



Memorandum

Date: November 15, 2021

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

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

Subject: Summary of Meeting 1 of the Direct Potable Reuse Criteria Expert Panel

The National Water Research Institute (NWRI) is pleased to present the proceedings of Meeting 1 of the Expert Advisory Panel (Panel) on Direct Potable Reuse Criteria. NWRI convened and facilitated the meeting online on August 24-25, 2021. See **Appendix A** for more information about NWRI.

This memorandum summarizes the content of the meeting. Additional information including the review materials, agenda, and links to the video recording and the slide presentations are referenced in this summary.

Panel Charge

The Panel charge is to review the proposed criteria and adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health (see California Water Code §13561.2).¹

Meeting 1 Objectives

- Review the Panel charge, discuss the Panel review process, and estimate a time frame for completing this review.
- Educate the Panel members on the State Water Board Division of Drinking Water (DDW) direct potable reuse (DPR) efforts, including research conducted on DPR and the current status of DPR criteria.
- Present the draft DDW DPR criteria.
- Provide time for Panel questions.
- Provide time for public questions to DDW.

¹ California Water Code §13561.2 says that before December 31, 2023, the state board shall adopt uniform water recycling criteria for direct potable reuse
https://leginfo.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT§ionNum=13561.2.



See **Appendix B** for the full meeting agenda and **Appendix C** for panel member expertise.

Review Materials

The following materials were provided to the Panel for review:

- Draft DPR Criteria revised August 17, 2021
- State Water Board DPR Research Webcast Part 1: Pathogens
- State Water Board DPR Research Webcast Part 2: Chemicals
- Peer Review of the DPR Draft Criteria
- Public Comments on the DPR Draft Criteria
- A Proposed Framework for Regulating Direct Potable Reuse in California, Second Edition, State Water Resources Control Board
- Report to Legislature on the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse (2016)
- Defining Potential Chemical Peaks and Management Options (WRF Project 4991 Report)
- Pathogen Monitoring in Untreated Wastewater (WRF Project 4989 Report)
- Evaluating Analytical Methods for Detecting Unknown Chemicals in Recycled Water (WRF Project 4992 Report)

Meeting Summary

Day 1 (August 24)

The Day 1 presentations and discussion were as follows:

- 1. Welcome, Introductions, Review Agenda, Overview of Panel Process, presented by Kevin Hardy, MPA, JD, NWRI Executive Director.**
- 2. Co-Chairs Welcome, Discuss the Panel Meeting Process, Self-Introduction of Panel Members, Establish no Conflict of Interest, and Overview of the DPR Feasibility Report, presented by Panel Co-Chairs James Crook, PhD, PE, and Adam Olivieri, DrPH, PE.**

Summary of Panel's preliminary discussion:

- The Panel asked if the standards must be different for Raw Water Augmentation or Finished/Treated Water Augmentation. DDW staff replied there is no significant difference in regulating the two types of DPR, it was a policy decision to proceed with developing a single overarching DPR regulation that covers all types of direct potable reuse after considering public comments received from the first framework document, and that the State Water Board will consider the Panel's comment if the Panel finds the regulation must be split into two separate regulations.



3. Direct Potable Reuse Regulation Development and Overview of Proposed Criteria, presented by DDW staffers Randy Barnard, PE; Kurt Souza, PE; and Jing Chao, PE.

Summary of Panel's preliminary discussion:

- The Panel commented that for pipe-to-pipe DPR, there are other considerations to take into account, such as temperature effects on performance of the distribution system, and asked several questions, including: (a) will there always be a second source of water entering the distribution system, and (b) where are treated water augmentation (TWA) and raw water augmentation (RWA) considered to be equivalent, and how is that equivalency monitored?
- DDW staff said that while the TWA definition doesn't specify a second water supply, operationally one is necessary since a community can't rely solely on its wastewater for its drinking water supply.
- DDW staff said there are three monitoring points, including untreated wastewater, after advanced treatment, and before the distribution system.

4. Water Research Foundation (WRF) Research Projects and Findings Briefing: Tools to Evaluate Microbial Risk, Plant Performance, and Reliability (DPR-1), and Raw Wastewater Pathogen Monitoring (DPR-2), presented by the project principal investigator (PI), Brian Pecson, PhD, of Trussell Technologies, Inc.

