facilitators: Alan Roberson, ASDWA and Dan Schmelling, EPA-OW	
	Group D: Water Reuse. *What are key technological gaps to cost-effective, environmentally sound approaches to onsite reuse?* Facilitators: Wendi Wilkes, ASDWA and Jay Garland, EPA-ORD	
	Group E: Capacity Development. *How are states/territories/tribes helping small systems develop their technical, managerial, and financial capacity to improve their sustainability and operations? Note: Focus will be on outreach and capacity development to systems, not on state strategy updates mandated by AWIA.* Facilitators: Kiri Anderer, EPA-OW and Amelia Springer, Kansas Department of Health and Environment	
12:30 pm ET	Break/Transition	
1:00 pm – 3:00 pm ET	SESSION 8A – MONITORING AND DISTRIBUTION V: **Monitoring and Risk Communication** *Moderator: Gregory Carroll, EPA-OW*	SESSION 8B – SOURCE AND TREATMENT V: **Implementing Innovative Treatments** *Moderator: Michael Finn, EPA-OW*
1:00 pm	**Unregulated Contaminant Monitoring Rule Update for UCMR 4 and UCMR 5** *Melissa Simic, EPA OW*	**Closing the Digital Divide: Challenges and Solutions for Small Systems** *Adán Ortega Jr, California Association of Mutual Water Companies; Joone Lopez, Moulton Niguel Water District (CA); and Donald Mah, Toshiba America-Digital Solutions*
1:30 pm	**Using State-Managed Data to Assess UCMR 4's National Representation of DBP and Manganese Occurrence** *Carleigh Samson, Corona Environmental Engineering*	**Sulfur-Assisted Biological Removal of Nitrate** *Nicholas Dugan, EPA-ORD*
2:00 pm	**Simple and Effective Water Communication Strategies? Support for Utilities to Improve the Quality and Accessibility of Consumer Confidence Reports** *Sridhar Vedachalam and Jessie Norriss, Environmental Policy Innovation Center*	**UV-C LED Application in Disinfection of Microbial Pathogens in Water** *Hodon Ryu, EPA-ORD*
2:30 pm	Panel Q&A	Panel Q&A
3:00 pm ET	Break/Transition	
3:30 pm – 5:30 pm ET	SESSION 9A – MONITORING AND DISTRIBUTION VI: **Distribution System Best Practices** *Moderator: Wendi Wilkes, ASDWA*	SESSION 9B – SOURCE AND TREATMENT VI: **System Oversight** *Moderator: Sarah Bradbury, EPA-OW*
3:30 pm	**Nitrification in Distribution Systems: Effects, Triggers, Monitoring, and Corrective Methods** *Helene Baribeau, Brown and Caldwell*	**Sanitary Survey: A Tool to Collate Data and Educate Stakeholders** *D. Lyle Setwyn, Indian Health Service*
4:00 pm	**Help for Solving Your Hydraulic Problems** *Tom Walski, Bentley Systems*	**Using Sanitary Survey Findings to Identify Risk Management Challenges** *Austin Heinrich, EPA-OW*
4:30 pm	**Preventing Pathogen Contamination: Disinfection, Tanks, and Cross Connections** *Ron Falco, Colorado Dept. of Public Health and Environment*	**California Drinking Water Needs Assessment Experience** *Gregory Pierce, University of California–Los Angeles*
5:00 pm	Panel Q&A	Panel Q&A
5:30 pm ET	Adjourn	

18th Annual EPA Drinking Water Workshop: Small Systems Challenges and Solutions

Virtual Workshop

August 30 – September 2, 2021

Workshop Bios and Summaries by Session

SESSIONS T1-T4: IN-DEPTH TRAINING

T1. Corrosion

This session will cover the fundamentals of lead and copper release including corrosion, the role of particles, and metal solubility relationships in drinking water. Distribution system assessment approaches, including water sampling strategies and pipe scale analyses, will also be addressed. Lastly, corrosion control strategies and corrosion control assessment tools will be presented. Cases study data will be used to illustrate important messages where appropriate.

Moderator:

Darren A. Lytle, Ph.D., P.E. is an environmental engineer with U.S. EPA's Office of Research and Development, Center for Environmental Solutions and Emergency Response (CESER) in Cincinnati, Ohio. Since beginning work at EPA in 1991, Darren's primary goal has been to research the quality of drinking water. Over the years, he has investigated and published works on drinking water systems, including work on distribution system corrosion control and water quality (e.g., red water control, lead and copper corrosion control); filtration (emphasis on removal of particles, and microbial contaminants and pathogens from water); biological water treatment; and iron and arsenic removal. Darren holds a B.S. in civil engineering from the University of Akron, an M.S. in environmental engineering from the University of Cincinnati, and a Ph.D. in environmental engineering from the University of Illinois.

Trainers:

Simoni Triantafyllidou, Ph.D. is an environmental engineer with U.S. ORD, CESER in Cincinnati, OH. Her research interests include aquatic chemistry, corrosion science, drinking water quality/treatment, sustainable drinking water infrastructure (premise plumbing/distribution systems) and public health. She has authored/co-authored more than 30 publications on various scientific aspects of these research areas. At EPA, Simoni is primarily conducting research on metallic corrosion and inorganic contaminants in drinking water. She holds both an M.S. and a Ph.D. in environmental engineering from Virginia Tech and is the recipient of First Place M.S., Thesis Awards by the Association of Environmental Engineering and Science Professors (AEESP) and by the American Water Works Association (AWWA), an Outstanding PhD Dissertation Award by AEESP, and Best Paper Awards from the journals Environmental Science and Technology, Journal AWWA and AWWA's Opflow Periodical. She is the Chair of AWWA's Committee, Premise Plumbing: Beyond the Meter.

Michael Schock is a chemist with U.S. EPA's ORD, CESER in Cincinnati, OH. He has spent 35 years of his 43-year professional environmental science career with the drinking water research program of the EPA in Cincinnati. Mike has conducted both in-house and field research into drinking water treatment with emphasis on metal release mechanisms and predictive modeling, corrosion control, pipe scale/sediment and inorganic water analysis, contaminant accumulation and water quality in domestic plumbing and municipal distribution systems, and development of sampling strategies for metal contamination in building and premise plumbing. He has provided technical consultation and served on numerous advisory committees. Since 1981, he has received more than 22 publication, research, and technical support awards from EPA, New England Water Works Association (NEWWA) and AWWA, including the A. P. Black lifetime achievement award in 2011.

Stephen Harmon is a physical scientist with U.S. EPA's ORD, CESER. He has been involved in the analysis of drinking water, pipe scale and particulate materials at EPA for over 30 years. Major analytical areas of interest include powder X-ray diffraction, scanning electron microscopy with energy dispersive spectroscopy (EDS), transmission electron microscopy with EDS, and wavelength dispersive X-ray fluorescence.

Mike DeSantis, Ph.D. is a physical scientist with U.S. EPA's ORD, CESER, in Cincinnati, OH. He has 16 years of experience on the characterization of corrosion solids and their effects on drinking water quality in lead, copper, and iron drinking water piping. Mike has a Ph.D. in geology from the University of Cincinnati, an M.S. in geology from the University of Idaho, and a B.A. in biology with specialization in marine science from Boston University.

Jennifer Tully is a physical scientist with U.S. EPA's ORD, CESER in Cincinnati, OH. She has spent the last five years examining lead drinking water pipe corrosion scales and developing sampling plans to investigate the occurrence of lead in drinking water. Jennifer has a B.S. in geology with a minor in biology and an M.S. in geology.

T2. Introduction to EPANET and Example Applications

This session will be structed as two parts: Part 1 will provide an overview and introduction to EPANET and Part 2 will provide four example EPANET applications that participants can follow to get familiar with and use EPANET. The four applications will be in the form of exercises and will include (1) building an EPANET model, (2) performing a hydraulic simulation using demand dependent and pressure dependent demands, (3) performing a water age analysis, and (4) performing a water quality chlorine analysis.

Trainers:

Robert Janke is a physical scientist with U.S. EPA's Office of Research and Development (ORD), Center for Environmental Solutions and Emergency Response (CESER). Prior to joining EPA in 2003, he spent 12 years with the Department of Energy overseeing a large-scale remediation while focused on developing real-time radiological survey instrumentation and procedures. Rob's research at EPA has focused on understanding and dealing with contaminant threats to drinking water distribution systems (TEVA-SPOT) and developing the tools for real-time modeling. He helped coordinate the establishment of the EPANET-RTX open-source project that contributed to the community open-source software project for EPANET. Rob holds a B.S. in chemistry and an M.S. in health physics from the University of Cincinnati.

Feng Shang, Ph.D. is an environmental engineer with U.S. EPA's ORD, CESER. After receiving his Ph.D., Feng worked briefly as a postdoc for the EPA, during which time he wrote the initial code for the multiple species extension (MSX) to EPANET. Feng joined the engineering software company Innovyze in 2008 and worked there as a principal software engineer until 2019. He then joined EPA in April 2019 and focuses on researching hydraulic and water quality issues in water infrastructure systems. Feng holds a B.S. and an M.S. in environmental engineering from Tsinghua University in China and a Ph.D. in environmental engineering from the University of Cincinnati.

Jonathan Burkhardt, Ph.D. is an environmental engineer with U.S. EPA's ORD, CESER. He worked at EPA in 2013 as an ORISE postdoctoral fellow and then joined EPA in 2015. His research at EPA has focused on modeling contaminant fate and transport in water distribution systems and more recently in premise plumbing systems. Jon has supported EPANET, EPANET-MSX, WNTR and PPMtools development to support research related to these systems. He also leads research efforts associated with understanding water treatment with granular activated carbon. Jon holds a B.S., an M.S., and a Ph.D. in chemical engineering from the University of Cincinnati.

Terranna Haxton, Ph.D. is an environmental engineer with U.S. EPA's ORD, CESER. She has a background in modeling the fate and transport of contaminants in the drinking water distribution systems using EPANET and has helped develop water distribution modeling tools that can assist drinking water utilities before, during, and after a contamination incident. Terra's past research areas have included using these tools to help detect contamination, identify the source of contamination, determine grab sample locations to outline contaminated areas, and evaluate response/decontamination strategies for contamination incidents, such as flushing, chlorine booster injection, and valve isolation. Her current research area is developing and applying modeling and simulation tools to assess the resilience of drinking water systems to disasters (e.g., earthquakes, power outages, pipe breaks, loss of source water).

Benjamen Burkhart (ORAU Contractor) joined U.S. EPA's Office of Research and Development, Center for Environmental Solutions and Emergency Response in 2020 as an ORAU contractor. Prior to joining the EPA, he spent his last three co-ops at Wayne Water Systems designing and testing residential water pumps. Ben's research at the EPA has focused on water age on providing technical support for EPANET, including responding to users' questions and producing presentations and papers to help with the usability of EPANET. Ben holds a B.S. in mechanical engineering from the University of Cincinnati.

T3. Sanitary Surveys—Treatment

This session will provide information for state and federal public water system oversight personnel on evaluating water treatment processes as part of sanitary surveys or technical assistance for public water systems. Presenters will be experienced field staff from multiple agencies.

Trainers:

Michael Finn, P.E. is an environmental engineer with U.S. EPA's Office of Groundwater and Drinking Water, Drinking Water Protection Branch. He joined EPA in 2001 to work on the development of the Long Term 2 Enhanced Surface Water Treatment Rule, the Stage 2 Disinfection Byproducts Rule and the Groundwater Rule and the related guidance documents. He is currently working with States and public water systems on the implementation of the National Primary Drinking Water Regulations focusing in the areas of microbial treatment and disinfection as well as water availability, alternate water supplies and water reuse in public water systems. Mike is a licensed professional engineer in California and Maryland and holds a California Grade 4 Water Treatment Operator Certificate.

Evan Hofeld, P.E. began working as a regional engineer for the Oregon Health Authority's Drinking Water Services Program since 2002. In this capacity, he is responsible for reviewing and approving construction plans, conducting sanitary surveys, providing regulatory and technical assistance for a wide variety of surface water treatment systems, and has also been heavily involved in Oregon's Area Wide Optimization Program. Prior to working in drinking water, he worked for the Diesel Vehicle Emissions Control Program of the Maryland Department of the Environment, where he assisted in implementing heavy duty diesel vehicle emissions regulations and conducted a number of pilot projects in cooperation with staff from U.S. EPA, the U.S. Army, and the U.S. Marine Corps. Evan holds a B.S. in environmental engineering from Oregon State University and is a registered professional civil engineer in Oregon.

