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City of Boise
Recycled Water Program

Independent Advisory Panel Meeting Report

Consensus Findings and Recommendations
from Meeting on December 6, 2023

Prepared by

NWRI Independent Advisory Panel for the City of Boise Recycled Water Program

Prepared for

City of Boise Public Works Department
PO Box 500
Boise, ID 83702

Submitted

May 17, 2024

Disclaimer

This report was prepared by an Independent Advisory Panel (Panel) that 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.

About NWRI

A 501c3 nonprofit organization and Joint Powers authority, 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, Metropolitan Water District of Southern California, Orange County Sanitation District, and Orange County Water District.

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Contents

Introduction

National Water Research Institute is pleased to present the findings and recommendations from the December 6, 2023, meeting of the Independent Advisory Panel to review the City of Boise Water Recycling Program. NWRI hosted and facilitated the hybrid meeting on Zoom and at the JUMP facility in Boise. The meeting was part of ongoing work since June 2021, when the City of Boise (the City) contracted with NWRI to convene a Panel to meet with city representatives to give feedback on its Recycled Water Program (Program).

The City presented information about the Program and asked the Panel to respond to questions on topics ranging from community engagement to regulation and test planning. The questions and responses are in the next section of this report.

Panel Members

The Panel consists of the following six experts:

- Rupam Soni, PE, Metropolitan Water District of Southern California, Chair
- Shawn Benner, PhD, Boise State University
- Liam Cavanaugh, PE, Metro Water Recovery, Denver
- Daniel Gerrity, PhD, Southern Nevada Water Authority
- David Reckhow, PhD, University of Massachusetts, Amherst
- Channah Rock, PhD, University of Arizona

Meeting Objectives

Staff from the City and NWRI collaborated on the agenda for the meeting, which was based on meeting the following specific objectives:

- Review the Recycled Water Program's decision roadmap and upcoming sequencing of program milestones and work.

- Gather insights on programmatic implementation of a fit-for-purpose water quality strategy.
- Review the recent water quality planning efforts, including the Advanced Water Treatment pilot and recent groundwater recharge site characterization efforts.
- Review the community engagement strategy and progress from 2021 through 2023 and feedback on planned community engagement efforts.

Meeting attendees included NWRI staff, city staff, and various stakeholders.

Organization of the Report

This report presents the Panel's findings and recommendations followed by appendices, which include information about NWRI Panels in Appendix A, the meeting agenda in Appendix B, and a list of meeting attendees in Appendix C. Questions were submitted by the public before and during the meeting; those questions and responses are in Appendix D.

Pre-Meeting Review Materials

Before the meeting, the City provided the following background materials for review:

- Recycled Water Program NWRI Briefing Packet
- Meeting 1 Panel Report
- City's Response Letter to Requests for Clarification of Meeting 1 Panel Report
- Source Water Quality Monitoring Plan
- Pilot Test Plan Technical Memorandum
- Groundwater Recharge Site-Specific Characterization Work Plan

Panel Questions and Responses

The City presented information about the Recycled Water Program and its pilot test facility and asked the Panel to respond to questions on a range of topics. Those questions and the Panel's responses follow.

Topic 1: Background and 2021 NWRI Panel Follow Up

- **Reflecting on how the 2021 NWRI panel recommendations were addressed, are there any additional follow-ups we should consider?**

Panel Response

The Panel commends the City for their responsiveness to feedback from the first report and for soliciting additional feedback on recent progress.

- The Panel appreciated the pre-meeting review materials, listed above. Going forward, the Panel recommends that the City organize future meetings and pre-meeting review materials to clearly focus on key decision points for the Recycled Water Program. It would help the Panel to have information arranged in sections that address decision points and the factors that influence the technical, economic, social, and schedule drivers for each decision.

  Further, if water quality will be a topic in future review materials, the Panel suggests organizing it into more descriptive categories that reflect current and future program activities. For example, categories such as: 1. Water Treatment, 2. Industrial Reuse, and 3. Groundwater Recharge will help the Panel review City materials and may help inform internal and external communication.

- The decision roadmap presented by the City offers several near-term and medium-term decision requirements, but the relationship between water quality decisions was unclear. For example, the allowed source water envelope and fit-for-purpose water quality objectives overlap with industrial pretreatment requirements and developing the recycled water treatment train. Breaking each decision out into

individually justified recommendations will help the City develop an easy-to-follow roadmap for the Recycled Water Program.

- After the 2021 meeting, the Panel recommended that the City develop explicit partnerships with stakeholders. The City made considerable progress by collaborating with Veolia, the City's drinking water provider; integrating Veolia technologies into the pilot-scale treatment train; locating and operating the pilot in collaboration with a potential industrial customer, Micron Technology, Inc.; and scheduling routine meetings with regulatory partners.

  To build on this momentum, the Panel encourages the City to pursue more formal—perhaps written—agreements and contracts with critical stakeholders, including industrial wastewater generators and recycled water customers. The Panel also recommends that the City develop a list or matrix that identifies all stakeholders and the type of agreement that is necessary to form the legal authority and basis for the Program to move ahead.