Summary of Panel's preliminary discussion:

- The Panel asked if there are any insights into why the molecular methods didn't perform as well as the cultured methods for the viruses and noted that the insights could help improve the methods.
- The PI noted that the main factor was associated with concentrating the samples and not with recovery or inhibition, as evidenced by the results of the stringent QA/QC plan. It took many liters to concentrate for the molecular analysis and it was not possible to run the high volumes needed.
- The Panel asked how the DPR-2 data compared to other projects that have tried to characterize pathogens in wastewater.
- The PI noted that strict criteria were used to screen the 100 US (and two international) references and about 12 met the data criteria. A comparison of the datasets against the DPR-2 data saw good consistency.
- The Panel noted that the DPR-2 dataset is one of the most extensive datasets available and asked if there was enough variability in water quality parameters to see if there is a water quality effect on the molecular/culture ratio.
- The PI noted the analysis had not been done but would look to see it could be investigated further.
- The Panel asked about reovirus, which is often the only virus that survives chlorine disinfection in wastewater treatment plants and may show up in treated water but not in raw wastewater.
- The PI noted that the DPR-2 project emphasis was on characterizing untreated wastewater and the pathogens that would be expected, including the best culture and molecular methods available.



- The Panel asked if data are available on the use of coliphage as a surrogate indicator.
- The PI noted that male-specific phage was measured in the untreated wastewater, and that there wasn't good correlation with other pathogens.
- The Panel mentioned the concept of reducing the virus PCR signal altogether after treatment.
- The PI noted there a number of treatment processes, and after full treatment viruses are typically not observed. The extensive dataset allows for the analysis and development of the necessary virus removal requirements.

5. DPR Proposed Pathogen Control Criteria, presented by DDW staffers Robert Hultquist, PE, and Saeed Hafezneami, PhD, PE

Summary of Panel's preliminary discussion:

- The Panel asked if an engineered storage buffer is needed for a TWA project and whether it would help with treatment. DDW staff said that a storage buffer would help with compliance and time to respond, but they aren't specifically requiring an engineered storage buffer.
- The Panel asked about what should be included in guidance, regulations, and the Title 22 engineering report. DDW staff said that they cannot just rely on guidance because they cannot enforce it, and that the project proponent must analyze the entire proposed project, including potential effects on the distribution system, as part of the engineering report required by the criteria.
- The Panel asked how the criteria addressed requiring the project to produce the highest quality water before advanced treatment and whether the criteria addressed return flows. DDW noted that optimization requirements have been used in other regulations and are written in an enforceable manner, such as requiring treatment to be optimized to minimize contaminants. It is difficult to write that kind of requirement because operating to reduce one contaminant might increase another contaminant. DDW also noted that return flows have not been addressed in the criteria.
- The Panel commented that they will provide opinions to DDW on a way to balance between performance-based regulations that are enforceable and specific topics that should be addressed as part of the engineering report, including issues related to enhanced source control.
- The Panel asked about the criteria for membrane processes and whether a membrane is required. DDW staff said that they do not necessarily require reverse osmosis (RO), but when they say physical separation, they mean a membrane.
- The Panel asked if DPR is equivalent to a membrane and how flexible the regulations are to respond to new technologies. DDW staff said that they intend for the regulations to be flexible to accommodate future technologies.
- The Panel asked about the LRV requirements. DDW said they need to build in redundancy to address possible failure scenarios. If a system loses some redundant treatment, a utility has 24 hours to correct the treatment problem.



- The Panel discussed the need for flexibility in the criteria to allow for future technological advances without the need for significant modifications to the criteria/regulations. DDW staff noted that the regulations should not be a barrier to advances and look forward to the Panel's input.

See **Appendix D** for links to the Day 1 video recording and all slides presented, and **Appendix E** for the list of meeting participants.

Day 2 (August 25).

The Day 2 Presentations and discussion were as follows:

6. DPR-4: Treatment for Averaging Potential Chemical Peaks, presented by the project principal investigator, Jean Debroux, PhD, PE, of Kennedy Jenks.

Summary of Panel's preliminary discussion:

- The Panel asked the project principal investigators (PIs) what they think caused spikes that did not fit the definition of peaks. The PIs suggested that background noise could be caused by a treatment train coming back online. The Panel then asked if it is possible to avoid these spikes by wasting some flow when the treatment train is brought online.
- The Panel asked the project PIs if there were differences or correlations with peak flow rates or diurnal variation. The PIs reported that there is diurnal variation in TOC concentrations. However, the advanced water treatment facility does not take all the flow from the wastewater treatment plant and it runs at a constant flow rate, so there is no peaking. They did not examine seasonal events, storms, or other events that increase flow at the treatment plant.
- The PIs also said that their study included five spikes and only one met the definition of a peak, and it was much lower than the 2013 peak. They must consider if a peak is an outlier or if it is caused by drift in the monitoring instruments.

