NATIONAL WATER RESEARCH INSTITUTE

Volume I

Expert Panel on the Development of Water Recycling Criteria for Indirect Potable Reuse (IPR) through Surface Water Augmentation and the Feasibility of Developing Criteria for Direct Potable Reuse (DPR)

for the
State Water Resources Control Board
Division of Drinking Water
(Agreement No. 13-21041)

Draft Final Panel Meeting Report: Panel's Initial Discussions on the Draft Surface Water Augmentation IPR Preliminary California Regulation Concept (Dated July 2014)

Based on a Panel Meeting Held July 24-25, 2014
Meeting #2

February 18, 2015
Fountain Valley, California

www.nwri-usa.org/ca-panel.htm

ABOUT NWRI

A 501c3 nonprofit organization, the 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.

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The Drinking Water Program was officially transferred from CDPH to the California State Water Resources Control Board (State Board) and renamed as the Division of Drinking Water (DDW) on July 1, 2014. Financial support for the Panel is being provided by the State Board through Agreement No. 13-21041.

The Panel would like to thank State Board staff for the information, materials, and suggestions received from the State Board as part of the second Panel Meeting, which is the focus of this Panel Report. In particular, the Panel thanks Mr. Randy Barnard, Mr. Mark Bartson, Mr. Brian Bernados, Mr. Bruce Burton, Mr. Robert Hultquist, and Mr. Mike McKibben of the State Board for their assistance. The Panel also appreciates the support of Mr. Bruce Burton, Chief of the Northern California Drinking Field Operations Branch, who serves as the State Board project representative on this effort.

In addition, the Panel thanks the National Water Research Institute for administering and organizing the Panel's efforts. The Panel would also like to recognize the WateReuse Research Foundation and members of the State Board's Direct Potable Reuse (DPR) Advisory Committee for participating in the second Panel Meeting and providing valuable information on current and future potable reuse research projects.

DISCLAIMER

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

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ACRONYMS

CDPH	California Department of Public Health
DDW	State Water Resources Control Board, Division of Drinking Water
DPR	Direct potable reuse
IPR	Indirect potable reuse
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
POTW	Publicly owned treatment works
State Board	State Water Resources Control Board
SWA	Surface water augmentation
SWSAP	Surface Water Source Augmentation Project
TOC	Total organic carbon
WRRF	WateReuse Research Foundation

1. PURPOSE OF THE REPORT

The purpose of this report is to provide the California State Water Resources Control Board (State Board) with the Expert Panel's initial discussions from their July 2014 meeting on the information presented by State Board staff regarding the initial draft document titled, "Surface Water Augmentation IPR Preliminary California Regulation Concept," prepared by the State Board and dated July 2014 (as provided in Volume II of this report). In addition, the Panel report also includes some very preliminary statements and recommendations regarding the Panel's intended approach to address the Panel's charge relative to indirect potable reuse (IPR).

2. PURPOSE AND HISTORY OF THE PANEL

In 2013, the National Water Research Institute (NWRI) of Fountain Valley, California, a 501c3 nonprofit, appointed state and national water industry experts to an independent, third-party Expert Panel to provide advice to the State of California on developing Water Recycling Criteria for IPR through surface water augmentation (SWA) and determining the feasibility of developing criteria for direct potable reuse (DPR).

The Panel was originally formed on behalf of the Drinking Water Program of the California Department of Public Health (CDPH). As of July 1, 2014, the Drinking Water Program was officially transferred from CDPH to the State Board and renamed as the Division of Drinking Water (DDW); therefore, hereafter, CDPH will be referred to as the State Board. The Panel for the State Board is being administered by NWRI.

2.1 Need for the Panel

The specific purpose of the Panel is provided in Chapter 7.3 – entitled "Direct and Indirect Potable Reuse" – of the California Water Code[1]. The exact wordage is as follows:

> 13565. (a) (1) On or before February 15, 2014, the department shall convene and administer an expert panel for purposes of advising the department on public health issues and scientific and technical matters regarding development of uniform water recycling criteria for indirect potable reuse through surface water augmentation and investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse. The expert panel shall assess what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for direct potable reuse. The expert panel shall then recommend an approach for accomplishing any additional needed research regarding uniform criteria for direct potable reuse in a timely manner.

With respect to surface water augmentation, the Panel's role – as stated in Section 13562 of the California Water Code – is as follows:

> (B) Prior to adopting uniform water recycling criteria for surface water augmentation, the department shall submit the proposed criteria to the expert panel convened pursuant to subdivision (a) of Section 13565. The expert panel shall review the proposed criteria and shall adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health.

[1] Appendix A contains a copy of Chapter 7.3 of the California Water Code, effective January 1, 2014. http://www.leginfo.ca.gov/cgi-bin/displaycode?section=wat&group=13001-14000&file=13560-13569 (last accessed October 6, 2014).

In addition, California Water Code Section 13565 requires the State Board to convene a DPR Advisory Committee to advise the Expert Panel regarding the "development of uniform water recycling criteria for DPR and the draft report required by Section 13563." The DPR Advisory Committee includes 15 members representing the State Board, water and wastewater utilities in regions like Los Angeles and San Diego, local environmental groups, county health departments in California, and the U.S. Environmental Protection Agency. The DPR Advisory Committee has met three times since the inception of the Expert Panel.

Please refer to Chapter 7.3 of the California Water Code (Appendix A) for a description of State Board activities, Expert Panel members, and DPR Advisory Committee members.

2.2 Panel Members

The Panel is made up of 12 individuals who meet the Water Code Section 13565 requirement that the Expert Panel "shall be comprised, at a minimum, of a toxicologist, an engineer licensed in the state with at least three years' experience in wastewater treatment, an engineer licensed in the state with at least three years' experience in treatment of drinking water supplies and knowledge of drinking water standards, an epidemiologist, a limnologist, a microbiologist, and a chemist."

Panel members include:[2]

- *Panel Co-Chair:* Adam Olivieri, Dr.P.H., P.E., EOA, Inc. (Oakland, CA)
- *Panel Co-Chair:* James Crook, Ph.D., P.E., Water Reuse and Environmental Engineering Consultant (Boston, MA)
- Michael Anderson, Ph.D., University of California, Riverside (Riverside, CA)
- Richard Bull, Ph.D., MoBull Consulting (Richland, WA)
- Dr.-Ing. Jörg E. Drewes, Technische Universität München (Munich, Germany)
- Charles Haas, Ph.D., Drexel University (Philadelphia, PA)
- Walter Jakubowski, M.S.., WaltJay Consulting (Spokane, Washington)
- Perry McCarty, Sc.D., Stanford University (Stanford, CA)
- Kara Nelson, Ph.D., University of California, Berkeley (Berkeley, CA)
- Joan B. Rose, Ph.D., Michigan State University (East Lansing, MI)
- David Sedlak, Ph.D., University of California, Berkeley (Berkeley, CA)
- Tim Wade, Ph.D., United States Environmental Protection Agency (Durham, NC)

Background information about the NWRI Panel process can be found in Appendix B, and brief biographies of the Panel members can be found in Appendix C. Further information about the Panel can also be found on the NWRI website at www.nwri-usa.org/ca-panel.htm.

[2] The Panel was originally chaired by R. Rhodes Trussell, Ph.D., P.E., of Trussell Technologies, Inc., who resigned as Chair effective June 6, 2014. Later that month, Adam Olivieri (a current Panel member) and James Crook (a water reuse expert and environmental engineering consultant) were selected as Co-Chairs by the State Board and NWRI. This selection was approved by the State Board's DPR Advisory Committee at a meeting held on July 11, 2014.