Eugene Leung, P.E. is a drinking water treatment technical specialist for California Water Board's Division of Drinking Water in California Environmental Protection Agency. He is based at the Richmond office in the San Francisco Bay Area and has been with the Drinking Water Program for 24 years. Eugene was a sanitary engineer and associate sanitary engineer at the Program's Santa Clara District and was promoted to his current position in 2010. Eugene holds a B.S. and an M.S. in civil engineering from the University of California, Los Angeles and is a registered civil engineer and a T4 water treatment operator in California.

Chad Fischer, P.E. is a licensed chemical engineer in the State of California. He has worked at the Division of Drinking Water for almost 14 years, initially working in the Visalia District for 6.5 years before leading the newly formed Tulare District beginning in Fall 2014. In 2019, he returned to lead the Visalia District as its District Engineer. Chad received a B.S. in chemical engineering from UC Berkeley.

Johnny Mendez has over 24 years of experience in the fields of environmental engineering, engineering consulting, and hydrology. For the past 18 years, he has worked for the Alaska Department of Environmental Conservation's Drinking Water Program. His main duties include performing engineering plan reviews and approvals of public water system designs; conducting inspections, sanitary surveys, and comprehensive performance evaluations of drinking water systems; and providing technical and compliance assistance to public water systems in Alaska. Johnny holds a B.S. in electrical engineering from the University of Michigan and an M.S. in environmental engineering from the University of Alaska Fairbanks.

T4. Managing Legacy Manganese in Your Distribution System

This session will help small utilities identify problems related to legacy manganese (Mn) and manage their impacts. Training goals: (1) appreciation of regulatory, public health, and aesthetic issues associated with legacy Mn; (2) identify important characteristics of legacy Mn; (3) observe a demonstration of lab techniques that can be used to measure total and dissolved Mn; (4) understand how a utility developed a distribution system monitoring program for legacy Mn; and (5) be familiar with the demonstrated effectiveness of techniques for trying to remove legacy Mn.

Trainers:

Phil Brandhuber, Ph.D. specializes in drinking water quality and treatment with focused work on the behavior of inorganic contaminants in drinking water. He has 20 years of experience as a consultant, working for McGuire Environmental and HDR Engineering and is currently president of his own firm, Brandhuber Water Quality & Treatment LLC. Phil is the current chair of the American Water Works Association Manganese Subcommittee and has been the principal or co-principal investigator for ten drinking water related research projects sponsored by the Water Research Foundation (WRF) and other agencies; he was the principal investigator for the WRF projects, Guidance for the Treatment of Manganese and Legacy of Manganese Accumulation in Water Systems. Phil holds a Ph.D. from the University of Colorado Boulder.

Melinda Friedman is the president of Confluence Engineering Group, LLC, (Confluence) located in Seattle, Washington. She has many years of experience providing services related to source water and distribution system water quality evaluation, regulatory compliance, and optimal corrosion control treatment. Melinda has participated in numerous research efforts and has helped to prepare many prominent industry guidance manuals published by the American Water Works Association (AWWA) and the Water Research Foundation. She was the recipient of the AWWA George Warren Fuller Award for engineering leadership in 2017.

Laura Meteer is the water quality analyst for the Operations, Maintenance and Monitoring Branch in the Regional Municipality of York, Ontario. For over 15 years, she has helped solve water quality issues, optimize treatment processes, participate in capital projects, and pursue research and innovation opportunities. Laura is very active in the industry as a member of the American Water Works Association's Water Quality Distribution Committee and Manganese Committee and is a member of the Ontario Water Works Association's Distribution Committee.

SESSION 1 – OPENING PLENARY

Moderator: Alan Roberson is executive director of the Association of State Drinking Water Administrators (ASDWA). ASDWA's members are co-regulators under the Safe Drinking Water Act with EPA. He has over 30 years of experience in the development of drinking water policy and federal and state drinking water regulations. He and his staff work closely with EPA and the state and territorial drinking water agencies in the development and implementation of federal drinking water regulations. Alan coordinates with his members to establish the policy direction on all federal water regulatory and security and preparedness issues, as well as manage the finances and strategic planning for ASDWA. He is also on the Board of Directors for Fairfax Water, the largest water system in Virginia, and serves as Treasurer and Chair of the Water Quality and Supply Committee. Alan holds a B.C.E. from Georgia Tech and an M.S. in civil engineering from Virginia Tech.

Welcome and Introductions:

Gregory Sayles, Ph.D. is the director of the U.S. EPA's Center for Environmental Solutions and Emergency Response (CESER), one of four research centers in EPA's Office of Research and Development (ORD). CESER research helps develop solutions to challenges around the built environment, including water infrastructure. He has conducted and led research programs for EPA for over 30 years. Greg holds a B.S., an M.S., and a Ph.D. in chemical engineering.

Keynote Speakers:

Christopher Frey, Ph.D. is the deputy assistant administrator for science policy in ORD as an appointee of the Biden/Harris Administration. Prior to joining EPA, Chris was the Glenn E. and Phyllis J. Futrell Distinguished University Professor at North Carolina State University, where he served on the faculty since 1994. His research has focused on modeling and measurement of emission sources and air pollution exposure, and on quantification of uncertainty, variability, and sensitivity in modeling. Dr. Frey was an AAAS/EPA Environmental Science and Engineering Fellow in 1992 and he served as exposure modeling advisor in ORD's National Exposure Research Laboratory from 2006-2007. He was a member of the EPA FIFRA Scientific Advisory Panel (2004-2006), the EPA Clean Air Scientific Advisory Committee (2008-2012), and the EPA Science Advisory Board (2012-2018) and was chair of CASAC (2012-2015). He has also served on committees and expert groups of the National Academies of Science, Intergovernmental Panel on Climate Change, and World Health Organization. Chris holds a B.S. in mechanical engineering from the University of Virginia and an M.E. in mechanical engineering and a Ph.D. in engineering and public policy from Carnegie Mellon University.

Zachary Schafer is senior advisor to EPA's Assistant Administrator for the Office of Water, Radhika Fox. The Office of Water works to ensure that drinking water is safe, wastewater is safely returned to the environment, and surface waters are properly managed and protected. Prior to joining EPA, Zach served as the founding Chief Executive Officer and Executive Director at United for Infrastructure and Senior Policy Director for the Council on Competitiveness. He also worked on water and climate policy at the White House Council on Environmental Quality during the Obama Administration. Zach holds a B.A. in economics, international affairs, and history from the University of Delaware and an M.A. in energy and environmental policy from the Biden School of Public Policy at the University of Delaware.

Workshop Review and Logistics:

Michelle Latham is a biologist with EPA's ORD, Immediate Office of the Assistant Administrator, where she leads the outreach and stakeholder engagement support for the cross-cutting national research programs. Prior to her current position, she served as the technical communications and outreach lead for ORD's Safe and Sustainable Water Resources Research Program from 2014-2019 and the Water Supply and Water Resources Division of ORD's National Risk Management Research Laboratory from 2008-2014. A large portion of Michelle's efforts at EPA focus on drinking water, particularly small systems. Michelle holds an M.Ed., a B.S. in biology, and a B.L.A. from Xavier University; an A.A.S. from Shoreline Community College; and a C.G. in advanced medical laboratory technology from the Naval School of Health Sciences.

Thomas Speth, P.E., Ph.D. is the associate director for science in the U.S. EPA's Center for Environmental Solutions and Emergency Response, one of four research centers in EPA's Office of Research and Development. where he is leading efforts on PFAS, lead, and small water systems. He is a professional engineer who has worked in the field of water-treatment research at EPA since 1986. Over his career, Tom has been active in numerous organizations, such as the American Water Works Association and the Water Research Foundation, where he has served as Trustee, Chair, and EPA Liaison on numerous divisions, committees, and advisory boards.

SESSION 2A – MONITORING & DISTRIBUTION I: PATHOGENS

Moderator: **Laura Boczek** is a research microbiologist for the U.S. EPA's Office of Research and Development. Her research areas have focused on disinfection efficacy of various microorganisms in drinking water, including the study of premise plumbing pathogens with an emphasis on Legionella, specifically the ecology of these organisms, understanding how they persist, and what steps can be taken to mitigate the risk of infection to insure public health protection. She has also been involved with antibiotic resistance studies in various environmental matrixes and with pathogens and method development in biosolids. Laura holds a B.S. in biological science from Northern Kentucky University and an M.S. in biological science from the University of Cincinnati.

1. Prevention and Control of Legionnaires' Disease in the Aftermath of a Severe Outbreak

The Veteran's Home in Quincy, IL experienced a severe Legionnaires' disease (LD) outbreak in 2015 with additional outbreaks occurring in 2016, 2017 and 2018. After the 2015 outbreak, between 2015 and 2018 the facility spent over $6.5 million on water system improvements and implemented numerous remediation measures including extensive flushing of mains, heaters, and resident rooms, which resulted in high water and energy costs and disruption to resident and staff routines. Water heaters where also operated at >150 °F and municipal monochloramine residual was continuously breakpoint chlorinated to form free chlorine. With all these (and more) measures, ~30% of samples were still culture positive for L. pneumophila in March-September 2018, sometimes at levels too numerous to count. We conducted five site visits and identified key factors that contributed to the initial and subsequent outbreaks by considering: 1) historical data collected by the water utility and facility regarding corrosion control strategies; 2) root-cause analysis of Legionella positivity through audits of building design, operation, and maintenance; 3) the relative efficacy and trade-offs of disinfectant programs, and 4) appropriate interpretation of routine sampling results and water management plan controls. When the facility returned to using monochloramine in December 2018, Legionella positivity decreased to <1%. This presentation will discuss the efficacy and trade-offs of various remedial measures, along with knowledge gaps and overall need for an effective multi-stakeholder approach that emphasizes engineering root-cause analysis and water management team structure to successfully respond to LD outbreaks in the future.

Presenter:

William Rhoads, Ph.D. conducts research that explores applied environmental microbiology and chemistry in building drinking water systems. He is a researcher with the Eawag Aquatic Research Institute in Switzerland, where he is continuing his work on growth and control of opportunistic pathogens in building plumbing systems. William holds a B.S. in civil engineering from Purdue University and a Ph.D. in civil and environmental engineering from Virginia Tech, where he was the recipient of the international 2017 CH2M/AEESP Outstanding Doctoral Dissertation Award.

2. Differences in the Inactivation of *Legionella Pneumophila* Serogroups Using Ultraviolet-C (UV-C) LED Technology in Drinking Water

Legionella pneumophila (Lp) is an opportunistic pathogen that causes respiratory infections primarily through inhalation of contaminated aerosols. Lp can colonize premise plumbing systems due to favorable growth conditions found within those environments (e.g., lower disinfectant residual, stagnation, warm temperatures). There are 15 serogroup(sg)s of Lp, all of which have been associated with clinical cases, but sg1 is the predominate disease-causing sg. UV light emitting diodes (UVC-LEDs) are an emerging water treatment technology and have been shown to effectively inactivate various drinking water pathogens. In this study, inactivation of four Lp strains (three clinical sg1, 4, and 6 isolates and one sg1 drinking water isolate) were evaluated using a UVC-LED collimated beam device. Three wavelengths (250, 265, and 280nm) and six fluence rates (0.5-34 mJ/cm2) were evaluated for each strain in drinking water. Efficacy testing was also performed using a UVC-LED point-of-entry (POE), flow-through device. Based on the log inactivation curves, at 255nm, the sg4 and sg6 clinical isolates were more susceptible to inactivation compared to the two sg1 isolates. However, at 265 and 280nm, the sg1 and sg4 clinical isolates were more resistant to inactivation compared to the sg6 clinical and sg1 drinking water isolates. Additionally, the POE device, operated at 3 gallons-per-minute with cold-tap water, reduced sg1 levels from 5.9 to 2.4 log10 CFU/mL. Results from this study indicate that although UVC-LED disinfection is effective, variations in Lp inactivation, wave lengths, and technology applications should be considered, especially when targeting specific serogroups and isolates within premise plumbing systems.

Presenter:

Helen Buse, Ph.D. is a microbiologist with U.S. EPA's Office of Research and Development in Cincinnati, Ohio. Since joining EPA in 2007, her research has focused on understanding the role of free-living amoebae, biofilms, water quality parameters, and operational and engineering aspects in the growth of Legionella pneumophila within drinking water systems. Her current work aims to utilize various treatment technologies to decontaminate and maintain drinking water quality within premise plumbing systems. Helen holds a B.S. in biological sciences from Carnegie Mellon University and a Ph.D. in microbiology and immunology from the University of Michigan.