7. DPR Proposed Chemical Control Criteria, presented by DDW staff Brian Bernados, PE

Summary of Panel's preliminary discussion:

- The Panel asked DDW about different options for source control, including working with selected industries to do either storage, hauling, or total relocation based on local needs. DDW staff said that issues related to problem discharges and illegal dumping of septic tank effluent are addressed in the enhanced source control risk assessment process.
- The Panel asked about options for agencies to partner with problem dischargers to require on-site pretreatment and eliminate the discharge to the sanitary sewer system. The Panel also commented that the pretreatment program wasn't designed to support DPR projects.
- The Panel commented that the level of detail in the regulation, as written, would require even more specifications to guide utilities in incorporating treatments technologies and operations effectively. For



example, the requirements for ozone and GAC, as written, would require other additional detail to make sure they are applied correctly.

The Panel noted that a balance between detailed criteria and what goes in the engineering report to address certain treatment objectives needed additional clarity. For example, the criteria are not clear what treatment function the Ozone/BAC addresses. As written, it appears adsorption is the function. The Panel noted that, given that function, other online monitoring for nutrient removal and nitrite is necessary. DDW staff said the mechanism is not adsorption but rather biodegradation, specifically compounds passing through RO.

- The Panel questioned the use of lead as a sensor because it is generally not a problem for the treatment process, but it gets into the water supply through lead pipes in the distribution and on-premises plumbing systems. DDW staff agreed but said that lead was included because it is particularly toxic and it might have its own MCL in the future; this action is a placeholder.
- The Panel asked if an enforcement piece will be added to the document. DDW staff said that the water supply permit will be issued by the DDW district offices and DDW has the ability to issue citations, fines, and compliance orders, since DPR is drinking water. In addition, the Water Board has added resources for additional attorneys and small systems would have to prove that they have the resources to produce safe water.
- The Panel asked about very small water systems wanting to do DPR. DDW staff noted that utilities would have to go above and beyond to demonstrate technical, managerial, and financial (TMF) capacity to do DPR, so it will be difficult for very small water systems to meet the DPR TMF requirements.
- The Panel asked about the decision around the 1:1 ozone:TOC ratio and dosing into wastewater. DDW staff said that Ozone-BAC is a chemical mechanism and similar to when they require advanced oxidation, the chemical process helps with pathogens. There has to be a fourth process besides AOP, RO, and microfiltration. Chlorine can't do it, so some kind of ozone would be the fourth barrier. The 1:1 isn't set in stone. If it can be demonstrated to be effective at lower levels, DDW would consider it.
- The Panel asked about the benefit of being so prescriptive about the ozone process in the regulation. DDW said they wanted to have criteria based on all the work that has been done and they will consider any alternatives.
- The Panel said that in light of the challenges caused by climate change, it is important that the criteria be written with options to save energy in mind.
- The Panel asked if Ozone-BAC counts as one or two processes. DDW staff said the combination counts as one process, the process where ozone creates a biologically active media, and that otherwise it would be a GAC process.
- The Panel asked the Chemical Peak Research PIs if they would recommend redundant TOC analyzers. The PIs said that the regulation does not need to be prescriptive, but they think project proponents are leaning toward redundant TOC analyzers.



- DDW staff said that the charge of this panel is to look at the proposed language for the DPR criteria and tell them if it is protective of public health. They appreciate language about alternatives, but the charge is just to make sure that what is in the draft DPR criteria is protective of public health. The Panel said that to get to an answer, they must understand the logic and rationale that went into writing the proposed language as part of their evaluation.

See **Appendix D** for links to the Day 2 video recording and all slides presented.

Next Steps

Panel Meeting 2 will take place online on December 1, 2021, and Panel Meetings 3 and 4 will take place online in the first quarter of 2022.

The Panel co-chairs propose that the Meeting 2 agenda will include pathogen issues, chemical issues, and a review of the Panel members' input on the draft criteria.

NWRI is working with the Panel co-chairs to schedule the Panel meetings.



Appendix A • About NWRI

About NWRI

A 501c3 nonprofit organization, National Water Research Institute (NWRI) was founded in 1991 by a group of California water agencies in partnership with the Joan Irvine Smith and Athalie R. Clarke Foundation to promote the protection, maintenance, and restoration of water supplies and to protect public health and improve the environment. NWRI's member agencies include Inland Empire Utilities Agency, Irvine Ranch Water District, Los Angeles Department of Water and Power, Orange County Sanitation District, Orange County Water District, and West Basin Municipal Water District.