Topic 2: Decision Roadmap

- **In reviewing the Recycled Water Program's recent progress and decision roadmap, are there areas of work that you would expect to be proceeding in a different sequence?**
- **What outstanding programmatic items or risks may need to be considered following program definition (i.e., any other items or risks not related to design and construction)?**
- **As we approach some of these decisions, what specific areas or items should we be ready to highlight or describe in more detail to our stakeholders?**

Panel Response

The Panel commends the City for its progress in hiring operations staff and completing the initial phase of operating the pilot-scale treatment train.

- As noted in the briefing documents, the City encountered challenges during pilot project operation and identified questions that remain unanswered. These

challenges are compounded by a project timeline that includes simultaneous activities and evaluations. Ultimately, there will need to be an iterative evaluation of the pilot-scale treatment train, including a period of continuous, optimized operation to demonstrate its ability to consistently achieve water quality, environmental, public health, and operational criteria. The Panel encourages the City to demonstrate how this will be achieved, and if funding is available to continue operation of the pilot-scale treatment train in the future.

- The Panel would like to better understand the drivers for the expedited timeline proposed by the City.
- The Panel notes that using industrial wastewater as a primary source water presents specific challenges and considerations for both Demonstration Project efficacy; and for planning, communications, design and implementation of the the Full-Scale Program. The Panel understands that this approach emerged as the consensus based on public input, however, potable reuse programs around the world commonly seek to avoid or minimize industrial contributions to their source waters. While innovative, the Panel recommends that the City continue to: (a) carefully and thoroughly justify this approach; (b) consider adding Technically Based Local Limits to its existing EPA approved Industrial Pretreatment Program; (c) seek opportunities to demonstrate its ability to accurately monitor and effectively mitigate the challenges of treating industrial wastewater in the short- and long-term; and (d) craft specific messaging that explains Project relevant risks and the City's approach to addressing these risks.
- The Panel is interested to know how much information the City will have about the chemical makeup of the industrial wastewater and if the chemicals are proprietary to Micron Technology, Inc., or other potential industrial partners. Based on preliminary water quality monitoring at pilot scale, the full-scale system will need to address chemical constituents that are somewhat challenging to treat for potable reuse, both because of the prevalence of the constituent (for example, fluoride) or expected concentration (for example, acetone).

These chemicals have proven to be particularly challenging for the pilot-scale operation. Note that such chemicals are not unique to this project (for example, acetone at Orange County Water District [OCWD]), but the magnitude of the treatment challenges are potentially greater because the source water is entirely industrial. The Panel also recommends that the City monitor for formaldehyde because it can pass through reverse osmosis (RO).[1]

- The Panel encourages the City to further develop and explain its source control program to address how challenging chemical constituents can be identified early and mitigated adequately to avoid "chasing" chemicals by adding treatment processes.
- If it does not have one, the City may want to consider implementing technically based local limits under the National Pretreatment Program or strengthening the City's source control and pretreatment rules.[2] Enhanced rules could help the City mitigate unforeseen treatment challenges, including any unanticipated chemicals from new industries that may discharge to the system in the future.
- The Panel recommends that the City reach out to wastewater (e.g., Los Angeles County Sanitation Districts) or potable reuse agencies (e.g., El Paso, Orange County Water District, West Basin Municipal Water District) that treat challenging source water to learn about their source control programs and to learn how they work with industrial dischargers.

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1 For more information, see Rodrigo A Tackaert, et al., "Demonstrating process robustness of potable reuse trains during challenge testing with elevated levels of acetone, formaldehyde, NDMA, and 1,4-dioxane," Journal of Water Supply: Research and Technology-Aqua (2019) 68 (5): 313–324. https://doi.org/10.2166/aqua.2019.134

2 See the City of Boise, Idaho, Code of Ordinances Title 10, Chapter 5: https://codelibrary.amlegal.com/codes/boise_id/latest/boise/0-0-0-13003

- The Panel notes that the focus on treating industrial wastewater represents an excellent messaging opportunity to attract businesses to the area. This project has the potential to promote significant economic development for the City. The Panel would like to see more information about how the City will formalize new stakeholder partnerships, ensure that these industries generate desired wastewater flows and quality, and determine if these industries are willing to receive recycled water as customers—and at what cost.
- The Panel recommends that the City consider the feasibility of direct potable reuse (DPR) as an alternative to groundwater replenishment. The Panel notes that the treatment train produces high-quality treated water, which, for most parameters, is approaching levels fit for human consumption. If the City decides not to move forward with DPR in the near-term, the Panel recommends that the reasons for that decision are documented and the barriers preventing DPR are clearly identified for the record. In California, some potable reuse projects initially pursued groundwater replenishment or surface water augmentation approaches, which pose significant sustainability challenges such as costs for pipelines and pumping to reservoirs. Now that DPR regulations have been adopted, these systems may avoid the challenges of using environmental buffers by moving to DPR.
- The Panel encourages the City to fully evaluate all three reuse options (spreading, injection, and DPR) and explain the rationale behind selecting its preferred approach. Some data that is needed to identify the best option may be unknown at this stage or conditions may change as the Project moves forward. For those reasons, the City should consider periodically reevaluating reuse alternatives, including industrial reuse and irrigation.
- If groundwater replenishment is selected, the City indicated that spreading is the preferred approach. The Panel has concerns about arsenic leaching during infiltration and the overall practicality of infiltration given the geology (basalt layer) in the area.