3. PANEL MEETING

A two-day meeting of the Panel was held on July 24-25, 2014, at the Orange County Water District in Fountain Valley, California. The specific focus of the meeting was to review the State mandate and Panel Charge, provide State Board staff with an opportunity to brief the Panel on their initial draft SWA Criteria, begin Panel discussions on the draft (as well as interact with State Board staff), receive an update on DPR research efforts to date, and initiate discussions on an approach for assessing the feasibility of DPR criteria.

3.1 Background Material

Prior to the meeting, the State Board provided the following background material to the Panel:

- *California Water Code Section 13560-13569 (*Chapter 7.3 is provided in Appendix A of this report), which contains the exact language of the Panel charge relative to IPR and DPR.

- *Surface Water Augmentation IPR Preliminary California Regulation Concept* (dated July 2014), prepared by State Board staff.

- *Supporting Material for Draft Surface Water Augmentation Criteria* (dated July 2014), prepared by the State Board. Items include:
    - Draft California Potable Reuse Organism Log Reductions (dated April 2014)
    - Draft Surface Water Augmentation – Where Should the Log Reduction Values and Advanced Treatment Go? (dated July 2014)
    - Draft Surface Water Augmentation: Indirect Potable Reuse Dilution Is a Horse of a Different Color (dated July 2014)

- *California Direct Potable Reuse Initiative Research Briefing* (dated July 2014), prepared by the WateReuse Research Foundation (WRRF) and WateReuse California.

- *California Direct Potable Reuse Initiative Research Plan* (updated July 2014), prepared by WRRF and WateReuse California. Sections include:
    - Section 1: Background, Drivers, and Participants of the DPR Initiative
    - Section 2: Research Path to Achieve DPR Initiative's Goal
    - Section 3: Current WateReuse Research Foundation DPR Research Projects
    - Section 4: Future Research and Next Steps

- *California Direct Potable Reuse Initiative Response to June 12, 2014 Expert Panel Report* (dated July 21, 2014), prepared by WRRF and WateReuse California.

These background materials are also provided in Volume II of this report.

3.2 Meeting Agenda and Logistics

Staff from NWRI and the State Board collaborated on the development of an agenda for the Panel meeting, which is included in Appendix D. The agenda was based on meeting the following specific objectives:

1. Review the State mandate and Panel Charge.
2. Review the draft SWA Criteria.
3. Review the approach for assessing the feasibility of DPR criteria.
4. Receive an update on DPR research efforts to date.

The first day included presentations by project managers on current and planned research efforts in potable reuse and DPR.

Specifically, presentations included:

- Statutory Mandates and Specific Tasks of the Panel
- Overview of Regulatory Process and Regulatory Feasibility
- Overview of Preliminary Surface Water Augmentation Criteria
- Overview of DPR Research Initiative Efforts
- Briefing on Potable Reuse in California
- DPR Advisory Committee Update

The slide presentations are provided in Volume III of this report.

Time was allowed for questions and discussion between State Board staff, research project managers, and Panel members following each presentation and throughout an open discussion held during the meeting.

The Panel met in a closed session on the second day to initiate review and discussions on the draft SWA criteria. Other topics covered, time permitting, included follow-up discussions on the DPR research status and an initiation of discussions on developing a framework for review of the feasibility of DPR criteria.

3.3 Meeting Attendees

All Panel members participated at the meeting with the exception of Dr. Kara Nelson (due to scheduling conflicts). Other attendees included NWRI staff, State Board staff, water reuse research representatives, and utility representatives. A complete list of Panel meeting attendees is included in Appendix E.

4. SUMMARY OF PANEL KEY COMMENTS AND RECOMMENDATIONS

A key focus of this Panel meeting was to provide State Board staff from the DDW with an opportunity to brief the Panel on their initial draft *Surface Water Augmentation IPR Preliminary California Regulation Concept* (dated July 2014) and to initiate Panel discussions on the draft (as well as interact with State Board staff). Based on Panel discussions, the Panel organized comments and recommendations under the following topics:

- General Understandings and Comments
- Reservoir Comments
- Pretreatment/Source Control Program
- Pathogens and Chemicals Comments
- Monitoring Comments
- Other Beneficial Uses, Water Quality, and Changes from Surface Water Augmentation

4.1 General Understandings and Comments

The comments and statements in this section focus on the overarching concepts and understandings that will guide and govern the Panel's approach to conduct the review of IPR criteria for SWA (and, eventually, DPR) as required by the California Water Code.

- The Panel commends the effort by the State of California, specifically the State Board, to develop SWA regulations for IPR, which will help communities throughout California supplement existing drinking water sources, improve the reliability of existing water supplies, and facilitate additional potable reuse in communities throughout California and the United States.

- As per California Water Code Section 13560-13569, the Panel recognizes that the State Board has been mandated to "develop and adopt uniform water recycling criteria for surface water augmentation" on or before December 31, 2016. Further, the Panel understands that it is charged to "review the proposed criteria and shall adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health" before the criteria are adopted.

- The Panel notes that State regulations are not specific about how the Panel is to conduct the review and how the term "adequate" is defined. While this is a challenge, the Panel will rely on the various factors noted below, as well as others (e.g., existing acceptable levels of public health risk defined within the State Board's water recycling statutes, the Safe Drinking Water Act, and the Clean Water Act).

- The Panel noted that it is critical for it to define specific concepts, considerations, and parameters it will consider as part of meeting the Panel charge provided in the California Water Code. The Panel will define, where necessary, the terms used as part of the Panel review process. The Panel cautioned that the definitions used by the Panel may or may not reflect the current regulatory and/or State staff working definitions.

- The Panel intends to discuss and consider the following factors (excerpted from the California Water Code relative to DPR) as part of meeting its consideration of the SWA-IPR:

    - The availability and reliability of recycled water treatment technologies.
    - Multiple barriers and sequential treatment processes that may be appropriate at wastewater and water treatment facilities.
    - Available information on health effects.
    - Mechanisms to protect public health if problems are found in recycled water that is being served to the public as a potable water supply, including, but not limited to, the failure of treatment systems at the recycled water treatment facility.
    - Monitoring needed to ensure the protection of public health, including, but not limited to, the identification of contaminants of specific concern, as well as appropriate indicator and surrogate constituents that are used to confirm the effectiveness of treatment.
    - Any other scientific or technical issues that may be necessary, including, but not limited to, the need for additional research.

- The Panel understands and acknowledges that while its review is strictly focused on criteria that "adequately protect public health," an important factor not being considered by the Panel is the practicality of the regulated community to meet the criteria. Addressing the practicality issue can be partially addressed based on the Panel's defining the term "adequate," as noted above.

- The Panel understands and acknowledges that it is not the Panel's charge to specifically review the City of San Diego's Pure Water San Diego Indirect Potable Reuse/Reservoir Augmentation project as it relates to IPR. However, to effectively review the draft criteria for IPR proposed by the State Board, it will be necessary to understand the scientific information developed as part of the City's investigations and how that information has been interpreted and used by State Board staff to prepare the draft IPR regulations.

- The Panel understands that the State Board's Groundwater Replenishment Using Recycled Water regulations (adopted June 18, 2014) were used as the template to prepare the draft IPR criteria. The Panel suggests that State Board staff carefully review the criteria to determine where the requirements in the groundwater recharge regulations either need to be further clarified to address IPR via SWA and/or deleted as not appropriate.