For more information, please contact:

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Kevin Hardy, Executive Director

Suzanne Sharkey, Project Manager

Mary Collins, Communications Manager

Disclaimer

This memorandum was prepared by an Expert Advisory Panel, which is administered by National Water Research Institute. Any opinions, findings, conclusions, or recommendations expressed in this report were prepared by the Panel. This report was published for informational purposes.



Appendix B • Meeting Agenda

Direct Potable Reuse (DPR) Criteria Expert Panel (AB 574)

August 24-25, 2021

Meeting Objectives

- Review the Panel charge, meeting process, and time frame for completion.
- Educate the Panel members on the current status and goals for the project.
- Allow the Panel members time to identify topics of interest or concern.
- Present the draft DPR criteria and provide time for Panel questions.

Tuesday, August 24, 2021

9:00 a.m.	Panel Member Login/Audio Test	
10:00 a.m.	Welcome, Introductions, Review Agenda, Overview of Panel Process	Kevin M. Hardy, NWRI
10:20 a.m.	Co-Chairs Welcome <ul style="list-style-type: none">• Discuss the meeting process• Self-introduction of the Panel members• Establish no conflict of interest of Panel members	Adam Olivieri and Jim Crook, Panel Co-Chairs
10:35 a.m.	Overview of the DPR Feasibility Report	Adam Olivieri and Jim Crook
10:50 a.m.	Break	
11:00 a.m.	<ul style="list-style-type: none">• Statutory Mandate and Tasks of the Panel• Overview of Regulation Development• Overview of Drinking Water Regulations• Overview of Draft Criteria	DDW Project Team Staff
12:00 p.m.	Lunch Break	



DPR Criteria Panel: Meeting 1 Proceedings Summary

12:30 p.m.	WRF Research Projects and Findings Briefing: Pathogen Monitoring and Plant Reliability-QMRA (DPR-1 and DPR-2)	Project Primary Investigator: Brian Pecson, Trussell Technologies
1:10 p.m.	DDW Briefing on Draft Criteria: Pathogens	DDW Project Team Staff
1:50 p.m.	Clarifying Questions From Panel	Kevin M. Hardy
2:00 p.m.	Adjourn Day 1	

Wednesday, August 25, 2021

9:45 a.m.	Panel Member Login/Audio Test	
10:00 a.m.	Welcome and Review Agenda	Kevin M. Hardy
10:10 a.m.	WRF Research Projects and Findings Briefing: Defining Chemical Peaks and Management Options (DPR-4)	Project Primary Investigators: Jean Debroux, Kennedy Jenks Shane Trussell, Trussell Technologies
10:50 a.m.	DDW Briefing on Draft Criteria: Chemicals	DDW Project Team Staff
11:50 a.m.	Clarifying Questions From Panel	Kevin M. Hardy
12:00 p.m.	Lunch Break	
12:30 p.m.	Clarifying Questions From Panel	Kevin M. Hardy
1:00 p.m.	Public Comment Session	Kevin M. Hardy
1:30 p.m.	Panel Working Session (Panel Only)	Panel Co-Chairs
2:00 p.m.	Adjourn Day 2	



Appendix C • Panel Members and Expertise

Brief professional biographies of the Panel members are available on the DDW web site at:

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/direct_potable_reuse/ab574panelroster.pdf

- Co-Chair James Crook, PhD, PE (Environmental Engineering Consultant)
- Co-Chair Adam Olivieri, DrPH, PE (EOA, Inc.)
- Richard Bull, PhD (Washington State University - Emeritus)
- Jörg E. Drewes, PhD (Technical Univ of Munich)
- Charles Gerba, PhD (University of Arizona)
- Charles Haas, PhD (Drexel University)
- Amy Pruden, PhD (Virginia Tech)
- Joan Rose, PhD (Michigan State University)
- Shane Snyder, PhD (Nanyang Technological University)
- Jacqueline E. Taylor, REHS, MPA (LA County Department of Public Health - Retired)
- George Tchobanoglous, PhD, PE (University of California, Davis - Emeritus)
- Michael P. Wehner, MPA (Orange County Water District - Retired)

Panel Expertise

Microbial Risk Assessment, Chemistry, Microbiology, Water Treatment Engineering, Wastewater Treatment Engineering, Toxicology, Multi-barrier System Reliability, Public Health, Potable Reuse Operations, and Water Recycling Regulations



Appendix D • Links to Meeting 1 Video and Slides and Publicly Available Review Materials

