



Memorandum

Date: October 12, 2023

To: Jing Chao, PE, State Water Board Division of Drinking Water

From: Expert Advisory Panel on Direct Potable Reuse Criteria

Submitted By: Adam Olivieri, DrPH, PE, Expert Panel Co-Chair
James Crook, PhD, PE, Expert Panel Co-Chair

Subject: Expert Panel Final Finding Memorandum on
DDW Draft DPR Regulations dated October 4, 2023

Introduction

Potable reuse is a vital option for meeting California's long-term water supply needs. Large-scale ocean desalination projects seem unlikely in the near future, and imported water supplies to the areas of greatest water demand are shrinking. Many areas of the state lack a suitable groundwater basin or surface water storage asset, so direct potable reuse (DPR) is the only viable alternative.

The State Water Resources Control Board (State Water Board) Division of Drinking Water (DDW) is working on developing statewide water recycling criteria for DPR, as mandated by the California Legislature. Assembly Bill 574 amended the California Water Code (CWC) to require the State Water Board's adoption of regulations for DPR through raw water augmentation by December 31, 2023.

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JPA MEMBERS: Inland Empire Utilities Agency • Irvine Ranch Water District • Los Angeles Department of Water and Power
Metropolitan Water District of Southern California • Orange County Sanitation District • Orange County Water District



Other amendments mandated by AB 574 require the State Water Board to (a) establish and administer an expert review panel (Panel) and (b) to submit the proposed criteria to that review Panel. As codified in Section 13561.2 of the CWC, the Panel's charge is to review the criteria as proposed by DDW and adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health.

The Panel, with support from the National Water Research Institute (NWRI), submitted a memorandum to DDW staff titled "Expert Panel Preliminary Findings, Recommendations, and Comments on Draft DPR Criteria (dated August 17, 2021)" on June 23, 2022 (the draft is dated March 14, 2022). DDW reviewed the Panel's memorandum and provided staff-level comments in response. The Panel provided a response to DDW staff comments dated July 13, 2022. The purpose of this memo is to provide the Panel's comments on the revised Draft DPR Regulations, dated October 4, 2023, and transmit the Panel's final findings.

Background and Findings

The Panel continues to be impressed by the high quality of the State Water Board/DDW staff work on developing the draft criteria. The Panel also appreciates the quality of the material prepared by the DDW Project Team, including six research projects and related presentations by the Water Research Foundation Principal Investigators. This body of work is essential for California's development of a healthy, reliable, and resilient water supply.

The Panel's review is based on a comprehensive scientific review of the August 17, 2021, draft criteria, and the revised draft criteria dated July 21, 2023, and October 4, 2023, presented to the Panel by DDW staff. DDW and the Panel share the same goal: determining if the proposed regulations adequately protect public health. The Panel's review reflects the Panelists' wide-ranging scientific and societal perspectives. While the focus of the review is to determine if the proposed criteria would "adequately protect public health," the Panel has addressed this issue and has taken a holistic approach to overarching concerns about public health protections. The Panel has evaluated whether the criteria are based on best available scientific knowledge and issues related to uncertainty, engineering practice, and guaranteeing compliance of DPR treatment trains. The Panel



also considered unintended consequences, particularly those related to excessive energy consumption and carbon footprint of the water treatment process.

The Panel extensively reviewed the May 4, 2022, responses that the DDW staff has developed on the Expert Panel Preliminary Findings, Recommendations, and Comments on Draft DPR Criteria (dated August 17, 2021). The Panel acknowledges the additional DDW staff modifications reflected in the revised draft DPR regulations (in versions dated July 21, 2023, and October 4, 2023) including, for example:

- Allowing for small environmental buffers (reservoir mixing and groundwater recharge) and blending to provide additional flexibility for pathogen reduction.
- Allowing for the 4-log, redundant pathogen treatment to decrease up to 10 percent in any month.
- Modifying TOC monitoring for chemical controls from every 5 minutes to 15 minutes.
- Adding a requirement for one year of 24/7, on-site operator staffing before utilities can request an alternative operating mode.
- Adding a provision for evaluating the wastewater treatment facility optimization (e.g., flow equalization, nitrification, or side-stream treatment) as part of the engineering report if treatment credit is requested.
- Adding a provision for considering an alternative empty bed contact time (EBCT).
- Clarifying that a safe drinking water permit is used to regulate all facilities where treatment credit (pathogen reduction) is requested.
- Including an early warning program (e.g., facility headworks monitoring) for chemical controls rather than wastewater collection system surveillance.