- The Panel is interested in better understanding the financial model for the Recycled Water Program and how it will be funded. The Panel suggests the City consider if industries will be required to use recycled water and at what cost. The Panel recommends that the City consider formalizing an approach to delineate where costs for recycled water treatment and wastewater treatment, in general, are applied. As the City adopts a more robust recycled water program, the costs to meet required water quality may need to be applied at City facilities, industrial wastewater pretreatment facilities, or both.

Topic 3: Water Quality

- **Based on the Advanced Water Treatment Pilot test plan, treatment technologies, and initial AWT Pilot results, do the planned Phase II pilot test additions address the identified treatment challenges?**
- **In reviewing the AWT Pilot Test Plan and treatment configurations, what results are most applicable to informing the implementation of the City of Boise's fit-for-purpose recycled water strategy?**
- **What factors have you seen other agencies/utilities evaluate to balance the tradeoffs between costs and producing fit-for-purpose water?**
- **What are the key characteristics or qualities that indicate when recycled water from the Recycled Water Facility can be termed "purified water?"**
- **How are travel times and buffer distances intended to be protective of down gradient well users, and how can the Recycled Water Program establish appropriate distances to reasonably manage impacts?**

Panel Response

- The Panel notes that pathogen attenuation does not appear to be an explicit requirement for indirect potable reuse (IPR) in Idaho, except for the five-log virus attenuation required for Class A designation. The City intends to separate sanitary and industrial wastewater to eliminate pathogen loads to the advanced treatment facility. However, the Panel encourages the City to document pathogen attenuation

capabilities of the advanced treatment train, including potential log reduction value (LRV) credits at critical control points (CCPs).

This best practice for potable reuse systems acknowledges that industrial flows may include sanitary flows and, based on the proposed treatment train, the project is expected to achieve LRVs that are consistent with systems where pathogen attenuation is required. In other words, it should not be a major roadblock for the City and will potentially improve the operation and reliability of the treatment train by establishing pathogen-based CCP criteria. A focus on pathogen attenuation would also mitigate concerns about potential cross-connections in the full-scale system and could ease transition to DPR if that path is considered.

- Some components of the design or experimental plan were not fully explained and/or justified in the briefing document, so the Panel would like to review additional information before the next meeting to explain certain design choices and observed results. The Panel would like more information on the following:
    - The City noted that the air stripper was designed for 200 parts per billion of acetone, yet the feed water to the pilot contained 10 times the expected acetone concentration. The reason for this unexpectedly high concentration was not provided, so it is unclear if this was an anomaly or if it indicates typical variability that could be observed in the future.
    - The City plans to evaluate the use of granular activated carbon (GAC) treatment for the full process flow instead of focusing only on the RO concentrate. It is unclear why treating the full flow would provide any benefit from a water quality or operational perspective. The Panel encourages the City to provide additional justification for this evaluation.
    - The Panel is interested in learning whether a mass balance on the RO concentrate return flow indicates a significant impact on contaminant loading to the Boise River, for example, for individual salts or PFAS. If not, GAC treatment

may not be warranted at all or may be better suited for polishing the RO permeate.

- The City made several references to bench- and pilot-scale biological treatment that could be evaluated independently of the pilot-scale treatment train. Without details, it is difficult for the Panel to evaluate if bench- or pilot-scale biological treatment is appropriate for a larger scale system such as the advanced water purification facility. Biological treatment systems are particularly difficult to mimic and, even if done appropriately, it is difficult to understand the implications for the downstream advanced treatment processes unless biological treatment is integrated into the treatment train.
- The Panel encourages the City to seek its input between meetings by reaching out to NWRI. Panel members have extensive experience in experimental design, which could help avoid unanticipated problems.
- The Panel would also be interested in hearing a full justification of UV/H_2O_2 as the preferred advanced oxidation process (AOP). For example, UV/HOCl has recently emerged as an alternative to UV/H_2O_2 for potable reuse applications. The City is encouraged to evaluate the advantages and disadvantages of alternative AOPs, perhaps even beyond UV-based AOPs.

- During the next meeting, the Panel would like to know if the team will only use the common EPA-approved methods for per- and polyfluoroalkyl substances (PFAS) (533 and 537.1), or if there is a broader interest in fluorinated analytes such as those measured by the total oxidizable precursor (TOP) assay or total organic fluorine (TOF).
- The Project Team frequently uses the terms "fit-for-purpose" and "best and highest use." It would help for the Panel to understand how the City defines these terms and how they plan to implement them. For example, the West Basin Municipal Water District refers to "five types of designer water" that are diverted at various treatment stages so that the water quality is consistent with the application. This is

consistent with the City's "fit-for-purpose" approach, but it is not clear to the Panel how the City will implement something similar.