- The Panel notes that its intent is to review the draft regulatory language to understand the basic objective(s) of the language, technical/scientific basis supporting the language, and inter-relationship between the various regulatory sections of the proposed criteria relative to meeting the Panel charge provided in the California Water Code.

4.2 Reservoir Comments

The Panel had a number of preliminary comments and questions as part of its initial discussion with State Board staff on the draft IPR criteria covering surface water reservoirs (draft sections currently identified as 64601 through 64603). Overall, the Panel noted that:

- The overall objectives of the reservoir requirements are not clear. For example, it is unclear if the intent is to provide reservoir treatment credit for all or some constituents of concern. A rationale is needed supporting which constituents will receive treatment credit and the conditions under which credit is provided.

- Additional clarification on the definition of dilution and the technical basis supporting the selection of what appears to be four separate requirements (see the excerpt below from the *Surface Water Augmentation IPR – Preliminary California Regulation Concept,* dated July 2014) needs to be provided before the Panel can review and evaluate the draft IPR criteria prepared by State Board staff.

  > *§64602. Retention and/or Mixing of Recycled Water in the Reservoir.*
  >
  > *(a) The reservoir must achieve one of the following between the discharge of the recycled water into the reservoir and its abstraction as a surface water source:*
  > - *A minimum 100:1 dilution of a 24-hour production of recycled water with suitable reservoir water*
  > - *A minimum 60-day retention of recycled water in the reservoir*
  > - *A minimum10:1 dilution of a 24-hour production of recycled water with suitable reservoir water and a minimum 30-day retention of recycled water in the reservoir*
  > - *A minimum10:1 dilution of a 24-hour production of recycled water with suitable reservoir water and a 1-log reduction of each organism in addition to the reductions required in section(s)*

- Within the discussion on retention time (page 15), it is critical to note that a purpose of the 3-D hydrodynamic modeling is to provide sufficient evidence that short circuiting is not occurring. In addition, the scenario for off-spec water and adjusting the credits should be informed by the 3-D hydrodynamic modeling.

4.3 Pretreatment/Source Control Program Comments

The Panel had a number of preliminary comments and questions as part its initial discussion with State Board staff on the draft IPR criteria covering pretreatment/source control (see the draft section currently identified as 60321[a]). Altogether, the Panel notes:

- The overall objective of this section needs to focus on the requirement for a source control program aimed at the protection of public health. The Panel understands that existing regulations (both Federal and State) and permits (i.e., publicly owned treatment works [POTW] and drinking water plants) require some form of source control and/or

pretreatment program. For example, National Pollutant Discharge Elimination System (NPDES) permits issued to POTWs typically require a pretreatment program that generally is focused on the protection of POTW operations. Over time, in some cases, this requirement shifted to include source control efforts as part of POTW permit compliance with water-quality based receiving water objectives. As part of regulating safe drinking water, watershed protection and source control focuses on protecting the source waters for public consumption. Thus, the pretreatment/source control program needs to be a credible barrier for the entire reclaimed water project. An additional level of scrutiny is needed as part of developing clear regulations that requires considering potential risks to the public through the drinking water supply and which contaminants are of concern today and which could be of concern tomorrow.

- Further clarification is necessary regarding the intention of the recycled water source control programs to prevent sources of contaminants unrelated to typical residential activity and dischargers (e.g., hospitals), as well as on informing the public about discharging contaminants down the drain (e.g., pesticides, pharmaceuticals).

- Further clarification and focus is necessary for potential recycled water projects that receive a significant (as defined by the State Board) contribution of wastewater from industrial sources. Questions may arise about contaminants from, for example, the biotechnology industry, nano-manufacturing, and wastewater mostly comprised of commercial and industrial operations.

4.4 Pathogens and Chemicals Comments

Panel questions and comments regarding the draft sections currently identified as 60321.001, 60321.003, and 60321.005 are provided below.

- If alternative treatment processes are proposed, it is unclear what criteria will be used to evaluate "equivalency." The State Board should provide the rationale for determining what constitutes equivalent treatment and reliability.

- What is the basis for the log reduction criteria listed in Section 60321.003, particularly those included in Part (c)? Further, this section should specify log reduction credits for both the reservoir and treatment plant.

- Clarify and/or correct requirements contained in the groundwater replenishment regulations and how they are included as part of the draft IPR criteria. For example, the total organic carbon (TOC) limit to verify reverse osmosis performance is different than that imposed for groundwater recharge projects, and there appears to be no TOC limit for the treated recycled water. The rationale for these changes should be provided.

- Provide technical rationale and references supporting assumptions for microbial log reduction credits that could be given to the reservoir – and how it is measured.

- Clarify criteria and the technical basis for allowing or not allowing log reduction credits in reservoirs.

4.5 Monitoring Comments

The preliminary comments below pertain to Section 60321.008 "Monitoring between a SWSAP Recycled Water Discharge and Domestic Water Supply Withdrawal Point" (page 11).

- The document indicates that monitoring should be undertaken for the following reasons: providing baseline data to (1) determine potential impacts of the recycled water discharge on water quality; and (2) identify treatment failures. The Panel questions the value of quarterly monitoring for detecting treatment failures. Additional clarification and specificity are needed regarding the location, parameters, and frequency of monitoring to address the above noted question.

- If primary or secondary contact will or may occur in reservoirs, then some type of regular monitoring needs to be considered to ensure recreational water quality criteria are being met. This monitoring, however, may be primarily for indicators; thus, a special baseline investigation prior to the initiation of an IPR project may be needed for key pathogens of concern in regard to addressing new pathogen inputs to the reservoir from the treated water.

- Pathogen monitoring will not *necessarily* provide failure information. The Panel believes that the State Board needs to consider an adaptive monitoring program with higher frequency testing initially scaled down as the number of samples increases (this can be addressed yearly to adjust the sampling strategy rather than just starting off with quarterly sampling). Human viruses may appear in reservoirs if there is recreation, as well as parasites from animals. In addition, the State Board should consider the need for both initial and future routine monitoring efforts in the reservoir prior to the introduction of treated source water. Factors such as sample location(s), seasonal variability, hydrodynamic changes, and the potential for surface runoff impacts need to be considered. More detail and scientific background is needed for Section 60321.008. New inputs of pathogens should not be seen when recycled water is added to the reservoir.

- Item (c)(2) in Section 60321.008 involving monitoring results for a coliform maximum contaminant level should be deleted as this appears to be included in error.

- Adding water with lower total dissolved solids could cause the mobilization of certain water constituents present in sediments by solubilization depending upon local geology. Is this a potential problem? If so, how will it be recognized and managed?

- The Panel was interested in the State Board's opinions about potential public health threats associated with toxic inorganic substances.

- Because of concerns about potential public health and water quality problems, the Panel would like to review the constituents and characteristics to be included in the monitoring program. Specifically, the Panel would like to receive a copy of the regulation sections mentioned in Section 60321.008 (b)(1) and (b)(2). In addition, there seems to be a need to clarify the relationship between Section 60321.006 "Additional Chemical and Constituent Monitoring" (which is on treatment and reservoir monitoring) and Section 60321.008 (reservoir monitoring and frequency).

- Sanitary surveys and other structures need to be incorporated into this regulatory process and/or clearly explained if they are part of other Clean Water Act, California Water Code, and Safe Drinking Water Act regulations.