3. Using Economic Optimization to Derive Site-Specific Treatment Objectives

A procedure to estimate the economically efficient site- or system-specific treatment objective for enteric viruses in drinking water is presented. The health benefits of treatment are estimated using an existing QMRA quantitative microbiological risk assessment model for Rotavirus, which yields a reduction in burden of disease, measured in DALYs. The community's willingness to pay for this reduced disease burden is then inferred using an estimate of the value of an avoided DALY from the literature. Economically efficient treatment occurs where the marginal cost of additional treatment equals the marginal benefit in terms of willingness to pay for avoided illness.

In a case study on a small water system, capital and operating costs are estimated for four alternative treatment levels using commercially available UV disinfection systems. The case study results compare the economically efficient virus disinfection level, risk of infection and burden of disease to international guidelines.
A sensitivity analysis suggests that source water quality, population served, and the dose-response model are key inputs. Site-specific treatment objectives offer a viable alternative to prescribed national standards while respecting water safety and local autonomy.

Presenter:

Dave Tamblyn is a public health engineer for the First Nations Health Authority in BC, Canada, and teaches in the Faculty of Engineering at the University of Northern BC. He is a civil/environmental engineer with 30 years of experience in hydrogeology, environmental impact and risk assessment, economics, and public health. Dave has worked as consultant, regulator, educator, and advisor and has a long-standing interest in risk assessment and science-based public policy. His research interests include public health policy, Indigenous issues, international development, economic assessment, human health risk assessment, risk-based decision-making, and sustainable resource management. Dave holds a B.Eng.Management in civil engineering from McMaster University and an M.Eng. in civil and environmental engineering from the University of Toronto.

SESSION 2B – SOURCE & TREATMENT I: PFAS

Moderator: Thomas Speth, P.E., Ph.D. is the associate director for science in the U.S. EPA's Center for Environmental Solutions and Emergency Response, one of four research centers in EPA's Office of Research and Development. where he is leading efforts on PFAS, lead, and small water systems. He is a professional engineer who has worked in the field of water-treatment research at EPA since 1986. Over his career, Tom has been active in numerous organizations, such as the American Water Works Association and the Water Research Foundation, where he has served as Trustee, Chair, and EPA Liaison on numerous divisions, committees, and advisory boards.

1. PFAS in Minnesota

MDH has taken a strategic approach to PFAS monitoring in drinking water that is informed by past monitoring results and current scientific evidence. It focuses on addressing potential public health risks, understanding how PFAS moves through the environment, and evaluating drinking water vulnerability. This strategic approach allows MDH to use its resources efficiently and target areas with public health risk.

Presenter:

Karla Peterson, P.E. is the Community Public Water Supply Unit supervisor at the Minnesota Department of Health. Her Unit is responsible for administering the federal Safe Drinking Water Act and anticipating and responding to changing needs and expectations related to drinking water. Karla is a registered Professional Engineer and holds a B.C.E. from the University of Minnesota and an M.A. in public administration from Hamline University. She has more than 25 years of experience in the state drinking water program and is a member of several organizations, including the American Water Works Association, serving in a variety of roles over her career and as a past Chair for the Minnesota Section.

2. Designing a Small System PFAS Occurrence Study - Lessons Learned

The New York State Department of Health conducted a study in the Spring of 2021 to assess per- and polyfluoroalkyl substance (PFAS) occurrence at small community public water systems (PWSs) serving less than 3,300 people. When designing the study nine key elements were considered: budget, PWS selection, study participation, sample collection, field cross-contamination, analytical method(s), sample analysis, data reporting, and data analysis. The presentation will explore each of these elements, the challenges faced in the design and implementation as well as lessons learned.

Presenters:

Courtney Davis currently works for the New York State Department of Health's Bureau of Water Supply Protection in the Director's Office as a Research Scientist focusing on emerging drinking water contaminants. She holds a B.A in environmental studies from St. Lawrence University, and a. M.P.H. focusing on environmental health from University at Albany.

Matthew Morse is a research scientist with the New York State Department of Health Bureau of Water Supply Protection. He is an integral member of a unit that conducts research and investigations to support the New York State Protection Against Legionella regulation. Matthew has degrees in biology and epidemiology and has seven years of experience working in water quality in the public and private sectors. His experience includes laboratory analysis, field investigations, community cluster investigations, data analysis, and research. Matthew is a core member of the cluster investigation and field work team within his section.

3. Collaborative Pilot-Scale Evaluation of Granular Activated Carbon (GAC) and Ion Exchange Medias for Removal of PFAS from Groundwater

A collaborative pilot-scale study of two granular activated carbons (GACs), bituminous and sub-bituminous, was conducted to compare GAC PFAS removal performance to two ion exchange (IX) medias, macro-type, and gel-type. All medias had been previously demonstrated to offer reasonably favorable PFAS removal performance. Whereas many pilot studies have been scaled to match the empty-bed contact time of the full-scale system, this pilot study was scaled to match hydraulic loading rate which offers a more accurate prediction of the full-scale performance via the bed depth-service time model. The utility, New Castle Municipal Services Commission (NMSC), partnered with Calgon Carbon Corporation and the Center for PFAS Solutions, a newly established PFAS analysis, research, and consulting company. The chemists at the Center for PFAS Solutions offered many insights beyond a typical analysis and the PFAS breakthrough was speciated not only on a compound-by-compound basis but also included the branched versus linear isomers, showing less selectivity of branched isomers by

both GAC and IX. Several hypotheses are posed for this outcome and the impact of both the molecular size and polar/non-polar surface areas is discussed. Finally, the results were used to generate a cost comparison of medias to guide the future technology selection of the utility.

Presenter:

Adam Redding, Ph.D. is the technical director of the Municipal Business Unit of the Calgon Carbon Corporation He has worked in the activated carbon industry since 2008 in applications involving municipal, industrial, and food and beverage water treatment. Adam holds a B.S. in civil engineering, an M.S. in environmental engineering, and a Ph.D. in environmental engineering from Penn State University.

SESSION 3A – MONITORING & DISTRIBUTION II: CORROSION & LEAD

Moderator: **Darren A. Lytle, Ph.D., P.E.** is an environmental engineer with U.S. EPA's Office of Research and Development, Center for Environmental Solutions and Emergency Response in Cincinnati, Ohio. Since beginning work at EPA in 1991, Darren's primary goal has been to research the quality of drinking water. Over the years, he has investigated and published works on drinking water systems, including work on distribution system corrosion control and water quality; filtration; biological water treatment; and iron and arsenic removal. Darren holds a B.S. in civil engineering from the University of Akron, an M.S. in environmental engineering from the University of Cincinnati, and a Ph.D. in environmental engineering from the University of Illinois.

1. Lead in Drinking Water in Schools and Childcare Facilities: The Massachusetts Experience

The Massachusetts Department of Environmental Protection (MassDEP) has been operating a voluntary lead in drinking water schools and childcare facilities program since the early 1990s. In 2016, after the events in Flint, Michigan turned a spotlight on the continued issues of lead in drinking water, MassDEP developed an ambitious testing program that collected 60,000 samples at nearly 1,000 public schools. Four years later, in 2020 MassDEP expanded the testing program to include all 8,000 childcare facilities and programs in the state. The still-voluntary expanded program has been significantly impacted by the passage of time since Flint and the disruptions due to the pandemic, which resulted in a number of new outreach efforts. This presentation will describe the assistance programs run by MassDEP, what the results tell us, and lessons learned.

Presenters:

Michael Celona is a drinking water analyst at the Massachusetts Department of Environmental Protection. He oversees the Lead in Drinking Water in Schools and the Small and Disadvantaged Community grant programs. He also supports the capacity development program. He joined MassDEP in 2019 after 20 years at the state health department. He has a B.A. in environmental science and an M.A. in environmental policy.

Jessica Sibirski is an environmental analyst working at MassDEP Drinking Water Program. At the present, she is the Lead and Copper Rule, Sanitary Survey, and Revised Total Coliform coordinator for the Drinking Water Program, and some of its experience includes work with the LCCA Program, the Assistance Program, Capacity Development, among others. Jessica holds a bachelor's degree in architecture and a master's degree in Environmental Management and Sustainability from Harvard University.

2. Experiences with Michigan's New Lead and Copper Rule

In 2018 Michigan revised its lead and copper rules to have more focus on the risk of lead in drinking water, and to increase the public health protection from lead in drinking water. This presentation will cover the changes to Michigan's lead and copper rules, present some of the data from monitoring over a two-year period, and Michigan's experience with implementing the new rule set.

Presenter:

Brandon Onan is currently the Lead and Copper Unit supervisor for the State of Michigan's Drinking Water and Environmental Health Division. He has experience in civil infrastructure design, ground water monitoring and remediation treatment systems, and municipal drinking water engineering oversight. Brandon holds a B.S. in civil engineering and an M.S. in environmental engineering with a focus in water treatment from Michigan State University.

3. Corrosion Control Evaluation Considerations with Change in Source and Treatment

This talk will outline the process by which Ohio EPA is ensuring corrosion implications are considered prior to a system making a source or treatment change so as to ensure a proactive approach to corrosion control.

Presenter:

Ashley Voskuhl is an environmental specialist with Ohio EPA's Division of Drinking and Ground Waters, Engineering, and Infrastructure Section. Since joining Ohio EPA in 2017, she has been involved with regulatory development and implementation with a specific focus on the lead and copper rule, unregulated contaminants, and engineering standards. She previously worked at U.S. EPA's Office of Research and Development studying the impacts of corrosion on lead in drinking water. Ashley holds a B.S. in chemical engineering from The Ohio State University.

SESSION 3B–SOURCE & TREATMENT II: SOURCE WATER QUALITY/QUANTITY

Moderator: **Alan Roberson** is executive director of the Association of State Drinking Water Administrators (ASDWA). ASDWA's members are co-regulators under the Safe Drinking Water Act with EPA. He has over 30 years of experience in the development of drinking water policy and federal and state drinking water regulations. He and his staff work closely with EPA and the state and territorial drinking water agencies in the development and implementation of federal drinking water regulations. Alan coordinates with his members to establish the policy direction on all federal water regulatory and security and preparedness issues, as well as manage the finances and strategic planning for ASDWA. He is also on the Board of Directors for Fairfax Water, the largest water system in Virginia, and serves as Treasurer and Chair of the Water Quality and Supply Committee. Alan holds a B.C.E. from Georgia Tech and an M.S. in civil engineering from Virginia Tech.

1. DWMAPS: A Tool for Source Water Protection

Safe drinking water starts at the source. State, local, or utility-led source water protection programs are an important component of source to tap drinking water protection. These programs conduct source water assessments and develop and implement source water protection plans. EPA's Drinking Water Mapping Application to Protect Source Waters (DWMAPS) is an online mapping tool that provides state and utility drinking water professionals, watershed protection groups, source water protection partnerships, and others with information to update source water assessments and prioritize source water protection measures in any location or watershed in the country.

During this presentation we will emphasize the importance of source water protection and demonstrate the tools available in DWMAPS that, when used together with state and locally available mapping tools and data, can help users do the following: (1) identify potential sources of contamination; (2) find data to support source water assessments and plans to manage potential sources of contamination; (3) evaluate accidental spills and releases, identifying where emergency response resources for accidental releases must be readily available; promote integration of drinking water protection activities with other environmental programs at the EPA, state, and local levels; and (4) identify source water protection partnerships and watershed projects.

Presenters:

Terrell Tiendrebeogo is an environmental engineer on the Source Water Protection Team at EPA Headquarters. Since 2019 he has worked with partners within and outside EPA to promote and strengthen source water protection. Prior to joining EPA, Terrell worked as a consultant for Maryland Department of the Environment. His primary roles at EPA include data analysis and outreach. Terrell has an M.S. in environmental science.

Daniela Rossi is with EPA's Office of Water, Office of Groundwater and Drinking Water on the Source Water Protection Program team. The Source Water Protection program strives to protect sources of drinking water by developing tools and supporting voluntary partnerships and approaches that can prevent contamination of sources of drinking water. Daniela holds a B.S in earth and environmental science and political science from Lehigh University and an M.E.M from Yale University.