- The term purified water is generally associated with recycled water that has been treated with micro- or ultrafiltration, reverse osmosis, advanced oxidation, or other processes. However, there is no formal definition for purified water. While the City may decide to use the term purified water to describe water from the pilot plant, the Panel recommends that it explicitly define the term for stakeholders and public partners. Consider how the definition of purified water will be distinguished from future iterations of reuse, including DPR. Furthermore, the City must be prepared to compare the quality of purified water, however it is defined, to the quality of the City's current drinking water.
- As the groundwater recharge plan evolves, the Panel recommends that the City develop their own expertise in hydrogeology, hydrologic engineering, and aquifer water quality. Brown and Caldwell is a solid partner for the city and has a strong reputation in this area. However, robust oversight of groundwater work will likely require in-house expertise. The Panel also recommends that the City share what a future groundwater quality monitoring program may entail.

The Panel encourages additional studies to better understand groundwater flows, interactions of treated water with sediments, the difference between injection versus infiltration, and the effects of the depth of injection. In the following sections, the Panel provides some questions for the City to consider.

Groundwater Flows

The Panel recommends that the City consider the following questions as it plans for groundwater replenishment. Some of these questions will require a local flow model, but some can be answered, at least partially, with the existing regional flow model. The answers to these questions may help inform the site selection process.

- What are the physical characteristics of groundwater flow such as direction and velocity at potential recharge sites? How do they vary between sites?

- What are the implications of those differences? Similarly, how will flow direction and velocity vary with depth?
- How does the interaction of water and sediments during recharge mobilize constituents that degrade groundwater quality? Could pilot testing answer this question?
- What existing information from other water reuse projects can inform the City's process?
- Can pilot testing, perhaps starting with bench-scale and field-scale projects, support development of a sound groundwater recharge strategy?
- Pilot testing with bench-scale and field-scale projects can be robust but also costly and time consuming. Do available time and resources support this strategy?

Infiltration versus Injection

The Panel recommends that the City consider the following questions when choosing a groundwater replenishment method:

- What are the physical constraints and implications of infiltration vs. injection?
- What are the technological advantages and disadvantages of each?
- How does each approach affect flow direction and fate of the recharged water? What are the groundwater quality outcomes of each approach?

Depth of Injection

For the injection option, the depth of injection will be an important variable. The Panel recommends that the City consider the following questions:

- How does flow direction and fate vary with depth?
- How do sediment characteristics, including physical flow and geochemical properties, vary with depth?
- How does that information shape decisions around injection depth?

Travel Time

California has one of the most explicit frameworks on travel time and buffer distance. The California framework aims to address two topics: Response Retention Time (RRT) and LRV crediting.

- To classify as an IPR project, the demonstrated storage/travel time must be at least two months; otherwise, DPR regulations apply. The lower bound of two months is assumed to provide sufficient RRT to address any treatment or water quality issues.
- California (and other jurisdictions) awards 1 LRV of virus credit for every month of storage/travel time underground, up to a maximum of 6 LRVs. If surface spreading (infiltration) is combined with at least 6 months of storage/travel time underground, then the project is awarded the full 10 LRVs for *Cryptosporidium* and *Giardia*. California also has requirements for how the storage/travel time is determined in a regulatory context (using a model vs. an intrinsic tracer vs. an added tracer).
- Since Idaho does not have similar pathogen requirements, the California model can potentially be used as a placeholder, but may not be useful in the context of this project. The City may be able to identify water quality parameters that can be used as surrogates for developing storage and travel time criteria.

Topic 4: Community Education and Engagement

- **Do you have any feedback on the community engagement strategy and progress from 2021 through 2023?**

Panel Response

The Panel applauds the City on their robust community education and outreach through their pilot plant tours, social media campaigns, and other efforts. To continue to build public awareness and trust, the Panel recommends the City continue with extensive outreach, along with the following recommendations:

- The Panel notes the lack of data supporting public perception components of the project. It seemed that the responses to Panel and stakeholder questions were

anecdotal rather than data driven. The Panel wants to see data to support public knowledge/acceptance and changes in public opinion, either good or bad.

- The Panel recommends the City conduct additional research on public attitudes and understanding of the Recycled Water Program. The public focus groups conducted by the City provided insightful information; the Panel is interested in seeing the focus group questions and comments along with data collected from those groups.
- The Panel suggests conducting quantitative research on public opinions and awareness using surveys. It is valuable to collect baseline data and then evaluate how attitudes change over time. Such data will support engagement efforts and will help the City plan future outreach. The City may find that Boise residents' opinions about recycled water use may evolve.