4.6 Comments on Other Topics: Reservoir Receiving Water Quality and Other Beneficial Uses, Operator Training and Certification, Public Outreach, Health Surveillance, and Emergency Operation and Water Supply

The Panel had a number of preliminary comments and questions as part its initial discussion with State Board staff on the draft surface water augmentation IPR criteria covering a number of other subjects, as noted above. Overall, the Panel notes:

Reservoir Water Quality and Other Beneficial Uses

- The draft criteria seem to be directed towards a non-contaminated isolated reservoir with the only inputs being clean river flow, clean groundwater flow, and/or non-contaminated surface run-off, plus the suitably treated wastewater under consideration. How will variations in quantity and quality of each of the above water sources be considered?

- The Panel cautions that the full set of beneficial uses for the reservoirs should be considered. Multiple beneficial uses can be allowed and are usually encouraged on reservoirs, including boating, kayaking, and swimming. Therefore, impacts beyond those activities on drinking water should be considered as part of SWA. An example of potential impacts includes raising the temperature of the reservoir (which could increase the likelihood of algal blooms – specifically, cyanobacteria blooms – and create an environment more conducive to the growth and survival of thermophilic microorganisms, some of which could be opportunistic pathogens).

- The ecological function of the reservoir could change as part of a SWA-IPR project. Thus, it may be necessary to initially characterize and then track water quality parameters, as well as biota, annually or more frequently to observe changes.

Operator Training and Certification

- POTW operators must be certified to ensure the proper and reliable operation of wastewater treatment plants to meet NPDES discharge requirements, and water system operators must be certified to ensure that systems are operated safely and produce safe potable water. The successful operation of IPR projects that adequately protect public

health will continue to require some of both types of operators and certifications and may also require a new operator and certification that bridges the boundary between these two very distinct types of plants.

Public Outreach

- Consider adding health education as an element of IPR regulations.

Health Surveillance

- Explore the feasibility of public health effects surveillance (implement a surveillance program, not epidemiological studies) approach and framework relative to human exposure and potential adverse health effects from IPR and/or DPR.

Emergency Operation and Water Supply

- Provision for emergency operation and water supply are absolutely necessary for the adequate protection of public health. A clear and transparent discussion of how this will be managed should be required of every project proposing a recycled water plan for potable reuse. The Panel will have additional comments on this subject as it reviews and better understands the definition of terms used within the criteria, specific objective(s) that the criteria are meant to achieve, and inter-relationship between the disparate sections in the draft criteria.

4.7 Recommendations and Next Steps

The overall focus of the next Panel meeting is on continuing the Panel review of the draft IPR criteria. Given the uncertainty associated with understanding the draft reservoir criteria, the Panel recommends that this subject should be the initial focus of the next Panel meeting. The goal of the next meeting should be as follows:

Reservoir Criteria

1) Technical briefing of the Panel by the technical modeling staff who conducted the water quality modeling that formed the basis of the draft criteria.

   Outcome – Panel understanding of modeling conducted and modeling assumptions and products, which should allow a review of its adequacy for the task.

2) Briefing by Panel member Dr. Michael Anderson on translating and linking the modeling results to the draft criteria.

3) Panel discussion with State Board staff on the intent of the reservoir criteria and technical basis.

Outcome – Panel review and discussion of the draft comments and recommendations prepared by Dr. Anderson, which should lead to Panel consensus on comments to State Board staff on criteria.

Continue Review of Draft SWA-IPR Criteria

1) Review other sections of the draft IPR criteria with State Board staff (requesting that the State Board staff provide a clear statement about the objective[s] of each section and the basis supporting the need for the section).

   Outcome – Understand the basic objective(s) of the language, technical/scientific basis supporting the language, and inter-relationship between the various regulatory sections of the proposed criteria relative to meet the Panel charge provided in the California Water Code.

CALIFORNIA WATER CODE
CHAPTER 7.3 DIRECT AND INDIRECT POTABLE REUSE
SECTION 13560-13569

13560. The Legislature finds and declares the following:

(a) In February 2009, the state board unanimously adopted, as Resolution No. 2009-0011, an updated water recycling policy, which includes the goal of increasing the use of recycled water in the state over 2002 levels by at least 1,000,000 acre-feet per year by 2020 and by at least 2,000,000 acre-feet per year by 2030.

(b) Section 13521 requires the department to establish uniform statewide recycling criteria for each varying type of use of recycled water where the use involves the protection of public health.

(c) The use of recycled water for indirect potable reuse is critical to achieving the state board's goals for increased use of recycled water in the state. If direct potable reuse can be demonstrated to be safe and feasible, implementing direct potable reuse would further aid in achieving the state board's recycling goals.

(d) Although there has been much scientific research on public health issues associated with indirect potable reuse through groundwater recharge, there are a number of significant unanswered questions regarding indirect potable reuse through surface water augmentation and direct potable reuse.

(e) Achievement of the state's goals depends on the timely development of uniform statewide recycling criteria for indirect and direct potable water reuse.

(f) This chapter is not intended to delay, invalidate, or reverse any study or project, or development of regulations by the department, the state board, or the regional boards regarding the use of recycled water for indirect potable reuse for groundwater recharge, surface water augmentation, or direct potable reuse.

(g) This chapter shall not be construed to delay, invalidate, or reverse the department's ongoing review of projects consistent with Section 116551 of the Health and Safety Code.

13561. For purposes of this chapter, the following terms have the following meanings:

(a) "Department" means the State Department of Public Health.

(b) "Direct potable reuse" means the planned introduction of recycled water either directly into a public water system, as defined in Section 116275 of the Health and Safety Code, or into a raw water supply immediately upstream of a water treatment plant.

(c) "Indirect potable reuse for groundwater recharge" means the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, as defined in Section 116275 of the Health and Safety Code.

(d) "Surface water augmentation" means the planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply.

(e) "Uniform water recycling criteria" has the same meaning as in Section 13521.

13561.5. The state board shall enter into an agreement with the department to assist in implementing this chapter.

13562. (a) (1) On or before December 31, 2013, the department shall adopt uniform water recycling criteria for indirect potable reuse for groundwater recharge.

(2) (A) Except as provided in subparagraph (C), on or before December 31, 2016, the department shall develop and adopt uniform water recycling criteria for surface water augmentation.

(B) Prior to adopting uniform water recycling criteria for surface water augmentation, the department shall submit the proposed criteria to the expert panel convened pursuant to subdivision (a) of Section 13565. The expert panel shall review the proposed criteria and shall adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health.

(C) The department shall not adopt uniform water recycling criteria for surface water augmentation pursuant to subparagraph (A), unless and until the expert panel adopts a finding that the proposed criteria would adequately protect public health.

(b) Adoption of uniform water recycling criteria by the department is subject to the requirements of Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code.

13562.5. Notwithstanding any other law, no later than June 30, 2014, the department shall adopt, by emergency regulations in accordance with Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, requirements for groundwater replenishment using recycled water. The adoption of these regulations is an emergency and shall be considered by the Office of Administrative Law as necessary for the immediate preservation of the public peace, health, safety, and general welfare. Notwithstanding Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, emergency regulations adopted by the department pursuant to this section shall not be subject to review by the Office of Administrative Law and shall remain in effect until revised by the department.

13563. (a) (1) On or before December 31, 2016, the department, in consultation with the state board, shall investigate and report to the Legislature on the feasibility of developing uniform water recycling criteria for direct potable reuse.