However, the Panel notes that some portions of the regulation do not reflect the most current scientific findings (see the Panel memos dated March 14, 2022, June 23, 2022, and July 13, 2022). For



example, the LRVs in the proposed regulation are not based on the most current data on the occurrence and removal of pathogens by treatment processes in California.

Further, the Panel notes that conservatism increases costs, both in terms of direct monetary expense and secondary costs associated with climate change or other unintended consequences. An overly conservative approach may push utilities toward less environmentally desirable alternatives, such as extracting groundwater without replenishing it, and it may limit the ability of smaller communities to use DPR. It is critical that the State Water Board continue to explore ways to incentivize DPR, thereby creating a path forward for DPR implementation and providing a roadmap for comprehensive, science-based public health policy.

A responsive, sustainable, and cost-effective approach to developing these regulations that does not sacrifice public health protection has to include recognition by the State Water Board that other types of harm can arise from overengineered treatment barriers (treatment processes/steps). The Panel recommends an intentional effort by DDW to ensure that the regulations do not lead to an unreasonable number and combination of overengineered barriers, which could deter adoption of DPR. The Panel encourages the State Water Board to consider issues of uncertainty, engineering practice, compliance safeguards, energy use, carbon footprint, and overengineering through a transparent risk and management assessment process informed by public input and hearings.

The Panel encourages DDW staff to proceed with the formal regulatory process to develop DPR regulations and believes that formal public input on the revised draft regulations is necessary and appropriate.

Thus, based on the Panel's review of the DDW revised draft DPR regulations the Panel finds that the State Water Board's draft regulations for Direct Potable Reuse - *Title 22, California Code of Regulations* (dated October 4, 2023) adequately protect public health. **If any substantive changes are made to the draft regulations, the Panel reserves its right to review the updated version.** This finding updates the Panel's preliminary finding (March 14, 2022) and represents the collective opinion of the Panel.



Attachments:

1 – Expert Panel Profiles



Attachment 1 • Expert Panel Profiles

Co-Chair: James Crook, PhD, PE, Environmental Engineering Consultant

Panel Co-Chair Dr. James Crook has more than 45 years of experience in state government and consulting engineering, serving public and private sectors in the United States and abroad. He has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. Crook spent 15 years directing the California Department of Health Services water reuse program, during which time he developed California's first comprehensive water reuse criteria. He spent 15 years consulting for engineering firms overseeing water reuse projects and is now an independent consultant specializing in water reuse. He was elected as a Water Environment Federation Fellow in 2014 and selected as the AAEE 2002 Kappe Lecturer and the WaterReuse Association's 2005 Person of the Year. Crook has a BS in Civil Engineering from the University of Massachusetts and MS and PhD degrees in Environmental Engineering from the University of Cincinnati. He is a registered professional engineer in California.

Co-Chair: Adam Olivieri, DrPH, PE, EOA, Inc.,

Panel Co-Chair Dr. Adam Olivieri has more than 35 years of experience leading technical and regulatory projects that involve wastewater, water recycling and reuse, groundwater, stormwater, and chemical and microbial public health risk assessments. Olivieri has worked in public, private, and university settings, giving him a unique perspective on water quality policy in California. He is Vice President at EOA and works as a project manager, principal engineer, and technical advisor on a wide variety of environmental projects. He has extensive experience in microbial risk assessment and modeling to make engineering and public health policy/regulatory decisions. Olivieri received his BS in Civil Engineering and his MS in Civil/Environmental engineering from the University of Connecticut. He received his MPH and Doctor of Public Health (DrPH) in Environmental Health Sciences from the University of California at Berkeley. Adam is a Registered Civil Engineer in the State of California.