  When the Panel asked for specific information on stakeholders' understanding of the connection between groundwater and the drinking water supply, the City indicated that this is a generally understood concept; however, current data from other locations that are considering DPR projects indicates that this is not the case. The Panel wants to see quantitative data to support the City's claims.
- Many agencies conduct short pre- and post-tour questionnaires to track information about public support, concerns, and changes in opinion before and after tours. During a future meeting, the Panel would like to see questions that the City asks tour participants before and after tours to assess their change in acceptance and understanding.
- Based on the questions from the public during tours and the Panel meeting, the Panel recommends the City consider additional messaging on project costs and water quality as indicated in the briefing packet.

  There were valid technical questions and comments from the public, and it is imperative for the City to evaluate them and respond directly with data. Questions from the public indicate an understanding of the potential for additional uses of the treated water. The Program may include groundwater replenishment, so the City

must consider if the program should be described as potable reuse and communicate this information transparently to the public.

Additional Recommendations

These recommendations are derived from documents given to the Panel, presentations by the City, and discussions during the meeting.

- The Panel commends the City on its progress since the last meeting and notes the City's enthusiasm for the Recycled Water Program. The City has been very responsive to the Panel's comments, community feedback, and stakeholder input.
- The Panel noted the emphasis on enhanced community engagement, which was demonstrated by the number of people who participated in the meeting in December. The City's community-centered approach to the project has generated strong interest in the future of the Recycled Water Program.
- The Panel also commends the City for its commitment to workforce development. Since the first meeting in 2021, the City has expanded critical operations staff who have led the pilot project and are gaining valuable experience for future operation of the full-scale facility. The City is also developing a workforce pipeline through its university internship program.
- Together, community engagement and workforce development are areas that are sometimes overlooked in the initial phases of recycled water programs, but the City immediately prioritized these important project components. The Panel encourages the City to continue advancing by allocating dedicated staff to other areas critical to the success of this Recycled Water Program.
- The Panel appreciates the supporting material provided by the City. To facilitate an effective review of such extensive materials in the future, the Panel asks that the City include relevant data to support all stated conclusions. This will allow the Panel to fully evaluate progress and more easily understand the direction of the project.

For example, the Panel was interested in reviewing data from the community survey and focus groups to evaluate measurable changes in public understanding and acceptance. Similarly, the City stated that the GAC treatment process was working as expected, but the Panel could not independently review performance data.

Further, the Panel recommends:

- The engineering consultant team should participate in Panel meeting presentations. While it is commendable for the City to lead the Panel meetings and interpret the data, it is important to leverage the expertise of the City's consultants. The Panel needs more technical detail to accurately assess the Project and would like to address questions to the technical experts on the engineering team.
- The Panel would like to review and provide feedback on groundwater characterization, modeling, and other groundwater studies. Several Panel members have extensive technical experience in this area, and it is imperative that the City leverage this expertise moving forward. The Panel would like to review any existing groundwater data and/or policy analysis as well as plans for future groundwater studies.

Appendix A • About NWRI Panels

NWRI Independent Advisory Panels are independent teams of internationally recognized experts that review challenging water resources management, policy, and investment issues. This process leads to decisions that are grounded in science and best practices. NWRI-facilitated Panels serve cities, counties, special districts, joint powers agencies, government agencies, nongovernmental organization partners, and private firms.

We have administered hundreds of Panel meetings across the country on topics that include water treatment and reuse infrastructure planning; design, commissioning, monitoring, and operations; groundwater quality and recharge management; surface water quality and reservoir design improvements; and a growing body of potable reuse policy guidance across the country.

NWRI Panels provide:

- Independent, third-party review and evaluation.
- Scientific and technical advice by relevant, leading industry experts.
- Help and support with challenging scientific questions and regulatory requirements.
- Reports on status, progress, findings, and recommendations as required by the engagement.
- Support in interactions with the public, decision makers, and regulators.

Appendix B • Agenda

Independent Advisory Panel for the City of Boise Recycled Water Program

December 6, 2023

Meeting Location

Jack's Urban Meeting Place
1000 W Myrtle Street, Inspire Room
Remote Access: Set Outlook Calendar Invitation

Contacts

Tianna Manzon: (562) 708-0123
Mary Collins: (206) 380-1930
Suzanne Sharkey: (949) 258-2093

Schedule

Time	Topic	Presenter
8:30 a.m.	Welcome, Introductions, Review Agenda and Panel Charge	Kevin M. Hardy, NWRI
8:45 a.m.	Overview of the City of Boise Recycled Water Program and Panel Follow Up	Haley Falconer, City of Boise
9:15 a.m.	Decision Roadmap	Royce Davis, City of Boise
9:40 a.m.	Break	
9:55 a.m.	Water Quality	Royce Davis, City of Boise
11:00 a.m.	Community Engagement	Abby Haydin, City of Boise
11:15 a.m.	Break	
11:40 a.m.	Public Questions	Facilitated by Kevin Hardy
12:00 p.m.	Final Panel Questions	Facilitated by Kevin Hardy
12:30 p.m.	Panel-Only Working Lunch and Report Drafting Session	Facilitated by Panel Chair
2:00 p.m.	Adjourn	

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NWRI Panel for the City of Boise Recycled Water Program: Meeting Agenda

Meeting Objectives

- Review the Recycled Water Program's decision roadmap and upcoming sequencing of program milestones and work.
- Gather insights on programmatic implementation of a fit-for-purpose water quality strategy.
- Review the recent water quality planning efforts, including the Advanced Water Treatment pilot and recent groundwater recharge site characterization efforts.
- Review the community engagement strategy and progress from 2021 through 2023 and feedback on planned community engagement efforts.