(2) The department shall complete a public review draft of its report by September 1, 2016. The department shall provide the public not less than 45 days to review and comment on the public review draft.

(3) The department shall provide a final report to the Legislature

by December 31, 2016. The department shall make the final report available to the public.

(b) In conducting the investigation pursuant to subdivision (a), the department shall examine all of the following:

(1) The availability and reliability of recycled water treatment technologies necessary to ensure the protection of public health.

(2) Multiple barriers and sequential treatment processes that may be appropriate at wastewater and water treatment facilities.

(3) Available information on health effects.

(4) Mechanisms that should be employed to protect public health if problems are found in recycled water that is being served to the public as a potable water supply, including, but not limited to, the failure of treatment systems at the recycled water treatment facility.

(5) Monitoring needed to ensure protection of public health, including, but not limited to, the identification of appropriate indicator and surrogate constituents.

(6) Any other scientific or technical issues that may be necessary, including, but not limited to, the need for additional research.

(c) (1) Notwithstanding Section 10231.5 of the Government Code, the requirement for submitting a report imposed under paragraph (3) of subdivision (a) is inoperative on December 31, 2020.

(2) A report to be submitted pursuant to paragraph (3) of subdivision (a) shall be submitted in compliance with Section 9795 of the Government Code.

13563.5. (a) The department, in consultation with the state board, shall report to the Legislature as part of the annual budget process, in each year from 2011 to 2016, inclusive, on the progress towards developing and adopting uniform water recycling criteria for surface water augmentation and its investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse.

(b) (1) A written report submitted pursuant to subdivision (a) shall be submitted in compliance with Section 9795 of the Government Code.

(2) Pursuant to Section 10231.5 of the Government Code, this section is repealed on January 1, 2017.

13564. In developing uniform water recycling criteria for surface water augmentation, the department shall consider all of the following:

(a) The final report from the National Water Research Institute Independent Advisory Panel for the City of San Diego Indirect Potable Reuse/Reservoir Augmentation (IPR/RA) Demonstration Project.

(b) Monitoring results of research and studies regarding surface water augmentation.

(c) Results of demonstration studies conducted for purposes of approval of projects using surface water augmentation.

(d) Epidemiological studies and risk assessments associated with projects using surface water augmentation.

(e) Applicability of the advanced treatment technologies required for recycled water projects, including, but not limited to, indirect potable reuse for groundwater recharge projects.

(f) Water quality, limnology, and health risk assessments

associated with existing potable water supplies subject to discharges from municipal wastewater, stormwater, and agricultural runoff.

(g) Recommendations of the State of California Constituents of Emerging Concern Recycled Water Policy Science Advisory Panel.

(h) State funded research pursuant to Section 79144 and subdivision (b) of Section 79145.

(i) Research and recommendations from the United States Environmental Protection Agency Guidelines for Water Reuse.

(j) The National Research Council of the National Academies' report titled "Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater."

(k) Other relevant research and studies regarding indirect potable reuse of recycled water.

13565. (a) (1) On or before February 15, 2014, the department shall convene and administer an expert panel for purposes of advising the department on public health issues and scientific and technical matters regarding development of uniform water recycling criteria for indirect potable reuse through surface water augmentation and investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse. The expert panel shall assess what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for direct potable reuse. The expert panel shall then recommend an approach for accomplishing any additional needed research regarding uniform criteria for direct potable reuse in a timely manner.

(2) The expert panel shall be comprised, at a minimum, of a toxicologist, an engineer licensed in the state with at least three years' experience in wastewater treatment, an engineer licensed in the state with at least three years' experience in treatment of drinking water supplies and knowledge of drinking water standards, an epidemiologist, a limnologist, a microbiologist, and a chemist. The department, in consultation with the advisory group and the state board, shall select the expert panel members.

(3) Members of the expert panel may be reimbursed for reasonable and necessary travel expenses.

(b) (1) On or before January 15, 2014, the department shall convene an advisory group, task force, or other group, comprised of no fewer than nine representatives of water and wastewater agencies, local public health officers, environmental organizations, environmental justice organizations, public health nongovernmental organizations, the department, the state board, the United States Environmental Protection Agency, ratepayer or taxpayer advocate organizations, and the business community, to advise the expert panel regarding the development of uniform water recycling criteria for direct potable reuse and the draft report required by Section 13563. The department, in consultation with the state board, shall select the advisory group members.

(2) Environmental, environmental justice, and public health nongovernmental organization representative members of the advisory group, task force, or other group may be reimbursed for reasonable and necessary travel expenses.

(3) In order to ensure public transparency, the advisory group established pursuant to paragraph (1) shall be subject to the Bagley-Keene Open Meeting Act (Article 9 (commencing with Section 11120) of Chapter 1 of Part 1 of Division 3 of Title 2 of the

Government Code).

(c) On or before June 30, 2016, the department shall prepare a draft report summarizing the recommendations of the expert panel.

(d) The department may contract with a public university or other research institution with experience in convening expert panels on water quality or potable reuse to meet all or part of the requirements of this section should the department find that the research institution is better able to fulfill the requirements of this section by the required date.

13566. In performing its investigation of the feasibility of developing the uniform water recycling criteria for direct potable reuse, the department shall consider all of the following:

(a) Recommendations from the expert panel appointed pursuant to subdivision (a) of Section 13565.

(b) Recommendations from an advisory group, task force, or other group appointed by the department pursuant to subdivision (b) of Section 13565.

(c) Regulations and guidelines for these activities from jurisdictions in other states, the federal government, or other countries.

(d) Research by the state board regarding unregulated pollutants, as developed pursuant to Section 10 of the recycled water policy adopted by state board Resolution No. 2009-0011.

(e) Results of investigations pursuant to Section 13563.

(f) Water quality and health risk assessments associated with existing potable water supplies subject to discharges from municipal wastewater, stormwater, and agricultural runoff.

13567. An action authorized pursuant to this chapter shall be consistent, to the extent applicable, with the federal Clean Water Act (33 U.S.C. Sec. 1251 et seq.), the federal Safe Drinking Water Act (42 U.S.C. Sec. 300f et seq.), this division, and the California Safe Drinking Water Act (Chapter 4 (commencing with Section 116270) of Part 12 of Division 104 of the Health and Safety Code).

13569. The department may accept funds from nonstate sources and may expend these funds, upon appropriation by the Legislature, for the purposes of this chapter.

APPENDIX B: Panel Background

About NWRI

For over 20 years, NWRI – a science-based 501c3 nonprofit located in Fountain Valley, California – has sponsored projects and programs to improve water quality, protect public health and the environment, and create safe, new sources of water. NWRI specializes in working with researchers across the country, such as laboratories at universities and water agencies, and are guided by a Research Advisory Board (representing national expertise in water, wastewater, and water reuse) and a six-member Board of Directors (representing water and wastewater agencies in Southern California).

Through NWRI's research program, NWRI supports multi-disciplinary research projects with partners and collaborators that pertain to treatment and monitoring, water quality assessment, knowledge management, and exploratory research. Altogether, NWRI's research program has produced over 300 publications and conference presentations.

NWRI also promotes better science and technology through extensive outreach and educational activities, which includes facilitating workshops and conferences and publishing White Papers, guidance manuals, and other informational material.

More information on NWRI can be found online at www.nwri-usa.org.