2. Managing Harmful Algal Blooms Based on Total Maximum Daily Load Models

The Maryland Department of the Environment recently engaged stakeholders in the Broadford Lake watershed to initiate the implementation of a Phosphorus TMDL. Broadford Lake is located in Maryland's western-most jurisdiction, Garrett County. MDE engaged stakeholders in the watershed because of several factors that distinguish it from other lakes with TMDLs in the State: (1) a U.S. EPA approved Phosphorus TMDL, (2) the occurrence of Harmful Algal Blooms (HABs), (3) Broadford Lake's "Use Class-P" (water supply) designation and the presence of a drinking water utility, (4) beach closures, (5) the watershed being relatively small and manageable, (6) a non-Chesapeake Bay drainage, and (7) the absence of stormwater permits. Locating the sources of excess phosphorus in the watershed will be valuable for numerous reasons, two of the most important are to reinforce public health protections, and to enhance an economic asset for the local economy. MDE proposed a panel of methodologies to stakeholders that are linked to TMDL models in order to identify and locate the source(s) of the nutrient impairment and track its reduction overtime using an implementation methodology that the Broadford Lake Watershed Committee (facilitated by the Western Maryland Resource Conservation & Development Council) decides upon. The committee would be the drivers of long-term implementation within the watershed with MDE providing technical support. Multiple approaches are proposed because MDE understands that in order for the long-term monitoring

and management of Broadford Lake to be successful, data collection and the implementation of best management practices must be affordable and feasible for local operators and stakeholders.

Presenter:

Jonathan Leiman works in the Integrated Water Planning Program at the Maryland Department of the Environment in Baltimore, Maryland. He works on a variety of water resource management issues related to the development of TMDLs and watershed implementation plans. Jonathan holds a B.S. from Cornell University and an M.S. from the University of Montana.

3. Eyes in the Sky Monitor Cyanobacterial Blooms at Source Waters

This study presents the first large-scale assessment of cyanobacterial frequency at surface drinking water intakes across the United States. Cyanobacteria and their toxins may degrade the quality of finished drinking water and can lead to negative health consequences. Satellite imagery can serve as a cost-effective and consistent monitoring technique for surface cyanobacterial blooms in source waters and can provide drinking water treatment operators information for managing their systems. This study uses satellite imagery from the European Space Agency's Ocean and Land Colour Instrument (OLCI) spanning June 2016 through April 2020. At 300-m spatial resolution, OLCI imagery can be used to monitor cyanobacteria in 685 drinking water sources across 285 lakes in 44 states, referred to here as resolvable drinking water sources. First, a subset of satellite data was compared to a subset of responses (n = 84) submitted as part of the U.S. Environmental Protection Agency's fourth Unregulated Contaminant Monitoring Rule (UCMR 4). These UCMR 4 qualitative responses included visual observations of algal bloom presence and absence near drinking water intakes. Overall agreement between satellite imagery and UCMR 4 qualitative responses was 94% with a Kappa coefficient of 0.70. Next, temporal frequency of cyanobacterial blooms at all resolvable drinking water sources was assessed. In 2019, bloom frequency averaged 2% and peaked at 100%, where 100% indicated a bloom was always present at the source waters when satellite imagery was available. Methods presented here demonstrate an effective and consistent monitoring technique of cyanobacterial blooms for source waters across the United States.

Presenter:

Megan Coffer, Ph.D. is a postdoctoral ORISE fellow with the U.S. EPA's Office of Research and Development in Durham, NC. Her research uses satellite remote sensing technologies to study aquatic ecosystems, including monitoring cyanobacterial blooms in inland lakes and reservoirs using freely available satellite data and mapping seagrass extent along the coast using commercial, high resolution satellite data. Megan holds a B.S. in mathematics from Meredith College, and M.S. in atmospheric science from North Carolina State University, and a Ph.D. in geospatial analytics from North Carolina State University (May 2021).

SESSION 4 – TECHNICAL FOCUS GROUPS I: BREAKOUT GROUP DISCUSSIONS FOR PRIMACY AGENCIES (STATE TERRITORY/TRIBAL) & FEDERAL PARTNERS

Group A: Corrosion

What are the most pressing corrosion issues and how are they being addressed?

Facilitators:

Darren A. Lytle, Ph.D., P.E. is an environmental engineer with U.S. EPA's Office of Research and Development (ORD), Center for Environmental Solutions and Emergency Response (CESER) in Cincinnati, Ohio. Since beginning work at EPA in 1991, Darren's primary goal has been to research the quality of drinking water. Over the years, he has investigated and published works on drinking water systems, including work on distribution system corrosion control and water quality (e.g., red water control, lead and copper corrosion control); filtration (emphasis on removal of particles, and microbial contaminants and pathogens from water); biological water treatment; and iron and arsenic removal. Darren holds a B.S. in civil engineering from the University of Akron, an M.S. in environmental engineering from the University of Cincinnati, and a Ph.D. in environmental engineering from the University of Illinois.

Ashley Voskuhl is an environmental specialist with Ohio EPA's Division of Drinking and Ground Waters, Engineering, and Infrastructure Section. Since joining Ohio EPA in 2017, she has been involved with regulatory development and implementation with a specific focus on the lead and copper rule, unregulated contaminants, and engineering standards. She previously worked at U.S. EPA's Office of Research and Development researching impacts of corrosion on lead in drinking water. Ashley received her BS in Chemical Engineering from The Ohio State University in 2016.

Group B: Analytics and Analytical Methods

What are the method-development priorities for emerging contaminants and method-improvement needs for regulated drinking water parameters?

Facilitators:

Steve Wendelken, Ph.D. is currently serving as the senior analytical chemist for the U.S. EPA Technical Support Center. Additionally, he is the project officer for the Analytical Laboratory Support contract at EPA's research facility in Cincinnati, Ohio. He has over 24 years of method development experience with the last nineteen years being spent at the OGWDW Laboratory. During this time, he has worked as a senior analytical chemist and principal investigator on multiple EPA drinking water methods. His background encompasses a broad number of analytical techniques including GC, GC/MS, GC/AED, LC, LC/MS/MS, CE, UV-Vis, SPE and electrochromatography.

Hunter Adams is the laboratory supervisor, deputy quality control manager, and technical manager of microbiology and inorganic chemistry for the Cypress Environmental Laboratory – City of Wichita Falls, TX. He has worked in the planning and implementation of microbiological and analytical testing for direct potable reuse and indirect potable reuse systems for the City of Wichita Falls. He has also successfully implemented a HAB and Taste and Odor Monitoring Program that has completely eliminated customer complaints for over five years. Hunter received the WEF Laboratory Analyst Excellence Award in 2020. He has worked to develop new methods for inclusion in Standard Methods. He serves as a TNI Microbiology Expert Committee Member, an APHL Environmental Laboratory Sciences Committee Member, and on several committees with AWWA and WEF. Hunter holds a B.S. in biology and an M.S. in biology from Midwestern State University. He is a licensed Class A Water Operator and Class C Wastewater Treatment Operator by the Texas Commission on Environmental Quality. He is also a certified water professional and certified in infrastructure protection and infrastructure disaster management by the Texas A&M Engineering Extension Service of Texas A&M University.

Group C: Pathogens

What pathogens are of concern from the distribution system to premise plumbing and what factors influence their presence?

Facilitators:

Laura Boczek is a research microbiologist for the U.S. EPA's ORD, CESER. Her research areas have focused on disinfection efficacy of various microorganisms in drinking water, including the study of premise plumbing pathogens with an emphasis on *Legionella*; specifically, the ecology of these organisms, understanding how they persist, and what steps can be taken to

mitigate the risk of infection to insure public health protection. She has also been involved with antibiotic resistance studies in various environmental matrixes and with pathogens and method development in biosolids. Laura holds a B.S. in biological science from Northern Kentucky University and an M.S. in biological science from the University of Cincinnati.

Michael Finn, P.E. is an environmental engineer with U.S. EPA's Office of Groundwater and Drinking Water, Drinking Water Protection Branch. He joined EPA in 2001 to work on the development of the Long Term 2 Enhanced Surface Water Treatment Rule, the Stage 2 Disinfection Byproducts Rule and the Groundwater Rule and the related guidance documents. He is currently working with States and public water systems on the implementation of the National Primary Drinking Water Regulations focusing in the areas of microbial treatment and disinfection as well as water availability, alternate water supplies and water reuse in public water systems. Mike is a licensed professional engineer in California and Maryland and holds a California Grade 4 Water Treatment Operator Certificate.

Wendi Wilkes is the regulatory and legislative affairs manager for the Association of State Drinking Water Administrators (ASDWA). Her work covers a range of issues including regulatory analysis under the Safe Drinking Water Act, water infrastructure funding, and Congressional relations. Prior to joining ASDWA, Wendi worked for the American Water Works Association's Government Affairs Office in Washington, DC and at the Texas Commission on Environmental Quality, where she served in the Office of Water. Wendi holds a B.S. in geography from the University of Texas at Austin and is working on her M.P.A. from Johns Hopkins.

Group D: Disinfection and Disinfection Byproducts

What is the highest priority regulatory or non-regulatory issue for reducing exposure to DBPs?

Facilitators:

Jonathan Pressman, P.E., Ph.D. is the branch chief of the Drinking Water Management Branch of U.S. EPA, ORD, CESER's Water Infrastructure Division. Since joining EPA in 2005, his research has focused on process engineering for improving disinfection, reducing disinfection byproducts, characterizing NOM and most recently PFAS removal. Jonathan holds a B.S. in civil engineering from Cornell University and an M.S. and a Ph.D. in civil engineering from The University of Texas at Austin. He is a registered professional engineer in Ohio and Texas.

Alan Roberson is executive director of the Association of State Drinking Water Administrators (ASDWA). ASDWA's members are co-regulators under the Safe Drinking Water Act with EPA. He has over 30 years of experience in the development of drinking water policy and federal and state drinking water regulations. He and his staff work closely with EPA and the state and territorial drinking water agencies in the development and implementation of federal drinking water regulations. Alan coordinates with his members to establish the policy direction on all federal water regulatory and security and preparedness issues, as well as manage the finances and strategic planning for ASDWA. He is also on the Board of Directors for Fairfax Water, the largest water system in Virginia, and serves as Treasurer and Chair of the Water Quality and Supply Committee. Alan holds a B.C.E. from Georgia Tech and an M.S. in civil engineering from Virginia Tech.

Group E: PFAS

How are primacy agencies and water systems addressing sampling, treatment, and public perception?

Facilitators:

Thomas Speth, P.E., Ph.D. is the associate director for science in the U.S. EPA's Center for Environmental Solutions and Emergency Response, one of four research centers in EPA's Office of Research and Development. where he is leading efforts on PFAS, lead, and small water systems. He is a professional engineer who has worked in the field of water-treatment research at EPA since 1986. Over his career, Tom has been active in numerous organizations, such as the American Water Works Association and the Water Research Foundation, where he has served as Trustee, Chair, and EPA Liaison on numerous divisions, committees, and advisory boards.

David Dani is the emerging contaminants coordinator for the Colorado Department of Public Health and Environment. Previously, he oversaw training for Colorado's Safe Drinking Water Program and provided leadership for the program's Acute Team that works with drinking water providers during emergencies.

SESSION 5A – MONITORING & DISTRIBUTION III: DISINFECTANTS & DISINFECTION BYPRODUCTS (DBPs)

Moderator: Jonathan Pressman, P.E., Ph.D. is the branch chief of the Drinking Water Management Branch of U.S. EPA, ORD, CESER's Water Infrastructure Division. Since joining EPA in 2005, his research has focused on process engineering for improving disinfection, reducing disinfection byproducts, characterizing NOM and most recently PFAS removal. Jonathan holds a B.S. in civil engineering from Cornell University and an M.S. and a Ph.D. in civil engineering from The University of Texas at Austin. He is a registered professional engineer in Ohio and Texas.

1. Regulated DBP Formation and Prediction for Long Residence Times

Design and operation of small drinking water treatment plants and associated distribution systems with long residence times are complicated by the formation of regulated DBPs, comprised of total trihalomethanes (TTHM) and five haloacetic acids (HAA5). Treated water dissolved organic carbon (DOC) concentrations, the unit processes required to meet those DOC concentrations, and disinfection strategies (e.g., booster chlorination) are the primary design and operational considerations that can require extensive testing or modeling to determine. In this study, twelve different treated drinking waters were generated at the bench-scale using ferric chloride coagulation and granular activated carbon adsorption from four parent raw waters collected from the San Juan River representing spring runoff, monsoon, and low flow events. Treated drinking waters with DOC concentrations of 0.9, 1.4, and 1.9 mg/L were tested for regulated DBP formation under simulated distribution system (SDS) conditions over residence times as long as 56 days and compared to 7-day formation potential (FP) testing. SDS free chlorine concentrations were maintained between 0.2 and 1.0 mg/L as Cl2 through periodic booster chlorination. Maximum SDS TTHM and HAA5 concentrations were 0.208 and 0.074 mg/L, respectively, with formation consistently varying by approximately ±20% across the four different parent raw waters despite having been treated to the same three DOC concentrations. An average of four existing TTHM models consistently underpredicted TTHM formation by approximatively 20%. Long considered a conservative measure of DBP formation, FP testing also underpredicted SDS DBP formation at 56 days by approximately 40% on average. The DBP testing approach presented in this study allowed for the development of several significant linear relationships for predicting DBP concentrations based on treated water ultraviolet light absorbance at 254 nm, water temperature, and cumulative free chlorine demand.

