NWRI National Water Research Institute

Joint Powers Agreement Members

Inland Empire Utilities Agency

Irvine Ranch Water District

Los Angeles Department of Water and Power

Orange County Sanitation District

Orange County Water District

West Basin Municipal Water District

Jeffrey J. Mosher
Executive Director

E-mail:
jmosher@NWRI-USA.org

18700 Ward Street
P.O. Box 8096
Fountain Valley, California
92728-8096

(714) 378-3278
Fax: (714) 378-3375

www.NWRI-USA.org

Memorandum

To: Jing-Tying Chao, P.E.
Division of Drinking Water
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

From: Adam Olivieri, Dr.P.H., P.E., EOA, Inc.
Expert Panel Co-Chair

James Crook, Ph.D., P.E., Environmental Engineering Consultant
Expert Panel Co-Chair

Jeffrey J. Mosher, National Water Research Institute
Expert Panel Administrator

Subject: Expert Panel Draft Key Research Recommendations Related to the Development of Uniform Water Recycling Criteria for Direct Potable Reuse in the State of California (under SWRCB Agreement No. 13-21041)

Date: June 30, 2016

On behalf of the Expert Panel, the National Water Research Institute (NWRI) is pleased to transmit this memorandum to the California State Water Resources Control Board (State Water Board) regarding preliminary key research recommendations related to the feasibility of developing uniform water recycling criteria for direct potable reuse (DPR). Note that the key research recommendations are draft recommendations and may be edited or otherwise modified as the Expert Panel's report is finalized.

Charge of the Expert Panel

Per California Water Code Section 13565(a)(1), the Expert Panel is charged with advising the State Water Board on the "feasibility of developing uniform water recycling criteria for direct potable reuse (DPR). The expert panel shall assess what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for DPR. The expert panel shall then recommend an approach for accomplishing any additional needed research regarding uniform criteria for DPR in a timely manner."

The Panel finds that there is no need for additional research to be conducted to establish uniform water recycling criteria for DPR. However, there are some areas of research that would enhance the understanding and acceptability of DPR in the State of California. The Panel encourages the State Water Board to address the following research recommendations.

Current Status of DPR Research

The Expert Panel notes that applied research has played a significant role in advancing potable water reuse. During the 1990s, the State of California Department of Public Health (now the State Water Board's Division of Drinking Water) pioneered the development of analytical methods for monitoring chemical contaminants and identified compounds to be monitored at potable reuse facilities (i.e., the compounds for which Notification Levels have been established). More recently, the WateReuse Research Foundation (now called the Water Environment & Reuse Foundation) funded research projects on treatment technologies and performance reliability that have been instrumental to advancing DPR. The Expert Panel is impressed by the research that has been funded by the WateReuse Research Foundation and supports the continuation of such research.

Nonetheless, the Expert Panel has identified important areas not being addressed in the WateReuse Research Foundation's research program related to public health, including efforts to identify new contaminants of concern and develop better monitoring techniques. As such, the Expert Panel believes the State Water Board or other agencies that have expertise in this area (e.g., the Department of Toxic Substances Control) should provide oversight and direction for research efforts designed to address these areas.

Expert Panel Research Recommendations for California

The Expert Panel identified several areas of research, as described below, that should be conducted to further ensure the protectiveness of DPR, which would best be supported directly by the State of California. The Expert Panel notes that the recommendations could be done either before and/or concurrent with the development of DPR criteria. While the results of the research could be used by the State to inform the development of draft DPR criteria, the absence of better information is not a barrier to the feasibility of establishing uniform criteria. The recommendations are as follows:

- **Research Recommendation #1**: To better inform targeted monitoring for source control and final water quality, the State Water Board should be proactive in monitoring the literature on the potential health risks that could present serious harm to health over short durations of exposure by compounds likely to be present in recycled water. Of specific concern are chemicals that adversely affect the development of fetuses and children. Other compounds that produce such effects will undoubtedly be discovered in the future. This activity could be initiated concurrently with the development of DPR regulations and continued as an ongoing effort. The Expert Panel recommends that a formal process be established by the State that includes: (1) an internal process to monitor the literature and (2) an external peer review process to address the results of the internal efforts to maintain a high level of awareness of the issues. See **Chapter 3** in the Expert Panel's final report.