Richard Bull, PhD, Washington State University (Emeritus)

Dr. Richard Bull was a senior staff scientist at the Department of Energy's Pacific Northwest National Laboratory, was a Professor of Pharmacology and Toxicology at Washington State University and was Director of the Toxicology and Microbiology Division in the EPA's Cincinnati Laboratories. He is a Consulting Toxicologist and researcher who consults on chemical problems in water for water utilities and government agencies. His research focused on central nervous system effects of heavy metals and studies of carcinogenic and toxicological effects of disinfectants and disinfection byproducts, halogenated solvents, acrylamide, and other drinking water contaminants. Bull was a member of the EPA's Science Advisory Board and Chair of the Drinking Water Committee and has served on committees for the National Academy of Sciences. Bull has a PhD in Pharmacology from University of California, San Francisco, and a BS in Pharmacy from University of Washington.

Jörg E. Drewes, PhD, Technical University of Munich

Dr. Jörg E. Drewes is Chair Professor of Urban Water Systems Engineering at Technical University of Munich (TUM) Germany. Previously, he served as Full Professor of Civil and Environmental Engineering at the Colorado School of Mines and as Director of the National Science Foundation Engineering Research Center on Reinventing the Nation's Urban Water Infrastructure (ReNUWIt). His research includes development of sustainable urban water systems that include energy recovery from waste streams, membrane hybrid processes, engineered natural treatment systems for groundwater recharge, water recycling, and the fate and transport of emerging trace organic chemicals in the environment. Drewes has published more than 300 journal papers, book contributions, and conference proceedings. His awards include the AWWA Rocky Mountain Section Outstanding Research Award and the William Dunbar Medal of the European Water Association. Drewes holds an MS and PhD in Environmental Engineering from Technical University of Berlin, Germany.

Charles Gerba, PhD, University of Arizona

Dr. Charles P. Gerba is Professor of Virology in the Department of Environmental Science at University of Arizona, where he researches pathogen transmission in the environment. His recent research encompasses pathogen transmission by water, food, and fomites; fate of pathogens in land-



applied wastes; development of new disinfectants; domestic microbiology, and microbial risk assessment. He has authored more than 500 articles, including several books in environmental microbiology, risk assessment, and pollution science. He is a fellow of the American Academy of Microbiology, American Association for the Advancement of Science, and the International Water Association. He is on the editorial board of the *Journal of Water and Health* sponsored by the World Health Organization and has served on the Science Advisory Board of the EPA and the Food Advisory Board of the FDA. Gerba received the A. P. Black Award from the American Water Works Association for outstanding contributions to water science and the McKee medal from the Water Environment Federation for outstanding contributions to groundwater protection. He holds a PhD in Microbiology from the University of Miami.

Charles Haas, PhD, Drexel University

Dr. Charles Haas is the L. D. Betz Professor of Environmental Engineering in the Department of Civil, Architectural, and Environmental Engineering at Drexel University. He has more than 45 years of experience researching water treatment, risk assessment, environmental modeling and statistics, microbiology, and environmental health. Haas has been at Drexel University since 1991, serving as Department Head from 2005-2020. He previously served on the faculties of Rensselaer Polytechnic Institute and Illinois Institute of Technology. Haas holds a BS in Biology and an MS in Environmental Engineering from Illinois Institute of Technology, and a PhD in Environmental and Civil Engineering from University of Illinois. He is a 2021 Member of the National Academy of Engineering and recipient of the 2021 College of Engineering Outstanding Career Research Award.

Amy Pruden, PhD, Virginia Tech

Dr. Amy Pruden is a University Distinguished Professor in the Department of Civil and Environmental Engineering at Virginia Tech. Her research focuses on microbial ecology in the design and management of water, wastewater, and recycled water systems. Her research focuses on advancing practical means of antibiotic resistance monitoring, mitigation, and risk assessment. Recently, she served on the NASEM committee on management of *Legionella* in Water Systems and co-authored a consensus report. She has authored more than 175 peer-reviewed scientific journal articles and is an Associate Editor of *Environmental Science & Technology*. Pruden is the recipient of the Presidential



Early Career Award in Science and Engineering, the Paul L. Busch Award for innovation in water research, the ReciPharm International Environmental Award, and is a fellow of the International Water Association. Pruden received her BS in Biological Sciences her PhD in Environmental Science at the University of Cincinnati.