Presenter:

Anthony Kennedy, Ph.D. works for the U.S. Bureau of Reclamation. At Reclamation's Technical Service Center in Denver, he works on a variety of projects ranging from feasibility level designs to applied research. Anthony previously worked for Denver Water and outside of work he enjoys trail running and skiing. Anthony holds a B.S., and M.S., and a Ph.D. from the University of Colorado.

2. DBP Compliance Assistance Training: Lessons Learned from Oklahoma Pilot

This presentation will include the DBP compliance assistance training pilot project background and approach, water quality data from Oklahoma showing baseline data and an early indication of project impacts, a discussion of lessons learned, and the next steps in the project.

Presenters:

Candy Thompson, P.E. is a professional engineer and has worked at the Oklahoma Department of Environmental Quality for 17.5 years. For a little over 13 years, she worked as a district engineer in the Public Water Supply Engineering and Enforcement Section. Currently, she is the Co-AWOP Coordinator and a DWSRF Project Engineer. Candy holds a B.C.E. and a M.A. in regional and city planning from the University of Oklahoma.

Matthew Alexander, P.E. is an engineer in the U.S. EPA's Office of Water (OW), Office of Groundwater and Drinking Water (OGWDW) in Cincinnati, Ohio. As a member of the Agency's Area-Wide Optimization Program (AWOP), he supports the development and demonstration of various optimization approaches and provides technical assistance related to disinfection and distribution system water quality, with particular emphasis on maintaining disinfectant residual, reducing DBP formation, and storage tank operations. Matthew holds a B.S. in civil engineering and an M.S. in environmental engineering from the University of Cincinnati. He is also a registered professional engineer in Ohio, has over 12 years of experience in drinking water, and is a member of the American Water Works Association.

3. Changes in HAA Occurrence vs Disinfectant Types and Treatment Processes from DBP Information Collection Request (ICR) to Unregulated Contaminant Monitoring Rule (UCMR) 4

This presentation provides preliminary observations by comparing monitoring results and relevant information collected from the 1998 DBP ICR versus the UCMR 4 by linking the two datasets. In addition, current baselines (based on UCMR4) are presented by system size (small versus large). The analytical results presented include occurrence of three HAA group (i.e., HAA5, HAA6Br, and HAA9), occurrence of precursor in source water (i.e., bromide and TOC), and treatment/disinfectants used.

Presenter:

Jimmy Chen, Ph.D. has devoted his 24 years of his career to the drinking water program in U.S. EPA's OW, OGWDW. He is a key technical expert contributing to the development of science-based standards, regulations, support documents, and educational tools for reducing the microbial and DBP risks. Jimmy was part of the technical work group supporting the Negotiated Rulemaking process for the Stage 2 DBP Rule. Particularly, he has expertise in developing national characterization of DBP occurrence/exposure and conducting national regulatory impact analysis. Before joining EPA, he worked for a consultant firm to assist local municipal governments in compliance with wastewater discharge limits for two years. Jimmy holds a B.S. in chemical engineering and an M.S. and a Ph.D. in environmental engineering. He has co-authored more than 20 papers.

SESSION 5B – SOURCE & TREATMENT III: EQUITY & UNDERSERVED COMMUNITIES

Moderator: **Michelle Latham** is a biologist with EPA's ORD, Immediate Office of the Assistant Administrator, where she leads the outreach and stakeholder engagement support for the cross-cutting national research programs. Prior to her current position, she served as the technical communications and outreach lead for ORD's Safe and Sustainable Water Resources Research Program from 2014-2019 and the Water Supply and Water Resources Division of ORD's National Risk Management Research Laboratory from 2008-2014. A large portion of Michelle's efforts at EPA focus on drinking water, particularly small systems. Michelle holds an M.Ed., a B.S. in biology, and a B.L.A. from Xavier University; an A.A.S. from Shoreline Community College; and a C.G. in advanced medical laboratory technology from the Naval School of Health Sciences.

1. All Rise for Safe Water: Study of Drinking Water Violations in Manufactured or Mobile Home Communities

Twenty-two million Americans live in manufactured or mobile homes, which are mostly served by small water systems. Residents are ethnically diverse with American Housing Survey data showing manufactured housing residents are more likely than residents of other housing types to be Hispanic or Latino, American Indian or Alaska Native, or of two or more races. Previous research finds that manufactured home communities experience reduced water service reliability and have an increased likelihood of contaminant levels in their drinking water that put their health at risk. The objective of this project is to understand the state of drinking water systems in these communities and identify the challenges and needs for improved federal and local support. The data used is from the EPA's Safe Drinking Water Information System (SDWIS) on systems that primarily serve mobile home parks from 1976 through Q2 2020. In this data timeframe, nearly 1.4 million people have been impacted by Safe Drinking Water Act (SDWA) violations. The maps developed identify hotspots where technical and financial training and resources would be beneficial. Additionally, this project includes case studies in Louisiana and Delaware, where a state judicial approach and Drinking Water State Revolving Funds were used to help manufactured home communities with SDWA compliance issues. These case studies highlight mechanisms and tools available to support safe drinking water for this vulnerable population, as well as existing gaps. This research shows the need for further support, empowering these communities with technical and managerial resources and tools to protect their drinking water.

Presenter:

Liana Prudencio, Ph.D. is an ORISE researcher in the U.S. EPA's, Office of Water (OW), Office of Ground Water and Drinking Water (OGWDW) in Washington, D.C. Her research journey began as an environmental beat reporter at a daily newspaper. After graduating with a B.S. in journalism from Iowa State University, she realized that she was interested in the science she had reported and moved on to study environmental sociology, earning her M.S. in sociology at the University of Utah. She continued to grow more passionate about water and environmental policy and knew that bridging the gap between social and physical science would provide significant value to her work. Liana went on to earn a Ph.D. in watershed science at Utah State University, where she conducted interdisciplinary research designed specifically to inform water policy and management.

2. Water Equity and Safe Drinking Water Act Compliance: Evidence from California

Disparity in access to safe drinking water persists as a public health concern across the United States. In particular, communities of color and low-income may face greater exposure to drinking water contaminants. Few studies systematically analyze disparities in drinking water quality; past literature mostly addresses ambient environmental pollution. This study analyzes temporal trends in violations and identifies whether low-income and/or communities of color bear disproportionate burdens. Logistic regressions assess the relationship between violations and demographics, using a balanced panel dataset of 1,710 community water systems in California from 2000-2018. Notably, this study develops demographic information at the water system level.

We find evidence of water equity concerns. Low-income communities and communities of color, such as African American and Latino populations face greater likelihood of water quality violations. Low-income areas, designated as severely disadvantaged communities, are 2.8 percentage points more likely to have health-related violations. This average marginal effect is sizeable, when considering that 9.1% of water system-year observations have a violation.

In recent years, there have been notable declines in violations overall and some compliance gaps have narrowed. Yet, disparities persist for African American-serving systems and have increased for severely disadvantaged communities. These findings highlight important compliance gaps and can inform policy discussions regarding prioritize assistance to communities disproportionately impacted by poor water quality.

Presenter:

Maura Allaire, Ph.D. is an assistant professor at the University of California, Irvine. With expertise in water economics and spatial statistics, her research focuses on assessing equity in drinking water quality and decision support for water resource management. Her professional experience spans the public and private sectors, including international organizations (World Bank, Fulbright Scholar Program), think tanks (Resources for the Future, International Water Management Institute), and environmental consulting (AMEC). Her research has been featured in PNAS, Water Resources Research, and media outlets such as the New York Times, NPR, and the Guardian. She holds a Ph.D. from the University of North Carolina and was a postdoctoral fellow at Columbia University's Earth Institute. She currently runs the Water Equity Lab at UC-Irvine.

3. How the Drinking Water State Revolving Fund Can Target Funding to Disadvantaged Communities

EPA's Drinking Water State Revolving Fund provides funding to all 50 states and Puerto Rico for low-cost financing for drinking water systems for a wide range of water infrastructure projects. There is a statutory focus on small and disadvantaged communities. This versatile federal-state partnership can provide loans with interest rates as low as 0% and offer flexible repayment options. State DWSRF programs can use about 30% of federal funds for non-infrastructure activities and programs, known as set-asides.

This presentation will lay out the flexibilities of the DWSRF program to assist disadvantaged communities, such as through loan forgiveness or attractive loan terms (low interest rates, longer loan repayment periods, etc.), as well as how set-asides can be used to help these water systems evaluate potential issues and develop infrastructure improvement projects.
In addition, there is a statutory requirement that all DWSRF programs provide anywhere from 6% to 35% of federal funds as loan forgiveness or grants. Section 1452(d) of the Safe Drinking Water Act defines a disadvantaged community as "the service area of a public water system that meets affordability criteria established after public review and comment by the State in which the public water system is located." Therefore, states define what it means to be disadvantaged in their state. EPA is reviewing these definitions and plans to collaborate with state DWSRF programs to strengthen their definitions and criteria used to reach the borrowers who need assistance the most.

Presenters:

Kiri Anderer, P.E. is a senior environmental engineer on the Drinking Water State Revolving Fund (DWSRF) Team with EPA's OW, OGWDW at headquarters, and is currently serving on a detail as the acting Sustainable Systems Team leader, where she provides oversight for the Capacity Development and Operator Certification programs, as well as works on partnership and workforce issues. The DWSRF provides water infrastructure financing for public health protection, with an emphasis on small and disadvantaged public water systems. She has spent much of her 12 years with the agency working on domestic preference requirements, as well as resiliency and eligibility aspects of the program. Prior to EPA, Kiri spent 11 years working as a consulting engineer in the Baltimore and then Phoenix metropolitan areas, assisting communities with integrated water resource planning. Kiri is a registered Professional Engineer in Maryland. Kiri holds a B.S. in civil engineering from Lehigh University and an M.P.P from The George Washington University.

Dallas Shattuck is a physical scientist EPA's OW, OGWDW in Washington, DC. She is part of the DWSRF Team, where she helps oversee the nationwide implementation of the American Iron and Steel Requirements. Before her current position, Dallas worked with the EPA's DWSRF team as an ORISE Research Participant. Dallas holds an M.A. in environmental resource policy from the George Washington University and a B.S. in chemistry and a B.S. in criminal justice from Saint Francis University.

SESSION 6A – MONITORING & DISTRIBUTION IV: RESILIENCY & EMERGENCY RESPONSE

Moderator: **Regan Murray, Ph.D.** is the director of the Water Infrastructure Division within the Center for Environmental Solutions and Emergency Response in EPA's Office of Research and Development. This division is made up of more than 70 engineers, chemists, biologists, and physical scientists who collaborate every day to solve problems associated with our nation's drinking water, stormwater, wastewater, and water reuse infrastructure. She has been with the EPA since 2003 as a researcher in the areas of drinking water security, sustainability, and resilience. Regan holds a Ph.D. in applied mathematics with a minor in hydrology and water resources.

1. Water Infrastructure Strategies to Support Community Resilience

Around the world communities are faced with a growing threat from natural hazards. These threats are becoming more frequent and more costly. Planning for these hazard events and implementing pre-disaster mitigation strategies have proven highly cost effective. A comprehensive approach focused on community resilience is essential to tackling these challenges, but many communities don't know where to start. The Alliance for National & Community Resilience (ANCR) has identified 19 community functions that support resilience. To support communities in understanding and improving their resilience ANCR is developing a coordinated set of Community Resilience Benchmarks that covers each of these functions. ANCR's third benchmark addresses water infrastructure systems and the policies and practices that support their resilience and the resilience of the community as a whole.

Water infrastructure is vital to a community's health and its ability to survive before, during and after a hazard event. From hospitals to hotels, schools to shopping centers, factories to farms, and restaurants to recreational facilities – entire communities would shut down without water service. Moreover, water is one of the most crucial elements in fighting fires. Without a reliable water supply, communities are more vulnerable to greater casualty losses in the event of fire and more susceptible to economic losses from business interruption. This presentation will examine the role of water infrastructure in supporting community resilience, key metrics to understand its current resilience and opportunities to improve, and its intersection with other community functions.