Questions for the Panel

Topic 1: Background and 2021 NWRI Panel Follow Up

- Reflecting on how the 2021 NWRI panel recommendations were addressed, are there any additional follow-ups we should consider?

Topic 2: Decision Roadmap

- In reviewing the Recycled Water Program's recent progress and decision roadmap, are there areas of work that you would expect to be proceeding in a different sequence?
- What outstanding programmatic items or risks may need to be considered following program definition (i.e., any other items or risks not related to design and construction)?
- As we approach some of these decisions, what specific areas or items should we be ready to highlight or describe in more detail to our stakeholders?

Topic 3: Water Quality

- Based on the Advanced Water Treatment Pilot test plan, treatment technologies, and initial AWT Pilot results, do the planned Phase II pilot test plan additions address the identified treatment challenges?
- In reviewing the AWT Pilot Test Plan and treatment configurations, what results are most applicable to informing the implementation of the City of Boise's fit-for-purpose recycled water strategy?
- What factors have you seen other agencies/utilities evaluate to balance the tradeoffs between costs and producing fit-for-purpose water?
- What are the key characteristics or qualities that indicate when recycled water from the Recycled Water Facility can be termed "purified water?"
- How are travel times and buffer distances intended to be protective of down gradient well users, and how can the Recycled Water Program establish appropriate distances to reasonably manage impacts?

Topic 4: Community Education and Engagement

- Do you have any feedback on the community engagement strategy and progress from 2021 through 2023?

NWRI Panel for the City of Boise Recycled Water Program: Meeting Agenda

Expert Panel Members

- Chair: Rupam Soni, PE, Metropolitan Water District of Southern California
- Vice Chair, Daniel Gerrity, PhD, Southern Nevada Water Authority
- Shawn Benner, PhD, Boise State University
- David Reckhow, PhD, University of Massachusetts Amherst
- Channah Rock, PhD, University of Arizona
- Rupam Soni, PE, Metropolitan Water District of Southern California

Project Team Members

- DeAnn Brown, City of Boise
- Royce Davis, City of Boise
- Zoe Clifford, City of Boise
- Haley Falconer, City of Boise
- Abby Haydin, City of Boise
- Melissa Stoner, City of Boise
- Karaline Bridgeford, Brown and Caldwell
- Emily O'Morrow, Brown and Caldwell
- Stephanie Corso, Rogue Water Group

National Water Research Institute

- Kevin M. Hardy, Executive Director
- Mary Collins, Technical Editor/Communications
- Tianna Manzon, Research Project Coordinator
- Suzanne Sharkey, Water Resources Scientist and Project Manager

Appendix C • Meeting Attendees

- Brett Himes, Imco Construction, bhimes@imcoconstruction.com
- Stephanie Corso, Rogue Water, stephanie@roguewatergroup.com
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- Neil Jenkins, Eagle Sewer District
- Cathy Cooper, Veolia, Catherine.cooper@veolia.com
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Appendix D • Public Questions and Responses

The following questions were submitted by the public before or during the December 6, 2023, meeting with the City of Boise.

1. What methods are currently available to capture PFAS found in municipal effluent and dispose of them safely, and how costly is this technology?

   Conventional wastewater treatment partially removes PFAS from the liquid stream, concentrating some PFAS constituents in solids that are subsequently removed from the system. Some advanced water treatment technologies, including several that are currently being evaluated by the City of Boise, are highly effective in isolating and concentrating PFAS but are unable to destroy these persistent compounds. PFAS treatment options, including granular activated carbon (GAC) adsorption, ion exchange, and reverse osmosis (RO), are considered best available technologies to address PFAS in water. These treatment options have become more common in the water industry, but they are still relatively costly and complex. In addition, the residuals from these processes include PFAS-laden GAC or concentrated brine streams that require further processing and disposal, with associated costs. Incineration and certain types of electrochemical treatments can be used to destroy PFAS in treatment residuals but have not yet been broadly implemented in the water industry.

2. I've never heard of a project like the City's recycled water program before. Are there other initiatives in the U.S. doing similar work? What sorts of challenges and successes have they encountered?

   (See answer to next question.)

3. Parallels have been offered for the City of Boise's reuse justification with significant community water scarcity concerns in California. How is this project, in this region, the same or different in justifying the level of capital investment?

   The City of Boise's recycled water program shares similarities with many projects throughout the United States and around the world, and it also has several innovative features. The United States Environmental Protection Agency's (EPA) Potable Reuse webpage is an excellent resource to learn about the different forms of water reuse practiced throughout the world, relevant regulations, types of treatment, and several benchmark systems/case studies.