About NWRI Panels

NWRI also specializes in facilitating Independent Advisory Panels on behalf of water and wastewater utilities, as well as local, county, and state government agencies, to provide credible, objective review of scientific studies and projects in the water industry. NWRI Panels consist of academics, industry professionals, government representatives, and independent consultants who are experts in their fields.

The NWRI Panel process provides numerous benefits, including:

- Third-party review and evaluation.
- Scientific and technical advice by leading experts.
- Assistance with challenging scientific questions and regulatory requirements.
- Validation of proposed project objectives.
- Increased credibility with stakeholders and the public.
- Support of sound public-policy decisions.

NWRI has extensive experience in developing, coordinating, facilitating, and managing expert Panels. Efforts include:

- Selecting individuals with the appropriate expertise, background, credibility, and level of commitment to serve as Panel members.

- Facilitating hands-on Panel meetings held at the project's site or location.
- Providing written report(s) prepared by the Panel that focus on findings and comments of various technical, scientific, and public health aspects of the project or study.

Over the past 5 years, NWRI has coordinated the efforts of over 20 Panels for water and wastewater utilities, city and state agencies, and consulting firms. Many of these Panels have dealt with projects or policies involving groundwater replenishment and potable (indirect and direct) reuse. Specifically, these Panels have provided peer review of a wide range of scientific and technical areas related water quality and monitoring, constituents of emerging concern, treatment technologies and operations, public health, hydrogeology, water reuse criteria and regulatory requirements, and outreach, among others.

Examples of recent NWRI Panels include:

- **Development of Water Recycling Criteria for Indirect Potable Reuse through Surface Water Augmentation and the Feasibility of Developing Criteria for Direct Potable Reuse** for the State Water Resources control Board Division of Drinking Water (CA)
- **Evaluating Water Quality Testing at the Silicon Valley Advanced Water Purification Center for Future Potable Reuse Applications** for the Santa Clara Valley Water District (CA)
- **Developing Proposed Direct Potable Reuse Operational Procedures and Guidelines for New Mexico** for the New Mexico Environment Department (NM)
- **Monterey Peninsula Groundwater Replenishment Project** for the Monterey Regional Water Pollution Control Agency (CA)
- **Groundwater Recharge Scientific Study** for the LOTT Clean Water Alliance (WA)
- **Groundwater Replenishment System Program Review** for the Orange County Water District (CA)
- **Examining the Criteria for Direct Potable Reuse** for Trussell Technologies (CA) and WateReuse Research Foundation (VA)
- **Evaluating Potable Reuse** for the Santa Clara Valley Water District (CA)
- **Indirect Potable Reuse/Reservoir Augmentation Project Review** for the City of San Diego (CA)
- **BDOC as a Surrogate for Organics Removal in Groundwater Recharge** for the California Department of Public Health (CA)
- **Recycled Water Master Plan** for Tucson Water (AZ)
- **Groundwater Replenishment Project Review** for the Los Angeles Department of Water and Power (CA)

More information about the NWRI Independent Advisory Panel Program can be found on the NWRI website at http://nwri-usa.org/Panels.htm.

APPENDIX C: Panel Member Biographies

Adam Olivieri, Ph.D., P.E. (Panel Co-Chair)
Vice President
EOA Inc. (Oakland, CA)

Adam Olivieri has 35 years of experience in the technical and regulatory aspects of water recycling, groundwater contamination by hazardous materials, water quality and public health risk assessments, water quality planning, wastewater facility planning, urban runoff management, and on-site waste treatment systems. He has gained this experience through working as a staff engineer with the California Regional Water Quality Control Board (San Francisco Bay Region), as staff specialist (and Post-doc fellow) with the School of Public Health at the University of California, Berkeley, project manager/researcher for the Public Health Institute, and as a consulting engineer. He is currently the Vice president of EOA, Inc., where he manages a variety of projects, including serving as Santa Clara County Urban Runoff Program's Manager since 1998. Olivieri is also the author or co-author of numerous technical publications and project reports. He received a B.S. in Civil Engineering from the University of Connecticut, an M.S. in Civil and Sanitary Engineering from the University of Connecticut, and both an MPH and Dr.PH in Environmental Health Sciences from University of California, Berkeley.

James Crook, Ph.D., P.E. (Panel Co-Chair)
Water Reuse and Environmental Engineering Consultant (Boston, MA)

Jim Crook is an environmental engineer with more than 35 years of experience in state government and consulting engineering arenas, serving public and private sectors in the U.S. and abroad. He has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. He has been involved in numerous projects and research activities involving public health, regulations and permitting, water quality, risk assessment, treatment technology, and all facets of water 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 also spent 15 years with consulting firms overseeing water reuse activities and is now an independent consultant specializing in water reuse. He currently serves on several advisory panels and committees sponsored by NWRI and others. Among his honors, he was selected as the American Academy of Environmental Engineers' 2002 Kappe Lecturer and the WateReuse Association's 2005 Person of the Year. Crook received a B.S. in Civil Engineering from the University of Massachusetts and both an M.S. and Ph.D. in Environmental Engineering from the University of Cincinnati.

Michael Anderson, Ph.D.
Professor of Applied Limnology and Environmental Chemistry and Chair
Department of Environmental Sciences

University of California, Riverside (Riverside, CA)

Michael Anderson, a Professor of Applied Limnology and Environmental Chemistry, has taught courses at the University of California, Riverside, since 1990. His research focus includes water and soil sciences, with particular emphasis in applied limnology and lake/reservoir management; surface water quality and modeling; fate of contaminants in waters, soils, and sediments; and environmental chemistry. Current research projects include laboratory, field, and modeling studies in support of the development of species conservation habitat at the Salton Sea, sponsored by the California DWR and DFG, and a survey of organochlorine pesticides and Polychlorinated Biphenyls (PCBs) in McGrath Lake that is funded by the Los Angeles Regional Water Quality Control Board. He and his students also recently completed studies quantifying the abundance and distribution of quagga mussel veligers in the reservoirs of the Colorado River Aqueduct, as well as assessing the ecological and biological conditions at Lake Elsinore. In addition, he has served on various panels and workgroups, including as member of the California Department of Water Resource's Salton Sea Hydrologic Technical Workgroup (2007-2008). Anderson received a B.S. in Biology from Illinois Benedictine College, M.S. in Environmental Studies from Bemidji State University, and Ph.D. in Environmental Chemistry from Virginia Tech.

Richard Bull, Ph.D.
Consulting Toxicologist
MoBull Consulting (Richland, WA)

Since 2000, Richard Bull has been a Consulting Toxicologist with MoBull Consulting, where he conducts studies on the chemical problems encountered in water for water utilities, as well as federal, state, and local governments. Bull is a Professor Emeritus at Washington State University, where he maintains Adjunct Professor appointments in the College of Pharmacy and the Department of Environmental Science. Formerly, he served as a senior staff scientist at DOE's Pacific Northwest National Laboratory, Professor of Pharmacology/Toxicology at Washington State University, and Director of the Toxicology and Microbiology Division in the Cincinnati Laboratories for the U.S. Environmental Protection Agency. Bull has published extensively on research on central nervous system effects of heavy metals, the carcinogenic and toxicological effects of disinfectants and disinfection by-products, halogenated solvents, acrylamide, and other contaminants of drinking water. He has also served on many international scientific committees convened by the National Academy of Sciences, World Health Organization, and International Agency for Research on Cancer regarding various contaminants of drinking water. Bull received a B.S. in Pharmacy from the University of Washington and a Ph.D. in Pharmacology from the University of California, San Francisco.