Presenter:

Ryan Colker, J.D., CAE is vice president of innovation at the International Code Council (ICC) and he also serves as executive director of the Alliance for National and Community Resilience (ANCR), a national coalition working to provide communities with the tools necessary to holistically assess and improve their resilience. Prior to joining ICC, Ryan served as vice president at the National Institute of Building Sciences where he led efforts to improve the built environment through the collaboration of public and private sector industry stakeholders. Ryan is the editor of the book, Optimizing Community Infrastructure: Resilience in the Face of Shocks and Stresses. Previously, he served as manager of government affairs for ASHRAE and program director of the Renewable Natural Resources Foundation. Ryan holds a B.A., with honors, in environmental policy from the University of Florida and a J.D. in environmental and administrative law from The George Washington University Law School.

2. Tools to Enhance Water Sector Supply Chain Resilience

The U.S. EPA will discuss the interdependencies between the water and chemical sector and provide tools and resources to assist utility staff with developing more resilient supply chains. The presentation will provide a background on what a supply chain is and what it means to be "supply chain resilient." Finally, the presentation will provide best practices for enhancing supply chain resilience at the water/wastewater utility level including identifying alternative suppliers and increasing inventory. This portion will feature a case study from a utility that implemented these best practices.

Presenter:

Gabrielle Minton is a physical scientist with U.S. EPA's Water Security Division in the Office of Water, Office of Ground Water and Drinking Water. She serves as the lead for the water and chemical sector interdependency and focuses on increasing water sector resilience to supply chain challenges. Gabrielle also supports the Water Security Division in developing communication and outreach materials to increase security and resilience within the sector. Prior to the EPA, she served as a research fellow at MDB Inc., to support global environmental and public health projects. Gabrielle holds a B.S. in neuroscience from Tulane University and an M.P.H. from George Washington University.

3. Capacity Building to Extreme Weather and Climate Events in the Water Sector

Extreme weather and climate events pose significant risks to water and wastewater systems. Drawing on the analysis of an online survey (n = 41) and 19 interviews with water managers and service providers in Louisiana and Alaska, this presentation examines the role of networks in supporting community planning and response to weather and climate extremes. Findings illustrate a range of historical, environmental, and social factors that influence the level of impact from extreme weather events. Formal and informal networks served multiple roles in building capacity and resilience, including building technical, managerial, and financial capacities; supporting operations, emergency response, and longer-term planning; data collection and monitoring; and information sharing. This project enriches our understanding of the social, relational, and networking processes that condition community capacities to mitigate risks associated with extreme events.

Presenters:

Sarah Trainor, Ph.D. is with the International Arctic Research Center-University of Alaska Fairbanks. She is an expert in climate change assessment and adaptation in Alaska with specific emphasis on climate and wildfire science communication, application, and stakeholder engagement. Her research interests include human dimensions of global change, especially in the Arctic and northern latitudes. Sarah specializes in boundary-spanning and co-production to inform planning and decision making in climate change adaptation and natural resource management.

Nathan Kettle, Ph.D. is with the International Arctic Research Center-University of Alaska Fairbanks. He is an expert in coastal climate adaptation, use-inspired science, the role of networks in supporting climate adaptation, and evaluation. Kettle has worked extensively with coastal planners in Alaska to understand expectations of climate change, the role of risk, uncertainty, and trust in support for planning, and cross-level differences in the timing of support for coastal climate adaptation planning. Nathan's research on networks includes a social network analysis of the climate-science practice interface in Alaska, the role of remote engagement in supporting boundary chain networks, and how climate webinars may be used to support knowledge to action networks across Alaska.

Jean "Renee" Edwards, Ph.D. is a professor of interpersonal communication in the Department of Communication Studies at Louisiana State University. Her work examines the role of the individual in communication with a recent focus on misunderstanding and factors that influence it such as perspective-taking and channel. Her current projects related to environmental risk focus on communication of climate tools, use of information by coastal stakeholders, and water management.

SESSION 6B – SOURCE & TREATMENT IV: CONTAMINANT REMOVAL

Moderator: **Kevin Letterly** has been a Policy Analyst with the Association of State Drinking Water Administrators for three years. Some of his areas of focus include: AWOP, drinking water security issues, and lead testing in schools.

1. Comparing the Triple Bottom Line of Centralized Water System Improvements to Point-of-Use or Point-of-Entry (POU/POE)

In small drinking water systems in the US, financing sustainable improvements requires balancing economic, public health, and environmental factors. To improve water quality and meet regulations, traditional approaches include augmenting treatment, replacing assets, or seeking out new water sources. However, point-of-use and point-of-entry (POU/POE) treatment devices installed at consumer homes could provide an alternative option for meeting regulations. This study captures the full range of potential benefits and costs of implementing POU/POE devices (public health, environmental and economic) in small water systems as compared to upgrading a centralized system in small water systems.
We use a Triple Bottom Line approach to evaluate economic, environmental sustainability, and public health trade-offs of these alternative options. Data from four case study community water systems with either arsenic or nitrate regulation violations in EPA Regions 1, 5, 7 and 9 with populations of <500 people were used to model the costs and benefits of using POU/POEs compared to upgrading the centralized water system. The case-specific community information accounts for state-level regulations and requirements, local context and water quality, and modeling of viable POUs/POEs and contextually relevant upgrades. EPA Cost models were adapted to model the life cycle costs of high/low cost POU/POE or improving centralized treatment. Life cycle analysis was used to model environmental impacts. Public health impacts were modeling with exposure assessment to determine chronic intake of a contaminant and maximum likelihoods of exposure. We will present the results of this Triple Bottom Line cost-benefit analysis in these four small community water systems.

Presenter:

Kaycie Lane, Ph.D. is a postdoctoral scholar at the University of Massachusetts Amherst, examining POU/POE devices as a solution to chronic contamination in small water systems. Kaycie holds a Ph.D. (2020) from Dalhousie University where she focused on risk assessment and management for municipal and Indigenous water systems.

2. Using POU for Safe Drinking Water Act Compliance: The States' Experience

This presentation will summarize the results of two surveys (2011 and 2021) of state primacy agencies on the use of POU and POE devices for SDWA compliance. State experiences with this alternative compliance path have varied significantly, with a wide variety of problems including access, operations and maintenance and homeowner cooperation and buy-in. Data analysis from the 29 states in 2011 will be presented, along with the results of 14 structure interviews with state agencies.

Presenter:

Alan Roberson is executive director of the Association of State Drinking Water Administrators (ASDWA). ASDWA's members are co-regulators under the Safe Drinking Water Act with EPA. He has over 30 years of experience in the development of drinking water policy and federal and state drinking water regulations. He and his staff work closely with EPA and the state and territorial drinking water agencies in the development and implementation of federal drinking water regulations. Alan coordinates with his members to establish the policy direction on all federal water regulatory and security and preparedness issues, as well as manage the finances and strategic planning for ASDWA. He is also on the Board of Directors for Fairfax Water, the largest water system in Virginia, and serves as Treasurer and Chair of the Water Quality and Supply Committee. Alan holds a B.C.E. from Georgia Tech and an M.S. in civil engineering from Virginia Tech.

3. Case Studies of POU/POE for Safe Drinking Water Act Compliance

As of late 2019, 97% of PWSs that are active in the U.S. are considered small PWSs under the Safe Drinking Water Act (SDWA), meaning that the system serves 10,000 or fewer people. Small PWSs may face a number of challenges in complying with the SDWA, such as aging infrastructure, lack of financial resources, state primacy agencies with limited resources to support the large number of small systems, etc. These challenges were addressed in the 1996 Amendments to the SDWA where congress explicitly allowed PWSs to install POU/POE treatment devices to achieve compliance with some of the maximum contaminant levels established in the National Primary Drinking Water Regulations (Section 1412(b)(4)(E)(ii) of SDWA). Although POU/POE treatment for PWS compliance is allowed at the federal level, State and local regulations may affect the ability of a small system to utilize this treatment strategy. While some states may permit POU/POE treatment for

compliance, they might not have an established approval process to accept applications for this treatment strategy. In reality, only a select number of States have actually implemented POU/POE for compliance.

This presentation will provide an update on a new research project funded by the Water Quality Research Foundation (WQRF) for feedback and guidance from small systems who are the subjects of the research survey. WQRF envisions a two-phased approach for the data collection. Phase 1 consists of interviewing an appropriate contact at the state primacy agency. Click here for a useful link in identifying the primacy agencies for each state. It is recommended to work with the Association of State Drinking Water Administrators (ASDWA) to find contacts when needed. Phase 2 involves interviewing representatives from PWSs that have used, or are currently using, POU/POE treatment for SDWA compliance. These contacts would be provided by the state primacy agencies that have experience implementing POU/POE for compliance.

Presenter:

Marc Verhougstraete, Ph.D. is an integrated health related water microbiologist. He examines the source, transport, and occurrence of pathogens in the environment, measures human exposures to pathogens, and defines associated risks to mitigate adverse health outcomes. His research includes assessment of microorganisms in irrigation canals, beaches, estuaries, rivers, lakes, groundwater wells, and household drinking water systems. Marc's research has highlighted multiple hazards in each system, the driving factors of microbial exposures, and defining critical interventions. His most recent research has quantified microbe and metal occurrences in water distribution systems of underrepresented individuals, modeled expected outcomes, and defined appropriate water treatment interventions for the most vulnerable communities. Ultimately, Marc aims to reduce pathogen infections that exacerbate chronic diseases by combining environmental assessment, novel dose-response approaches, and risk assessment models all to inform health- oriented interventions.

SESSION 7 – TECHNICAL FOCUS GROUPS II: BREAKOUT GROUP DISCUSSIONS FOR PRIMACY AGENCIES (STATE TERRITORY/TRIBAL) & FEDERAL PARTNERS

Group A: Inorganics

What are important regulatory and non-regulatory issues for managing inorganic contaminants (iron, manganese, arsenic, nitrate, etc.) from the source to the tap?

Facilitators:

Asher Keithley, Ph.D. is an environmental engineer with U.S. EPA's Office of Research and Development (ORD), Center for Environmental Solutions and Emergency Response (CESER), Water Infrastructure Division in Cincinnati, Ohio. Their work focuses on aerobic and anoxic biological drinking water treatment processes for organic and inorganic contaminants, such as ammonia, manganese, and nitrate.

Cynthia Klevens, P.E. is a chemical engineer with the New Hampshire Department of Environmental Services (NHDES). She has been working 30 years in the environmental field, half of which have been in drinking water treatment. She joined the NHDES Drinking Water and Groundwater Bureau in 2005 to assist small water systems and private wells with water treatment issues including arsenic, radionuclides, disinfection byproducts, and corrosion control. She currently serves as the Bureau's water treatment engineer and manages the Small Systems Section. Cynthia holds a M.S. in civil and environmental engineering and is a licensed professional engineer.

Group B: Lead Testing in Schools

How are states/territories/tribes preparing for the LCRR lead testing in schools and childcare facilities?

Facilitators:

Kevin Letterly has been a Policy Analyst with the Association of State Drinking Water Administrators for three years. Some of his areas of focus include: AWOP, drinking water security issues, and lead testing in schools.

Anna Schliep is the Minnesota Department of Health's coordinator for the WIIN grant program. She was previously a compliance engineer for the community public water supply unit focusing on the LCR and on arsenic and radionuclide rules.

Group C: Emergency Preparedness

What is a reasonable expectation for cybersecurity for a water system, and what is the expectation of the primacy agency in understanding their systems' cybersecurity?

Facilitators:

Dan Schmelling is an environmental engineer with U.S. EPA's Office of Water (OW), Office of Groundwater and Drinking Water (OGWDW). He has been with the EPA since 1998 and has worked on the development of drinking water quality and treatment standards, along with drinking water security policy, guidance, and training. Dan's current portfolio includes cybersecurity and risk assessments.

Alan Roberson is executive director of the Association of State Drinking Water Administrators (ASDWA). ASDWA's members (the state and territorial drinking water agencies) are co-regulators under the Safe Drinking Water Act with U.S. EPA. He has over 30 years of experience in the development of drinking water policy and federal and state drinking water regulations. He and his staff work closely with EPA and the state and territorial drinking water agencies in the development and implementation of federal drinking water regulations. Alan coordinates with his members to establish the policy direction on all federal water regulatory and security and preparedness issues, as well as manage the finances and strategic planning for ASDWA. He is also on the Board of Directors for Fairfax Water, the largest water system in Virginia, and serves as Treasurer and Chair of the Water Quality and Supply Committee. Alan holds a B.C.E. from Georgia Tech and an M.S. in civil engineering from Virginia Tech.