Joan Rose, PhD, Michigan State University

Dr. Joan Rose is the Homer Nowlin Endowed Chair for Water Research at Michigan State University. She has made groundbreaking advances in understanding water quality and protecting public health for more than 20 years and has published more than 300 articles. Rose is widely regarded as the world's foremost authority on *Cryptosporidium* and was the first person to present a method for detecting this pathogen in water supplies. She is a member of the National Academy of Engineering. Rose served as the Chair of the Science Advisory Board for the EPA's Drinking Water Committee for four years and serves on the Science Advisory Board for the Great Lakes and on the NWRI Expert Panel for the state of California on developing water recycling criteria for indirect potable reuse through surface water augmentation and determining the feasibility of developing criteria for direct potable reuse. Rose received a BS in Microbiology from the University of Arizona, an MS in Microbiology from the University of Wyoming, and a PhD in Microbiology from the University of Arizona.

Shane Snyder, PhD, Nanyang Technological University

Dr. Shane Snyder is a Professor and Executive Director at Nanyang Technological University in Singapore. His research focuses on the identification, fate, and health relevance of emerging water pollutants. Snyder and his teams have published more than 100 peer-reviewed manuscripts and chapters on emerging contaminant analysis, treatment, and toxicology. He has testified before the US Senate about pharmaceuticals in water four times and has served two terms on the advisory committee to EPA's Endocrine Disruptor Screening Program and was an expert panel member for EPA's CCL3. He was a member of the National Academy of Science's committee on Water Reuse and served twice on the California Chemicals of Emerging Concern Expert Panel. At NTU Singapore, Dr. Snyder leads a team of more than 300 faculty, staff, research fellows, and students to advance water and environmental research, including wastewater and solid waste management, recycling, and



upcycling. Snyder received a BA in Chemistry from Thiel College and a PhD in Zoology and Environmental Toxicology from Michigan State University.

Jacqueline E. Taylor, REHS, MPA, LA County Dept of Public Health (Retired)

Jacqueline Taylor, MPA, is a Registered Environmental Health Specialist with more than 30 years of experience. She has managed and directed environmental health programs in one of the largest, most diverse, and progressive environmental health departments in the nation. Her work experience has involved policy development and regulatory oversight in food and housing protection, water and wastewater resource management, recreational water and beach monitoring, cross connections and water pollution control, land use planning, solid waste management, radiation management, lead poisoning prevention, staff development, and program planning. In addition to her professional career, Ms. Taylor has had hands-on volunteer experience in the field working to better the lives of those affected by environmental and natural disasters.

George Tchobanoglous, PhD, PE, University of California, Davis (Emeritus)

For more than 35 years, Dr. George Tchobanoglous taught courses on water and wastewater treatment and solid waste management at the University of California, Davis in the Department of Civil and Environmental Engineering. He has authored or coauthored more than 550 publications, including 23 textbooks and 8 engineering reference books. With coauthors, he has written extensively on water reuse, including the textbook *Water Reuse: Issues, Technologies, and Applications*; the report *Direct Potable Reuse: A Path Forward*; and the NWRI white paper *Direct Potable Reuse: Benefits for Public Water Supplies, Agriculture, the Environment, and Energy Conservation*. He is a member of the National Academy of Engineers and has an Honorary Doctor of Engineering from the Colorado School of Mines. In 2012, he received the first Excellence in Engineering Education Award from the American Academy of Environmental Engineers (AAEE) and AEESP. Tchobanoglous has a BS in Civil Engineering from the University of the Pacific, an MS in Sanitary Engineering from the University of California, Berkeley, and a PhD in Environmental Engineering from Stanford University.



Michael P. Wehner, MPA, Assistant General Manager, OCWD (Retired)

Mike Wehner, MPA, has almost 40 years of experience in water quality control and water resources management. He spent 20 years with the Orange County Health Care Agency and moved to the Orange County Water District (OCWD) in 1991. He managed the Water Quality and Technology Group, including Laboratory, Water Quality, Research and Development, and Health and Regulatory Affairs. He was involved in many aspects of OCWD's Groundwater Replenishment System, the nation's largest IPR project, including providing technical guidance on treatment and quality, as well as managing monitoring programs for the purification facility and receiving groundwater. He also managed OCWD's eight-year Santa Ana River Water Quality and Health Study, which evaluated the impact of using effluent-dominated river water for groundwater recharge. He received a Masters of Public Administration from California State University Long Beach and a BS in Biological Sciences from the University of California, Irvine.