Dr.-Ing. Jörg E. Drewes
Chair Professor, Chair of Urban Water Systems Engineering
Technische Universität München (Munich, Germany)

Jörg Drewes joined the Technische Universität München in 2013. Prior, he was a professor in the Department of Civil and Environmental Engineering at Colorado School of Mines (CSM), where he taught from 2001 to 2013. While at CSM, he served as the Director of Research for the National Science Foundation's Engineering Research Center *ReNUWIt* (which included Stanford University, University of California Berkeley, New Mexico State University, and CSM). He also served as Co-Director of CSM's Advanced Water Technology Center (AQWATEC). Drewes is actively involved in research in the areas of energy efficient water treatment and non-potable and potable water reuse. Current research interests include treatment technologies leading to potable reuse and the fate and transport of persistent organic compounds in these systems. He has published more than 250 journal papers, book contributions, and conference proceedings, and served on National Research Council Committees on *Water Reuse as an Approach for Meeting Future Water Supply Needs* and *Onsite Reuse of Graywater and Stormwater*. He also currently serves as Chair of the International Water Association (IWA) Water Reuse Specialist Group. Drewes received a Cand. Ing. (B.S.), Dipl. Ing. (M.S.), and Doctorate (Dr.-Ing.) in Environmental Engineering from the Technical University of Berlin, Germany.

Charles Haas, Ph.D.
Department Head, L.D. Betz Professor of Environmental Engineering
Drexel University (Philadelphia, PA)

Charles Haas is the Department Head of the Civil, Architectural, and Environmental Engineering at Drexel University since 1991. He is also the L.D. Betz Professor of Environmental Engineering and Director of the Drexel Engineering Cities Initiative. Prior to joining Drexel, he served on the faculties of Rensselaer Polytechnic Institute and the Illinois Institute of Technology. Haas specializes in water treatment, risk assessment, environmental modeling and statistics, microbiology, and environmental health. He received a B.S. in Biology and M.S. in Environmental Engineering, both from the Illinois Institute of Technology. He also received a Ph.D. in Environmental Engineering from the University of Illinois at Urbana-Champaign.

Walter Jakubowski, M.S.
Consultant
WaltJay Consulting (Spokane, WA)

Walter Jakubowski has degrees in Pharmacy from Brooklyn College of Pharmacy, Long Island University; in microbiology from Oregon State University, and graduate training in epidemiology from the University of Minnesota. He has research publications on hospital pharmacy; on microorganisms in oysters and clams under the federal Shellfish Sanitation Program, and more than 40 peer-reviewed publications on determining the health effects and public health significance of pathogens, especially intestinal protozoa and viruses, in drinking water, waste water and municipal sewage sludge. He has served as a consultant to the World

Health Organization on pathogenic intestinal protozoa (for development of the International Drinking Water Guidelines), and to the Pan-American Health Organization on environmental virus methods. He was instrumental in conducting the first international symposium on *Legionella* and Legionnaire's Disease at the Centers for Disease Control. He has more than 48 years of experience working with waterborne pathogens, especially enteric viruses, *Giardia* and *Cryptosporidium.* He initiated landmark studies on the human infectious dose of *Cryptosporidium* and chaired the Joint Task Group on Pathogenic Intestinal Protozoa for *Standard Methods for the Examination of Water and Waste Water* from 1978 to 2005. He was a charter member of U.S. Environmental Protection Agency's Pathogen Equivalency Committee and served on that committee until his retirement from the U.S. Public Health Service/Environmental Protection Agency in 1997. Since then, he has been practicing as a private consultant while serving on various professional committees, panels, and boards.

Perry McCarty, Sc.D.
Silas H. Palmer Professor of Civil and Environmental Engr. Emeritus
Stanford University (Stanford, CA)

Perry McCarty is the Silas H. Palmer Professor of Civil and Environmental Engineering Emeritus at Stanford University. McCarty received the Clarke Prize Award in 1997 for his significant contributions to the areas of water treatment, reclamation, groundwater recharge, and water chemistry and microbiology. He is universally recognized for his research on understanding contaminant behavior in groundwater aquifers and sediments. McCarty has received numerous honors, including being elected to the National Academy of Engineering and American Academy of Arts and Sciences, as well as receiving an honorary doctorate from the Colorado School of Mines. He was also awarded the John and Alice Tyler Prize for Environmental Achievement in 1992 and the Stockholm Water Prize in 2007. McCarty received his B.S. from Wayne State University, and both his M.S. and Sc.D. from Massachusetts Institute of Technology.

Kara Nelson, Ph.D.
Professor
University of California, Berkeley (Berkeley, CA)

Kara Nelson is a Professor in Civil and Environmental Engineering at the University of California, Berkeley. She received her B.A. degree in biophysics from U.C. Berkeley, her M.S.E. degree in environmental engineering from the University of Washington, and her Ph.D. in environmental engineering from U.C. Davis. Her research program addresses critical issues at the intersection of public health and the environment, with a focus on reducing the threat posed by waterborne pathogens by improving our engineering infrastructure to make it more effective, affordable, as well as maximize its environmental benefits. Specific research areas include mechanisms of pathogen inactivation, molecular techniques for pathogen detection, optimizing treatment processes, water reuse, and challenges with providing safe drinking water and

sanitation in the developing world. Dr. Nelson has published over 50 articles in peer-reviewed journals, including two invited reviews, and one book chapter. She is the Director of Graduate Education at the National Science Foundation Engineering Research Center for Reinventing our Nation's Urban Water Infrastructure (ReNUWIt), the faculty leader of the Research Thrust Area on Safe Water and Sanitation at Berkeley Water Center. Dr. Nelson was awarded the Presidential Early Career Award for Scientists and Engineers (PECASE) at a ceremony in the White House in 2004. This award is the nation's highest honor for scientists in the early stages of their career.

Joan B. Rose, Ph.D.
Homer Nowlin Endowed Chair for Water Research
Michigan State University (East Lansing, MI)

Joan Rose, a professor at Michigan State University, has made groundbreaking advances in understanding water quality and protecting public health for more than 20 years and has published over 300 articles. She is widely regarded as the world's foremost authority on the microorganism *Cryptosporidium* and was the first person to present a method for detecting this pathogen in water supplies. She examines full-scale water treatment systems for the removal of pathogens. In 2001, she received the Athalie Richardson Irvine Clarke Prize from NWRI for her advances in microbial water-quality issues. She served as the Chair of the Science Advisory Board for the U.S. Environmental Protection Agency's Drinking Water Committee for 4 years, and currently serves on the Science Advisory Board for the Great Lakes. In addition, she is Co-Director of the Center for Water Sciences (which includes work with the Great Lakes and Human Health Center of the National Oceanic & Atmospheric Administration) at Michigan State University, where she is also Director of the Center for Advancing Microbial Risk Assessment. Rose received a B.S. in Microbiology from the University of Arizona, an M.S. in Microbiology from the University of Wyoming, and a Ph.D. in Microbiology from the University of Arizona.