   Historically, indirect potable reuse (IPR) that incorporates an environmental buffer via groundwater replenishment or surface water augmentation has been the most common application, with decades of demonstrated success in Arizona, California, Colorado, Georgia, Nevada, Texas, Virginia, and other states.

   Building upon this success, in 2013, Texas became the first state to permit direct potable reuse (DPR), which essentially eliminates the environmental buffer. Colorado became the first state to officially adopt DPR regulations in 2022. California adopted its own DPR regulations in 2023, and Arizona is expected to follow suit. Importantly, the City of Boise's proposed project shares many of the same advanced treatment processes that have been successfully used in these other locations.

   The City of Boise's proposed project is unique in that industrial wastewater is proposed as the principal source water for the advanced water purification facility, while other systems typically treat a combined flow of domestic, commercial, and industrial wastewater.

4. Has research on how to purify water via sound, prayer, and intention, such as in indigenous traditions, and emerging science of cymatics? being done?

   Water purification techniques for the Recycled Water Program were selected based on the recommendations of water quality experts and regulators with input from community members on water quality expectations. These suggested techniques

were not among those recommended, so the city does not employ them at this time.

5. Please speak about how water can be recycled to recharge aquifers, via porous roads, curbs, hydrocarbon soil berms (buried branches or charcoal) waterscapes, etc.?

   The "One Water" approach to managing water envisions all water as a valuable resource that can be put to beneficial use after an appropriate level of treatment that considers the original source (such as surface water, groundwater, stormwater, wastewater) and intended application (such as irrigation, groundwater replenishment, or drinking).

   Water reuse has historically focused on advanced treatment of wastewater for beneficial reuse, but stormwater reuse has become a greater focus in some areas. Interestingly, regardless of whether water is percolating through an engineered filter, the soil, or even a porous construction material, some of the same principles and mechanisms apply to recycled water. These same mechanisms will be relevant if the City of Boise selects infiltration as the preferred approach for replenishing the local groundwater.

6. How will Boise pay for a water recycling plant? Do we know if there will be enough customers to support it? Will the recycled water be competitively priced? Can the city require businesses to use recycled water?

   The recycled water facility will add treatment capacity to the water renewal system necessary to keep pace with increased water use due to population growth. Funding is included in the water renewal utility budget for planned capital improvements. The facility will be paid for by the Water Renewal Services enterprise fund and with some federal infrastructure grant funding. User rates, and connection or use requirements will be determined during ongoing utility development planning.

7. I was surprised to hear that the current plan to treat RO brine is to send it back to the standard treatments that are not designed to remove many of those most problematic contaminants such as PFAS and nonylphenols, so that these will end up in the river or other reused purposes. It seems like a taking a big step backward -- redistribution of difficult to remove contaminants.

   (See answer to next question.)

8. Please explain the reasoning to put osmosis brine back in standard collection system. That seems exactly wrong—a point source of highly concentrated contaminants distributed into standard treatment.

   Reverse osmosis brine, or reverse osmosis concentrate (ROC), is the concentration of contaminants that are removed from purified water through reverse osmosis. Responsible management and disposal of ROC is a key priority for the City of Boise, and community input and environmental regulations for ROC management in Boise will be considered in evaluating management strategies. Additional treatment may be required to discharge ROC into the existing collection system such that the water quality can be treated at the existing water renewal facilities. The City is currently studying the effects ROC may have on the treatment processes at the West Boise and Lander Street Water Renewal Facilities to understand if additional treatment is required to keep the Boise River clean and healthy.

9. Isn't aquifer recharge in the proximity of domestic wells essentially indirect potable reuse? I believe that potable reuse could be important (e.g., I could support it), but shouldn't we categorize the reuse appropriately.

   Groundwater recharge is one of many strategies for indirect potable reuse, where an environmental buffer, such as a lake, river, or groundwater aquifer is used between treated wastewater and a drinking water treatment plant. The city's groundwater recharge effort provides storage of water in the ground for multiple future water uses.

10. As a formerly critical member of the community re: irrigation reuse without considering impacts on private domestic wells, I have been generally supportive of the pilot program, and I think potable water is feasible as it addresses and deals with the contamination problems explicitly.

    Thank you for your involvement. We rely on engaged and informed residents to tell us what our community expects and supports as we develop this new reusable water supply.

11. Could the panel describe their experience or knowledge with industrial exclusive groundwater recharge and how it differs from municipal recharge.

    The Panel is not aware of any groundwater replenishment project that only uses industrial wastewater as its source water. Municipal wastewater is generally perceived to be more consistent in quality since it is dominated by domestic (i.e., household) wastewater flows. However, large municipal reuse systems outside of Idaho have observed unexpected influxes of industrial contaminants.

    Industrial wastewater sometimes contains challenging constituents, but the City of Boise has an opportunity to work closely with its industrial partners to characterize the expected source water quality—a concept known as source control. Source control consists of identifying all constituents that would be expected in the industrial wastewater along with the concentrations range and variability.