Group D: Water Reuse

What are key technological gaps to cost-effective, environmentally sound approaches to onsite water reuse?

Facilitators:

Wendi Wilkes is the regulatory and legislative affairs manager for the Association of State Drinking Water Administrators (ASDWA). Her work covers a range of issues including regulatory analysis under the Safe Drinking Water Act, water infrastructure funding, and Congressional relations. Prior to joining ASDWA, Wendi worked for the American Water Works Association's Government Affairs Office in Washington, DC and at the Texas Commission on Environmental Quality, where she served in the Office of Water. Wendi holds a B.S. in geography from the University of Texas at Austin and is working on her M.P.A. from Johns Hopkins.

Jay Garland, Ph.D. is a senior scientist with EPA's, ORD, CESER. His current efforts focus on advancing innovative approaches to water infrastructure, including mitigating risks associated with antimicrobial resistance in the water cycle. Jay holds a Ph.D. in environmental science from the University of Virginia.

Group E: Capacity Development

How are states/territories/tribes helping small systems develop their technical, managerial, and financial capacity to improve their sustainability and operations?

Facilitators:

Kiri Anderer, P.E. is a senior environmental engineer on the Drinking Water State Revolving Fund (DWSRF) Team with EPA's OW, OGWDW at headquarters, and is currently serving on a detail as the acting Sustainable Systems Team leader, where she provides oversight for the Capacity Development and Operator Certification programs, as well as works on partnership and workforce issues. The DWSRF provides water infrastructure financing for public health protection, with an emphasis on small and disadvantaged public water systems. She has spent much of her 12 years with the agency working on domestic preference requirements, as well as resiliency and eligibility aspects of the program. Prior to EPA, Kiri spent 11 years working as a consulting engineer in the Baltimore and then Phoenix metropolitan areas, assisting communities with integrated water resource planning. Kiri is a registered Professional Engineer in Maryland. Kiri holds a B.S. in civil engineering from Lehigh University and an M.P.P from The George Washington University.

Amelia Springer is the capacity development and enforcement unit chief for the State of Kansas. She has worked in the Bureau of Water for five years and previously worked for the Bureau of Environmental Remediation for ten years. Amelia holds both a B.S. and an M.S. in physical science from Emporia State University.

SESSION 8A – MONITORING & DISTRIBUTION V: MONITORING RISK & COMMUNICATION

Moderator: **Gregory Carroll** has worked with EPA's Office of Water (OW), Office of Groundwater and Drinking Water (OGWDW) in Cincinnati, Ohio for 34 years. He spent the first part of his career with EPA's Office of Research and Development and has served as director of OGWDW's Technical Support Center (TSC) for the past 21 years. TSC supports the development and implementation of EPA's drinking water regulations. Among TSC's core program areas are collection of national occurrence data under the Unregulated Contaminant Monitoring Rule; chemistry and microbiological method development, evaluation, and approval; drinking water treatment optimization; laboratory certification; and a variety of other rule support. Greg holds a B.S. in chemical engineering and an M.A. of business administration.

1. Unregulated Contaminant Monitoring Rule Update for UCMR 4 and UCMR 5

U.S.EPA's Unregulated Contaminant Monitoring Rule (UCMR) provides national occurrence data for unregulated contaminants in drinking water to protect public health and support future regulatory decisions. The official sample collection period for the fourth cycle (UCMR 4) has ended and the fifth cycle (UCMR 5) has been proposed. This presentation will provide a summary of the UCMR 4 data (e.g., manganese, disinfectant byproducts and cyanotoxins) and an overview of the UCMR 5 proposal including sampling design, contaminant selection, and implementation activities. It is important that public water systems, laboratories, and states/tribes learn about the UCMR 5 proposed requirements now to properly prepare for monitoring in 2023.

Presenter:

Melissa Simic has been a physical scientist with U.S. EPA for 12 years. She is currently working in OGWDW's TSC as the implementation team leader for the Unregulated Contaminant Monitoring Rule (UCMR). Melissa holds a B.S. in cell and molecular biology from Oklahoma State University and an M.S. in environmental epidemiology, exposure, and risk from Harvard University.

2. Using State-Managed Data to Assess UCMR 4's National Representation of DBP and Manganese Occurrence

This presentation will utilize a database comprised of data collected from 46 states to assess how well the US EPA's Fourth Unregulated Contaminant Monitoring Rule (UCMR4) captures national occurrence of disinfection byproducts (DBPs), e.g., the sum of five haloacetic acids (HAA5), and manganese. Larger systems, serving greater than 10,000 people, make up 74% of systems included in UCMR4, while they make up only 3% of all active public water systems (PWSs). Alternatively, the database of drinking water quality data, referred to as CWQD, includes data for 74% of active PWSs. CWQD contains HAA5 data for 42,622 PWSs, 8.1% of which are larger systems (serving > 10,000) and the remaining 91.1% are smaller systems (serving 10,000 or fewer). Similarly, CWQD contains manganese data for 39,970 PWSs, of which 6.3% are larger systems and the remaining 93.7% are smaller systems. Thus, CWQD provides a greater representation of national occurrence among all PWSs as compared with UCMR4. An assessment of HAA5 and manganese data in CWQD shows that smaller systems have the highest HAA5 and manganese occurrence. Further analysis of HAA5 and manganese occurrence based on system size, system type, and source water type are used to describe limitations of UCMR4 data in representing national occurrence. The talk will also describe the database itself and how it can be used to answer questions regarding national drinking water quality and occurrence, as well as introduce the data mapping tool designed to visualize national occurrence data.

Presenter:

Carleigh Samson, Ph.D. is a water process engineer with Corona Environmental Consulting. She focus on drinking water treatment processes and statistical modeling and has experience in management and assessment of national (i.e., EPA UCMR and SYR) and state (i.e., SDWIS State databases, Drinking Water Watch platforms) drinking water compliance data, evaluating water treatment processes at bench-, pilot-, and full-scale, and meaningful analysis of drinking water occurrence data. Carleigh holds a Ph.D. from the University of Colorado Boulder.

3. Simple and Effective Water Communication Strategies? Support for Utilities to Improve the Quality and Accessibility of Consumer Confidence Reports

Each year, America's 50,000 water systems provide their customers with federally mandated information about drinking water quality, formally called Consumer Confidence Reports. They are filled with complex scientific language and figures, not easily understood by most people, in formats that differ from common ways people get information today, and rarely translated into languages other than English.

Over the last year, the Environmental Policy Innovation Center (EPIC) has engaged with utilities, technologists, community advocates, state agencies and the EPA to inspire new approaches for sharing information about water quality. Through a Water Data Prize competition, more than 30 organizations in the water sector submitted entries that help all consumers make informed decisions about whether their water is safe to drink. An esteemed panel of judges awarded prizes to five submissions that each provided easy to implement strategies and tools for CCRs and related communications. Submissions overwhelmingly showed that the answer to a better CCR isn't more data, it's more context and better design.

EPIC continues to amplify simple and effective ways to communicate about health data to as many people as possible. Throughout 2021, we are piloting state-specific programs with regulators, community advocates and utilities, as well as regulatory sandboxes that enable utilities to work alongside their regulators to experiment with new approaches for CCR communications. This presentation will explore the lessons shared from our partners and the role that regulators could play to support utilities in their endeavors to improve the quality and accessibility of CCRs.

Presenters:

Sridhar Vedachalam, Ph.D. leads the water program at the Environmental Policy Innovation Center (EPIC), a think- and do-tank that prioritizes innovation and speed in bringing environmental progress. His work has addressed national water issues such as affordability and equity, aging infrastructure, extreme weather impacts, financing, and non-point source pollution. He currently serves on the advisory board for Water Hub and the Great Lakes Commission's Blue Accounting Initiative and the Virginia Health Catalyst's Water Equity Task Force. Sri is the editor for Urban Water at the Global Water Forum, a UNESCO-sponsored resource for evidence-based, accessible, and open-access articles on freshwater governance. He brings water policy experience from his years in academia, government, and the non-profit sector. Sri holds a Ph.D. from The Ohio State University.

Jessie Norriss is a senior analyst of water and technology policy at EPIC. Prior to joining EPIC, she led business development and strategy for Upstream Tech, a technology start-up that uses satellite imagery to monitor and evaluate natural resources. She has also worked on programs related to regional planning for wetlands restoration and urban climate change resilience for the Massachusetts Division of Ecological Restoration and Stantec. Jessie holds a B.A. in geography from The University of Texas and an M.S. in water resource engineering and environmental policy from Tufts University.

SESSION 8B – SOURCE & TREATMENT V: IMPLEMENTING INNOVATIVE TREATMENTS

Moderator: **Michael Finn, P.E.** is an environmental engineer with U.S. EPA's Office of Groundwater and Drinking Water, Drinking Water Protection Branch. He joined EPA in 2001 to work on the development of the Long Term 2 Enhanced Surface Water Treatment Rule, the Stage 2 Disinfection Byproducts Rule and the Groundwater Rule and the related guidance documents. He is currently working with States and public water systems on the implementation of the National Primary Drinking Water Regulations focusing in the areas of microbial treatment and disinfection as well as water availability, alternate water supplies and water reuse in public water systems. Mike is a licensed professional engineer in California and Maryland and holds a California Grade 4 Water Treatment Operator Certificate.

1. Closing the Digital Divide: Challenges and Solutions for Small Systems

Panel discussion highlighting insights into unique challenges facing small systems in adopting technology to support their operations and the increasing digital divide between larger, well-resourced systems and smaller, poorer systems. The session will introduce the California Association of Mutual Water Companies (CalMutuals) Digital Divide Primer. The panel will include insights from a California Data Collective partner about best practices for small systems in selecting and using technology and highlight a case study of Fresno County Waterworks District 18's collaboration with Toshiba Digital in selecting and implementing an easy to use, affordable technology solution to support essential remote monitoring, visualization, analytics and data collection capabilities and to improve processes. The presentation will also identify the type of technology factors that reduce costs and achieve new levels of efficiency and operational control.

Presenters:

Adán Ortega Jr. is executive director of the California Association of Mutual Water Companies (CalMutuals), a non-profit organization that supports, educates, and represents mutual water companies in the legislative and regulatory process. He brings thirty years of experience through senior leadership roles in California and U.S. government, business, and environmental organizations. Adán is well known for his entrepreneurial, innovative, and organizational approaches in the public policy arena and communications. His other recent professional accomplishments under the banner of his firm, Ortega Strategies Group, include forming the Community Water Systems Alliance for cities and special districts serving disadvantaged communities and seniors, helping establish the San Gabriel Valley Water Association's legislative program, co-founding Water Education for Latino Leaders (WELL), and winning state authorization to create the Joint Powers Risk Insurance Management Authority for small water systems.

Joone Lopez is the general manager of the Moulton Niguel Water District, which provides water, wastewater, and recycled water services to six cities in South Orange County in California. Her previous experience includes work as general manager of Calaveras County Water District, assistant general manager for Apple Valley Ranchos Water Company, and the deputy general manager of Central Basin Municipal Water District. She is a Board Member for California Water Reuse Association, California Water Data Consortium, Southern California Water Coalition, South Orange County Wastewater Authority, and WaterNow Alliance. Additionally, she serves on the Water Environment Federation's Diversity and Inclusion Task Force, UC Irvine Water Leadership Board, The Smart Water Networks Forum Utility Advisory Group, BAYWORK Advisory Committee for its Digital Worker Initiative, The National Association for the Advancement of Colored People California/Hawaii Executive Committee, The Korean American Coalition Board of Directors, and the California State University, Fullerton Center for Real Estate Advisory Board. She's also a founding member of the California Data Collaborative. Joone holds a B.A. in communications from University of California San Diego and an M.P.A. from California State University of Northridge

Donald Mah is the senior sales engineer for Toshiba's Digital Solutions Division, which is the U.S. arm of Toshiba responsible for creating digital solutions that help companies better manage their businesses. Donald has over 25 years of experience in high tech at various companies, including Cisco and 13 at Toshiba. Donald also has over 13 years working specifically on the development and management of IoT Solutions, including the last directly for the water industry.