David Sedlak, Ph.D.
Malozemoff Professor, Department of Civil and Environmental Engineering
University of California, Berkeley (Berkeley, CA)

David Sedlak is a Professor of Civil and Environmental Engineering at the University of California, Berkeley. He is also Co-Director of the Berkeley Water Center and Deputy Director of the National Science Foundation's Engineering Research Center for Reinventing the Nation's Urban Water Infrastructure (ReNUWIt). His research focus is on the fate of chemical contaminants, with the long-term goal of developing cost-effective, safe, and sustainable systems to manage water resources. Sedlak's previous experience includes Staff Scientist at ENVIRON Corporation and membership on the National Research Council's Committee on Water Reuse. He has individually or co-authored over 70 peer-reviewed publications, among many other publications and presentations. Sedlak published a book in 2014 called "Water 4.0: The Past, Present, and Future of The World's Most Vital Resource," where he points out that most of the

population gives little thought to the hidden systems that bring us water and take it away and how these marvels of engineering face challenges that cannot be solved without a fundamental change to our relationship with water. Sedlak received a B.S. in Environmental Science from Cornell University and a Ph.D. in Water Chemistry from the University of Wisconsin.

Tim Wade, Ph.D.
Epidemiology Branch Chief
United States Environmental Protection Agency (Durham, NC)

Tim Wade is the Epidemiology Branch Chief at the United States Environmental Protection Agency (U.S. EPA) and Assistant Professor of Epidemiology at the University of North Carolina, Chapel Hill. Wade has been working with the U.S. EPA since 2005, conducting a series of epidemiologic studies to evaluate the health effects of arsenic exposure in well water in Inner Mongolia. As Branch Chief, Wade determines research priorities, directs staff and post-doctoral students, and manages an annual budget of over $1 million annually. In 2011, Wade received the EPA Office of Water Bronze Medal for his exceptional service to the Office of Water in the development of recreational water quality criteria. He received a B.A. in Biological Science from California Polytechnic at Pomona, a B.A. in Psychobiology from Claremont McKenna College, and both an MPH and Ph.D. in Epidemiology from the University of California at Berkeley.

NATIONAL WATER RESEARCH INSTITUTE

Expert Panel:

SWRCB's Division of Drinking Water: Development of Water Recycling Criteria for Indirect Potable Reuse through Surface Water Augmentation and the Feasibility of Developing Criteria for Direct Potable Reuse

Meeting #2 Final Agenda

July 24-25, 2014

Location
Orange County Water District
18700 Ward St
Fountain Valley, CA 92708
Board Room

Contacts:
Jeff Mosher (Cell)
714-705-3722
Brandi Caskey (NWRI Office)
(714) 378-3278

Meeting Objectives:

- Review State mandate and Panel Charge.
- Review draft Surface Water Augmentation Criteria.
- Review approach for assessing feasibility of DPR criteria
- Receive an update on DPR research efforts to date.

Thursday, July 24, 2014

8:30 am	Agenda Item #1: Welcome and Introductions	Jeff Mosher, NWRI Adam Olivieri and Jim Crook, Co-Chairs
8:45 am	Agenda Item #2: Review Agenda and Purpose of Meeting	Co-Chairs
9:00 am	Agenda Item #3: Summary of Panel Activities (Meeting #1)	Jeff Mosher, NWRI
DDW Perspective and Panel Overview		
9:15 am	Agenda Item #4: Statuary Mandates and Specific Tasks of the Panel	Mike McKibben, DDW
9:30 am	Panel Discussion	Co-Chairs

Review Draft DDW Surface Water Augmentation Criteria

9:45 am	Agenda Item #5: Overview of Regulatory Process and Regulatory Feasibility	Mike McKibben, DDW
10:00 am	Discussion	
10:15 am	**BREAK**	
10:30 am	Agenda Item #6: Overview of Preliminary Surface Water Augmentation Criteria	Bob Hultquist, DDW
11:30 am	Panel Discussion	Co-Chairs
12:00 noon	**LUNCH**	

DPR Research Update

1:00 pm	Agenda Item #7: Overview of DPR Research Initiative Efforts	Doug Owen, Vice Chair, WateReuse Research Foundation
1:20 pm	Panel Discussion	Co-Chairs

Approach to DPR Criteria Review

1:30 am	Agenda Item #8: Briefing on Potable Reuse in California	Bob Hultquist, DDW Brian Bernados, DDW
2:45 pm	Panel Discussion	Co-Chairs
3:15 pm	**BREAK**	
3:30 pm	Agenda Item #9: DPR Advisory Committee Update	Mike Wehner, OCWD
3:50 pm	Panel Discussion	Co-Chairs

Open Session Discussion

4:00 pm	Open discussion	Co-Chairs
5:00 pm	**ADJOURN**	

Friday, July 25, 2014

8:30 am	**CLOSED SESSION**	Co-Chairs
8:45 am	Review: - Surface Water Augmentation Criteria - DPR Research Status - Feasibility of DPR Criteria	

12:00 noon	**LUNCH**	
12:45 pm	Continue Panel Discussions	Co-Chairs
2:15 pm	Wrap-Up, Final Review, Schedule, Assignments, and Next Steps	Co-Chairs
2:45 pm	**ADJOURN**	

APPENDIX E: Meeting Attendees

Panel Members:

- *Panel Co-Chair:* Adam Olivieri, Dr.P.H., P.E., EOA, Inc. (Oakland, CA)
- *Panel Co-Chair:* James Crook, Ph.D., P.E., Water Reuse and Environmental Engineering Consultant (Boston, MA)
- Michael Anderson, Ph.D., University of California, Riverside (Riverside, CA)
- Richard Bull, Ph.D., MoBull Consulting (Richland, WA)
- Dr.-Ing. Jörg E. Drewes, Technische Universität München (Munich, Germany)
- Charles Haas, Ph.D., Drexel University (Philadelphia, PA)
- Walter Jakubowski, M.S., WaltJay Consulting (Spokane, Washington)
- Perry McCarty, Sc.D., Stanford University (Stanford, CA)
- Joan B. Rose, Ph.D., Michigan State University (East Lansing, MI)
- David Sedlak, Ph.D., University of California, Berkeley (Berkeley, CA)
- Tim Wade, Ph.D., United States Environmental Protection Agency (Durham, NC)

National Water Research Institute:

- Brandi Caskey, Events Manager
- Jeff Mosher, Executive Director
- Gina Vartanian, Outreach and Communications Manager

State Water Resources Control Board

- John Bishop, P.E., Chief Deputy Director

State Water Resources Control Board, Division of Drinking Water:

- Randy Barnard, P.E., Recycled Water Treatment Specialist
- Mike McKibben, P.E., Senior Engineer
- Brian Bernados, P.E., Technical Specialist
- Bob Hultquist, P.E., Drinking Water Program Expert

City Consultants:

- Rhodes Trussell, Ph.D., P.E., BCEE, NAE, CEO, Trussell Technologies, Inc.
- Shane Trussell, Ph.D., P.E., BCEE, President, Trussell Technologies, Inc.

WateReuse Research Foundation:

- Doug Owen, Executive Vice President and Chief Technical Officer, ARCADIS-US

Utility Representatives:

- Trevor Currie, Civil Engineering Associate, Los Angeles Department of Water and Power
- Albert Lau, P.E., Director of Engineering and Planning, Padre Dam Municipal Water District
- Jeff Pasek, Watershed Manager, City of San Diego
- Marsi Steirer, Deputy Director, City of San Diego

- Toby Roy, Water Resources Manager, San Diego County Water Authority
- Karen Scott, Senior Environmental Specialist, Metropolitan Water District of Southern California
- Chris Stacklin, P.E., Engineer, Environmental Compliance Division, Orange County Sanitation District
- Mike Wehner (Advisory Committee Member), Assistant General Manager, Orange County Water District