- **Research Recommendation #2:** The State Water Board should adopt the use of probabilistic QMRA to confirm the necessary LRVs of viruses, *Cryptosporidium,* and *Giardia* needed to maintain a risk of infection equal to or less than 10^{-4} per person per year. The State should provide oversight, direction, and funding for implementing probabilistic QMRA. The purpose of using probabilistic QMRA is to provide a better assessment of the performance of DPR treatment trains and to provide an opportunity to identify additional effective DPR treatment trains.

Input values for pathogen concentrations should be based on descriptive pathogen statistics resulting from additional review of the literature (as well as information collected from **Research Recommendation #3**). Also, as DPR systems are built, owners and regulators need to take advantage of such full-scale systems to sample and assess actual as-built performance and reliability characteristics. See **Chapter 7**.

- **Research Recommendation #3:** To better inform decisions associated with updating LRVs as well as probabilistic-based QMRA modeling, the State Water Board needs to include monitoring requirements in a regulatory permit to measure pathogens (i.e., *Giardia* cysts, *Cryptosporidium* oocysts, and several human viruses) in raw (untreated) wastewater feeding a DPR system that provide more complete information on concentrations and variabilities. Improved methods should be used that will allow better characterization and improved precision of concentrations of pathogens. See **Chapters 5** and **7**.

- **Research Recommendation #4**: The State Water Board should investigate the feasibility and, where feasible, collect pathogen concentration data for raw wastewater associated with community outbreaks of disease. See **Chapters 5** and **7**.

- **Research Recommendation #5:** The State Water Board should encourage the conduct of short-term research to identify suitable options for final treatment processes that can provide some "averaging" with respect to potential chemical peaks (in particular, for chemicals that have the potential to persist through advanced water treatment). These options might involve: (1) use of a buffer tank (clear well) of a sufficient size, potentially blended with an alternative water source prior to releasing it into the drinking water supply distribution system, or using two tanks feeding into the drinking water supply distribution system; (2) removal of volatile contaminants during a degassing step (decarbonization) similar to the approach that is commonly employed after reverse osmosis treatment in established AWTFs for potable reuse; (3) use of a biologically-active filter after reverse osmosis/advanced oxidation, to provide an additional opportunity for microorganisms (if microorganisms will be able to survive in that environment) to degrade contaminants that may otherwise pass through the filter; or (4) other options. See **Chapter 8**.

- **Research Recommendation #6:** It is important to focus on non-targeted analysis and, furthermore, low molecular weight compounds. For example, the inability of reverse-phase liquid chromatography/mass spectrometry to detect many uncharged, low molecular weight compounds (e.g., halogenated solvents, formaldehyde, and 1,4-dioxane) problematic for potable reuse projects demonstrates the limitations of current analytical approaches for the detection of unknowns that are likely to pass through reverse osmosis membranes. Research is needed to develop more comprehensive methods to identify low molecular weight unknown compounds. It is possible these compounds may be detected by gas chromatography interfaced with time-of-flight mass spectrometers or hydrophilic interaction liquid chromatography (HILIC) coupled with reversed-phase (RP) chromatography prior to triple quadrupole mass spectrometry; however, to date, these methods have not been applied to potable reuse projects to detect these compounds. These methods or others need to be developed to increase the understanding of the make-up of the remaining total organic carbon composed of low molecular weight compounds. In addition, these methods also could address the potential vulnerability of AWTF treatment processes to unintended spills or batch releases of chemicals in the sewershed. See **Chapter 3**.