Meeting 1, Day 1 Recording

https://www.youtube.com/embed/_aDqIW0Libk?modestbranding=1&rel=0&autoplay=1

Meeting 1, Day 2 Recording

<https://www.youtube.com/embed/yhASB6plG-c?modestbranding=1&rel=0&autoplay=1>

Meeting 1 Presentations in Order of Agenda

NWRI Introduction and Expert Panel Co-Chairs' Welcome

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1_nwri_epchairs_slides.pdf

DPR Statutory Mandate and Regulation Development, Drinking Water Statutes, Regulations, and Permits

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1_ddw_dpr_criteria_overview.pdf

WRF Research Projects and Findings Briefing: Pathogen Monitoring and Plant Reliability QMRA

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1-pecson-dpr1and2.pdf

DPR Proposed Pathogen Control Criteria

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1_ddw_pathogen_control_criteria_1.pdf

NWRI Introduction for Meeting 1, Day 2

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1_nwri_day2_intro.pdf

Water Research Foundation Projects and Findings Briefing: Defining Chemical Peaks and Management Options

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1-debroux-trussell-dpr4-1.pdf

DPR Proposed Chemical Control Criteria

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/epmtg1_ddw_chemical_control_criteria.pdf

DDW DPR Framework

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/direct_potable_reuse/dprframewkseced.pdf



Evaluation of the Feasibility of Developing Uniform Recycling Criteria for Direct Potable Reuse (2016 NWRI Expert Panel Report/Appendix A of the DDW Report to the Legislature)

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/rw_dpr_criteria/app_a_ep_report.pdf

Draft DPR Criteria

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2021/aug2021addendum_ep.pdf

Defining Potential Chemical Peaks and Management Options (WRF Project 4991 Report)

<https://www.waterrf.org/research/projects/defining-potential-chemical-peaks-and-management-options>

Pathogen Monitoring in Untreated Wastewater (WRF Project 4989 Report)

<https://www.waterrf.org/research/projects/pathogen-monitoring-untreated-wastewater>

Evaluating Analytical Methods for Detecting Unknown Chemicals in Recycled Water (WRF Project 4992 Report)

<https://www.waterrf.org/research/projects/evaluating-analytical-methods-detecting-unknown-chemicals-recycled-water>



Appendix E • GoToMeeting Attendees

Day 1 Participants

Panel Members

- Co-Chair James Crook, PhD, PE (Environmental Engineering Consultant)
- Co-Chair Adam Olivieri, DrPH, PE (EOA, Inc.)
- Richard Bull, PhD (Washington State University - Emeritus)
- Jörg E. Drewes, PhD (Technical Univ of Munich)
- Charles Gerba, PhD (University of Arizona)
- Charles Haas, PhD (Drexel University)
- Amy Pruden, PhD (Virginia Tech)
- Joan Rose, PhD (Michigan State University)
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- Jacqueline E. Taylor, REHS, MPA (LA County Department of Public Health - Retired)
- George Tchobanoglous, PhD, PE (University of California, Davis - Emeritus)
- Michael P. Wehner, MPA (Orange County Water District - Retired)

State Water Board Staff

- Faraz Asad
- Randy Barnard
- Brian Bernados
- Robert Brownwood
- Jing Chao
- Saeed Hafeznezami
- Robert Hultquist
- Kurt Souza

Project Primary Investigators

- Jean Debroux
- Brian Pecson
- Shane Trussell



NWRI Staff

- Mary Collins
- Kevin Hardy
- Natalie Roberts
- Suzanne Sharkey

Day 2 Participants

Panel Members

- Co-Chair James Crook, PhD, PE (Environmental Engineering Consultant)
- Co-Chair Adam Olivieri, DrPH, PE (EOA, Inc.)
- Richard Bull, PhD (Washington State University - Emeritus)
- Jörg E. Drewes, PhD (Technical Univ of Munich)
- Charles Gerba, PhD (University of Arizona)
- Charles Haas, PhD (Drexel University)
- Amy Pruden, PhD (Virginia Tech)
- Joan Rose, PhD (Michigan State University)
- Shane Snyder, PhD (Nanyang Technological University)
- Jacqueline E. Taylor, REHS, MPA (Director, Environmental Protection Branch, LA County Department of Public Health - Retired)
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- Robert Hultquist
- Kurt Souza



Project Primary Investigators

- Jean Debroux
- Brian Pecson
- Shane Trussell

Community Members for Public Comment

- Sherlin Hamlin
- Jennifer West

NWRI Staff

- Mary Collins
- Kevin Hardy
- Natalie Roberts
- Suzanne Sharkey