    Source control will ensure that the City of Boise can develop and operate an advanced treatment system capable of treating the potentially challenging nature of industrial wastewater. In other words, treating industrial wastewater can be challenging, but the City of Boise is in a unique position to develop a successful industrial reuse program through close collaboration with its partner and through testing of treatment technologies at the Advanced Water Treatment Pilot.

12. Fairly recently a high-level Idaho DEQ regulator commented on a neighborhood social media site that concerns about PFAS contamination of canals from municipal water reuse were irrelevant because PFAS was also frequently found in rainwater.

The lack of understanding, re: exposure with varying differences of magnitude in concentration was dismaying, as this is the official regulatory body overseeing these projects. It is essential that Boise continues to aim above Idaho regulators in terms of water quality. Parallels have been offered for the City of Boise's reuse justification with significant community water scarcity concerns in California. How is this project, in this region, the same or different in justifying the level of capital investment?

In addition to regulatory requirements, the city will continue to engage the community and the National Water Research Institute to determine the purified water quality that is right for Boise based on regulations, affordability, and community priorities.

The City of Boise 2016 Climate Risk Assessment identified the most significant climate impacts that Boiseans will experience in the next 60 years, and of the eight impacts that were identified, six relate to water. Resilience to the impacts of climate change and water scarcity were key priorities in the city's 2020 water renewal utility plan. Recycled water was identified as a solution to addressing necessary system and discharge capacity and climate resiliency in the utility plan which included input from over 2,700 community members on the city's level of service goals and water use in Boise. The recycled water program was prioritized in the utility plan to address multiple challenges – increasing capacity, meeting regulatory requirements and producing a drought-proof water supply. Please see the answer to question 3, where NWRI addresses parallels with projects in other states.

13. Can you explain what is needed for surface and groundwater rights for the reuse project?

    As a recipient of water that has been used under an existing water right, the city does not require any water rights to purify the source water for direct industrial reuse. After groundwater recharge, the city would be required to apply for a water right to divert stored water from the aquifer.

14. How will the City ensure that treated water from a high-tech manufacturing facility, with new contaminants regularly, be ok for drinking water?

    The goal of the recycled water program is to create water that meets or exceeds groundwater quality because after purified water is put into the groundwater, it may eventually be pulled out of the ground to use again. The recycled water program conducted one year of source water monitoring from six different industrial businesses to understand the wide swath of the types of potential contaminants the Recycled Water Facility could see and would need to test for. Continued testing at the Advanced Water Treatment Pilot has supported the source water monitoring results and monitoring for potential contaminants will continue at the future Recycled Water Facility.

    The Advanced Water Treatment Pilot data analysis results will allow us to understand what types of chemicals each treatment technology can remove. This data can be used even for chemicals that were not initially detected because some classes of chemicals are similar enough that they behave the same when treated through different types of advanced processes. This analysis will also define the range of chemical concentrations that can be readily removed and what the facility cannot accept. The work culminates by using the results to develop discharge permits for industry. These discharge permits and service agreements will limit what is discharged and require industry to share when a process change impacts what is being discharged to the city's system.

15. Even clean water can mobilize contaminants in the aquifer. How will the city ensure this doesn't happen?

    The city is conducting extensive interaction testing between treated water from the pilot and soils found in test wells. Purified water will be conditioned appropriately after advanced treatment to negate interaction with or mobilization of contaminants underground. Post-treatment conditioning will change certain characteristics of the water, such as pH, to closely match the quality of the existing groundwater to prevent dissolving minerals and contaminants in the groundwater.

Once the future groundwater recharge facility is operational, the city will use a monitoring well network to collect water quality samples and monitor performance of the recharge system to ensure contaminants have not mobilized. The results will be shared with regulators and will help identify and prevent any issues that could impact water quality. The city will collaborate with regulators to determine the exact monitoring well network locations and sampling frequency.

16. How will industrial reuse impact river flows for downstream irrigation users?

    The Recycled Water Program is focused on adding capacity to the city's water treatment system to prepare for population growth and economic development. West Boise and Lander Street water renewal facilities will still be rated to treat 30 million gallons of used water every day. Residential and economic growth in Boise are expected to replace the diversion of water to the future Recycled Water Facility, maintaining the current discharge to the Boise River in the long-term. By purifying and returning water to the ground and industries for reuse, more water will be reliably available in the future for all uses without negatively impacting the Boise River.

17. What is the modeled flow rate and long-term (e.g., 50 year) extent of flow, and how was this determined at the recharge site?

    A groundwater recharge site has not been selected yet. The city is currently developing a groundwater model based on industry and agency experience in the Treasure Valley. This model will be calibrated using the data collected at potential recharge sites and validated through experiments to confirm accuracy. All these tools are being employed right now by the program to determine flow rates and the extent of flow. The future recycled water facility will be designed to purify six million gallons per day of recycled water and sized to be able to expand to 12 million gallons per day. The amount of water that is recharged will be highly dependent on the volume of recycled water allocated for industrial reuse.