2. Sulfur-Assisted Biological Removal of Nitrate

Sulfur-assisted biological reduction of nitrate uses elemental sulfur as the electron donor to support the biological removal of nitrate under anoxic (low dissolved oxygen conditions). Bench-scale testing has demonstrated that the process is capable of removing influent concentrations of 17 mg NO3-N/L at hydraulic loading rates similar to those employed in slow sand filtration. Effluent nitrate concentrations were well below the 1 mg NO-N/L MCL. A combination of re-aeration and slow sand filtration were used to polish the effluent.

Presenter:

Nicholas Dugan, P.E. is an environmental engineer in the U.S. EPA's Office of Research and Development (ORD), Center for Environmental Solutions and Emergency Response (CESER) in Cincinnati, Ohio. He conducts bench- and pilot-scale treatment studies to evaluate the removals of cyanobacteria, cyanobacterial toxins, nitrate, perchlorate, pesticides, and cryptosporidium. Nick is licensed as a Professional Engineer in Ohio and is a member of American Water Works Association.

3. UV-C LED Application in Disinfection of Microbial Pathogens in Water

Ultraviolet (UV) light technology has been successfully employed in drinking water treatment against a broad suite of pathogens. It also has an advantage over many halogenated disinfectants because it can efficiently disinfect pathogens without the formation of carcinogenic disinfection by-products (DBPs). The latest UV technology of light emitting diodes (LEDs) has shown the capability to effectively inactivate waterborne pathogens including opportunistic premise plumbing pathogen, Legionella pneumophila. UV-LED is mercury-free and moreover has enormous potential for point-of-use (POU) water disinfection since they are much smaller, lighter, and less fragile. However, there are still many practical application challenges inherent in a POU device regarding its treatment efficacy due to water flow rate and disinfection contact time. In this presentation, we will 1) summarize our current research efforts for microbial inactivation efficacy of newly designed POU devices and 2) discuss about smart reactor design to formulate an efficient water treatment in POU application.

Presenter:

Hodon Ryu, Ph.D. is a chemical engineer/microbiologist in the U.S. EPA's, ORD, CESER in Cincinnati, Ohio and has been with EPA since 2009. His main research interests lie in health-related environmental microbiology and biotechnology, particularly focusing on interdisciplinary research (i.e., hybrid engineering and microbiology studies). More recently, he has conducted a study on inactivation efficacy of waterborne pathogens using germicidal multiple-wavelength UV-LEDs. He is a member of EPA's Pathogen Equivalency Committee and CCL5 Microbial Workgroup. Also, he is a recipient of the EPA 2018 Trudy A. Speciner Award for advancing environmental protection. Hodon has served on the international editorial board of Journal of Water and Health and Journal Water. He has published more than 90 papers in peer-reviewed journals and presented over 100 abstracts in international and domestic conferences. Hodon received his doctoral degree from Arizona State University.

SESSION 9A – MONITORING & DISTRIBUTION VI: DISTRIBUTION SYSTEM BEST PRACTICES

Moderator: **Wendi Wilkes** is the regulatory and legislative affairs manager for the Association of State Drinking Water Administrators (ASDWA). Her work covers a range of issues including regulatory analysis under the Safe Drinking Water Act, water infrastructure funding, and Congressional relations. Prior to joining ASDWA, Wendi worked for the American Water Works Association's Government Affairs Office in Washington, DC and at the Texas Commission on Environmental Quality, where she served in the Office of Water. Wendi holds a B.S. in geography from the University of Texas at Austin and is working on her M.P.A. from Johns Hopkins.

1. Nitrification in Distribution Systems: Effects, Triggers, Monitoring, and Corrective Methods

This presentation will provide an overview of nitrification in drinking water distribution systems. The following information will be presented: (1) explanation of the nitrification phenomenon, its effects, and how nitrification relates to regulatory compliance; (2) causes and triggers of nitrification, including water quality conditions (substrates, chloramine residual, chlorine-to-ammonia ratio, temperature, pH, alkalinity, and organic materials), and distribution system characteristics and operational practices (water age, sediments and biofilms, corrosion, and darkness). Inhibitory substances will also be discussed; (3) indicators and monitoring: One of the challenges of nitrification is the lack of rapid and easy methods to detect nitrifying microorganisms. This will be explained by presenting the analytical methods that currently exist to measure these microorganisms and contrast them with nitrification indicators. Monitoring sites and monitoring frequency will also be discussed; and (4) preventive and corrective strategies: The response strategies discussed will include "adjusting" water quality (i.e., controlling ammonia residual, chloramine stability, chlorine-to-ammonia ratio, pH, and organic materials), using disinfectants and chemicals (chloramines, free chlorine, chlorine dioxide and chlorite), the effects of tank and reservoir operation (tank cycling, mixing, and cleaning), and distribution system pipe flushing including conventional and unidirectional flushing.

Presenter:

Hélène Baribeau, Ph.D. is Brown and Caldwell's distribution system water quality leader. She focuses on disinfectant and DBPs, microorganism inactivation and control, corrosion control, impact of treatment processes on distribution system water quality, and regulatory compliance. Her work experience with past and current employers has allowed her to approach drinking water supply from various angles including academia, water providers, consulting firms, and regulatory agencies.

2. Help for Solving Your Hydraulic Problems

Here are some typical water distribution system questions that can't answer off the top of your head:

- Do we have enough distribution capacity to serve that new subdivision?
- Do we have enough isolation valves so that a pipe break doesn't crash the whole system?
- Are we running our pumps efficiently or are we wasting money?
- How can we determine the available fire flow through our system without needing to run all sorts of hydrant flow tests?
- What can we do to maintain chlorine residual at the far end of our system?
- Can we do a better job creating/modifying our pressure zones?
- Is it better to keep fixing that old pump or replace it with something more efficient?
- Is waterhammer causing all those problems in our system and how can we fix them?
- How can you plan a shutdown to minimize the customers affected?

Large systems usually have hydraulic model and personnel who can open the model and analyze these problems and many more in a matter of minutes to hours. Large systems can devote resources to hydraulic analysis. Smaller systems have the same problems but fewer resources. This presentation discusses options for smaller systems to leverage hydraulic modeling to improve their system and avoid problems. A small investment in hydraulic analysis tools can save a lot in making the best engineering and operational decisions.

Presenter:

Tom Walski has worked in water distribution and wastewater collection system hydraulics for over 40 years and participated in studies all over the world. He has presented numerous training classes on hydraulic analysis of water systems. He is especially interested in topics like pipe sizing, pump and valve selection, and overall system planning and operation.

3. Preventing Pathogen Contamination: Disinfection, Tanks, and Cross Connections

This presentation will cover Colorado's experiences with disinfection, finished water storage tanks, and cross connections over the last 12 years. Topics included involve the Alamosa waterborne disease outbreak and investigation from 2008 to 2009, its impacts and subsequent follow-up. This Salmonella outbreak was one of the largest in the U.S. since the early 1990s sickening 1,300 people and costing millions of dollars in economic damage. The presentation will show how tank problems persisted in the state following the outbreak and then Colorado's efforts to develop and implement specific rules regarding disinfection, specific storage tanks and cross connections. Colorado's rule requirements, implementation efforts, and findings will be discussed in some detail. Since focusing more efforts on storage tanks, hundreds of significant deficiencies associated with storage tanks in Colorado have been identified and addressed. Combined with efforts on disinfection and cross connections, E. coli violations in Colorado have been dramatically reduced.

Presenter:

Ron Falco joined the Colorado Department of Public Health and Environment (CDPHE) in 2000, where he has been the safe drinking water program manager since 2006. Prior to joining CDPHE, he worked thirteen years for a consulting firm in Nashville, Tennessee, eventually becoming its director of operations. Ron holds a B.S. in chemical engineering from the University of California at Berkeley and an M.S. in environmental engineering from Vanderbilt University.

SESSION 9B – SOURCE & TREATMENT VI: SYSTEM OVERSIGHT

Moderator: **Sarah Bradbury** is a physical scientist with EPA's Drinking Water Protection Division in the Office of Water (OW), Office of Ground Water and Drinking Water (OGWDW) in Washington, DC. She is currently working on implementation of the Consumer Confidence Rule, the Public Notice Rule, and is the project lead for the Consumer Confidence Report Rule revisions. In her 10+ years of experience, Sarah has had the opportunity to work on a variety of water resource topics, including total maximum daily loads, water quality sampling, and source water protection. Sarah holds a B.S. in oceanography from the University of Michigan and an M.S.E.S. in water resources and an M.P.A. in environmental policy and natural resource management from Indiana University's School of Public and Environmental Affairs.

1. Sanitary Survey: A Tool to Collate Data and Educate Stakeholders

With a large infrastructure bill pending, it is imperative that the finances provided best meet the need of existing infrastructure. Sanitary surveys can be used to collate data and educate stakeholders of the needs of small water systems; however, the sanitary surveys themselves will need to change. To that end, inviting all stakeholders, taking pictures during the survey, referencing code, conducting an engineering analysis, reviewing operational plans, and having comprehensive data collection will serve to bring stakeholders together to identify operational, managerial, and capital improvement needs of small water systems.

This presentation will share anecdotal experience from seven+ years of experience conducting sanitary surveys for the Indian Health Service (IHS) and the Environmental Protection Agency (EPA) in Arizona, American Samoa, Nevada, Idaho, Utah, California, Oklahoma, and Kansas.

Presenter:

D. Lyle Setwyn, P.E., REHS/RS graduated from the University of Wisconsin-Madison in 2003. After a brief two-year stint in the Peace Corps as a mathematics teacher in Burkina Faso, he has found employment working for the Public Health Service's (PHS) Commissioned Corps and the Indian Health Service (IHS). He has worked in the PHS as an engineer in such remote locations as Yuma, AZ; Pago Pago, AS; and Holton, KS and as a utility consultant/O&M coordinator in both Reno, NV and Oklahoma City, OK. Lyle holds an M.S. in green technologies from the University of Southern California. He is also a licensed professional engineer and a National Environmental Health Association (NEHA) certified registered environmental health specialist (REHS/RS).

2. Using Sanitary Survey Findings to Identify Risk Management Challenges

Sanitary surveys are conducted at all public water systems (PWSs) in the U.S. to assess the PWSs capability to supply safe drinking water. Primacy agencies, as defined under the Safe Drinking Water Act (SDWA), are responsible for completing sanitary surveys. The surveys provide an opportunity for the primacy agency to visit the water system and educate the operator about proper monitoring and sampling procedures and to provide technical assistance. We reviewed information collected by primacy agencies during sanitary surveys with the goal of identifying the most frequent deficiencies found at U.S. PWSs. Analysis of deficiencies found during sanitary surveys helps to characterize the potential challenges faced by water systems in providing safe drinking water and assists systems and regulatory authorities with prioritizing risk management efforts and providing technical assistance. We identified deficiencies using sanitary survey data from surface water systems reported to U.S. Environmental Protection Agency's Safe Drinking Water Information System (SDWIS). The dataset used in this analysis, based on sanitary survey records from 48 states and the District of Columbia for surveys conducted from January 1, 2010 to December 31, 2017, contains records from more than 14,000 PWSs, serving over 200 million people. The presentation will provide insights from the dataset including the types of deficiencies that were reported most frequently to the SDWIS system and how those deficiencies varied by system size. Results from our review of sanitary survey findings and common deficiencies could help primacy agencies and PWSs better evaluate infrastructure and utility training needs.

Presenter:

Austin Heinrich is a physical scientist within U.S. EPA's, OW, OGWDW. In his position, Austin evaluates health and environmental data relevant to microbial pathogens, disinfection byproducts, and PFAS chemicals to better understand public health risks and to formulate strategies for providing safe drinking water. Austin holds a B.S. in environmental and natural resource economics from the University of Rhode Island. In his free time, he enjoys exploring the outdoors through hiking and fly fishing.

3. California Drinking Water Needs Assessment Experience

This presentation will discuss California's first statewide drinking water needs assessment. The assessment and associated 2021 report is the first comprehensive analysis of how clean water is provided in California, and it estimates how much it would actually cost to deliver safe water to every resident. It could inform other state efforts and federal infrastructure funding discussions.

Presenter:

Gregory Pierce, Ph.D. is the co-director of the University of California, Los Angeles (UCLA) Luskin Center for Innovation, and the co-director of the UCLA Water Resources Group. He is also a faculty member in the UCLA Department of Urban Planning. Since joining the Center in 2015, he has been instrumental in guiding its research to inform Human Right to Water policy in California, as well as across the United States. He has authored 41 peer-reviewed journal articles and numerous major research reports, including many with state and local agencies, such as the California Water Board. Greg holds an M.A. and a Ph.D. in urban planning from UCLA.