Direct Potable Reuse Workshop

April 26-27, 2010
Sacramento, CA

Workshop Report

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DISCLAIMER

This workshop report summarizes comments made at the Direct Potable Reuse Workshop, which was held in April 2010 by the California Urban Water Agencies, National Water Research Institute, and WateReuse California. Any opinions, findings, conclusions, or recommendations expressed in this report were provided by workshop participants. This report was published for informational purposes.

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CONTENTS

1. BACKGROUND

California is facing a potential water crisis due to current limitations on traditional water supplies and the anticipated growth of additional stressors related to population growth and climate change. As a result, new strategies are needed to satisfy future water demands. To partially address this water supply gap, the California Legislature established a goal to increase water recycling to 1 million acre feet annually (MAF) by 2010.[1] In addition, the Legislature has passed statewide water conservation requirements, requiring long-term water-use reduction.[2] Expanding recycled water in California can help the state meet future water demands and offset demands on potable water supplies. Locally controlled recycled water programs offer communities the added benefit of minimizing uncertainty associated with state and federal systems. Meeting future water demands by using recycled water for nonpotable reuse applications such as landscape irrigation, however, offers limited feasibility due to factors such as the seasonality of demand and the cost of building and maintaining a separate recycled water distribution system ("purple pipe") from the water reclamation plant to the use sites. Therefore, in water-scarce areas, the feasibility of using recycled water to augment local potable water supplies is being raised in response to the need for water supply and cost reliability.

Planned indirect potable reuse by groundwater recharge of potable aquifers has been practiced in California since the 1960s. Indirect potable reuse augments drinking water sources (groundwater or surface water) with advance treated (or purified) recycled water, followed by an environmental buffer (which may also serve as a hydraulic buffer). Indirect potable reuse projects are being considered more "acceptable" by communities due to the technology available to safely produce water, the cost-effectiveness of the projects, and the benefits associated with a locally controlled water supply. In addition to the current indirect potable reuse projects in California, a number of new and expanded indirect potable reuse projects are underway, including reservoir augmentation in San Diego and groundwater recharge in Los Angeles.

Direct potable reuse – the introduction of recycled water directly into a potable water distribution system – could provide further flexibility than indirect potable reuse to augment potable water supplies. Indirect potable reuse is not feasible for many water utilities due to a lack of large reservoirs or suitable groundwater geology; therefore, direct potable reuse may be the only option available to maximize the use of recycled water.

While indirect potable reuse projects have been approved and permitted in the United States (Arizona, California, and Texas) and abroad (Singapore and Australia), no direct potable reuse projects are currently operating in the United States. Additionally, direct potable reuse criteria have yet to be developed.

Direct potable reuse may provide greater flexibility for some water agencies that do not have access to groundwater or surface water storage. However, direct potable reuse requires a careful examination of issues regarding public acceptance, public health, regulatory requirements, and project management and operation.

[1] Section 13577, Water Code.
[2] California's Water Conservation Act of 2009 (SBx7-7).

The California Urban Water Agencies (CUWA), National Water Research Institute (NWRI), and WateReuse Association California Section (WateReuse) are interested in developing a strategic plan for addressing barriers to direct potable reuse as a feasible water resource option. These organizations collaborated to provide a forum to work on issues related to direct potable reuse topics, identify areas of potential collaboration, and avoid duplicative efforts.

A 2-day "Direct Potable Reuse" workshop was held April 26-27, 2010, in Sacramento, California, and included representatives from regulatory, academia, environmental, and water and wastewater industries. The purpose of the workshop was to identify information gaps and existing barriers that need to be addressed to develop direct potable reuse regulations in California. Information gathered from this workshop is expected to help support the needs of water, wastewater, and recycled water agencies in long-term planning and in prioritizing research-related activities.

This report provides a summary of the outcomes of the workshop.

2. WORKSHOP INTENT

Criteria have yet to be developed or proposed for direct potable reuse in the United States. The objective of the Direct Potable Reuse Workshop was to identify information gaps and existing barriers that need to be addressed to develop direct potable reuse regulations in California.

Information gaps in the following subject areas were addressed at the workshop:

- Public acceptance.
- Communication between agencies in the water supply chain and between agencies and the public/customers.
- Microbial and chemical constituents of concern.
- Effectiveness and reliability of treatment unit processes.
- Multiple barriers of protection.
- Monitoring needs (treatment processes and product water).
- Use of indicators/surrogates for both microbial and chemical constituents.
- Redundancy in treatment.
- Management and operational controls.
- Permitting issues.

This report summarizes the input provided by workshop participants. The report is intended to document the outcomes of the workshop and to provide the basis of a follow-on report; that is, a work plan for conducting the studies and research needed to (1) support an evaluation of whether developing direct potable reuse regulations is appropriate and (2) support the development of any regulations.

3. WORKSHOP STRUCTURE

The 2-day Direct Potable Reuse Workshop was held at the Holiday Inn Capital Plaza in Sacramento, California, on April 26-27, 2010 (the workshop agenda is included in Appendix A). Over 60 representatives with various technical, scientific, policy, and social science backgrounds from regulatory, academia, environmental, and water and wastewater industries were invited to attend. A list of workshop attendees is provided in Appendix B.

3.1 White Papers

In advance of the workshop, NWRI sponsored the development of a white paper titled *Regulatory Aspects of Direct Potable Reuse in California* by James Crook.[3] In addition, WateReuse California sponsored the development of a white paper titled *Public and Political Acceptance of Direct Potable Reuse* by Margaret Nellor and Mark Millan.[4]

These two white papers, along with research topics developed at the WateReuse Research Foundation's (WRRF) "Research Needs Workshop" held in San Diego in December 2009, served as a basis for discussion at the workshop. Workshop attendees received these materials prior to the workshop for review.

3.2 Workshop Presentations

On the first day of the workshop, the authors of the white papers summarized the findings of their reports. In addition, research topics developed at the WRRF Research Needs Workshop were summarized by Wade Miller, Executive Director of WRRF. Each presentation was followed up with a discussion with workshop participants.

3.3 Breakout Groups

Based on areas of expertise, workshop participants were separated into four groups to deliberate on four areas of focus (breakout group assignments are included in Appendix C). The four focus areas were:

1. Treatment
2. Monitoring
3. Regulatory
4. Public Acceptance

The four groups met during two breakout sessions. One breakout session was held during the afternoon of the first day and the second breakout session was held during the morning of the second day.

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[3] Crook, James (2010). *NWRI White Paper on Regulatory Aspects of Direct Potable Reuse in California*, National Water Research Institute, Fountain Valley, CA.

[4] Nellor, Margaret H., and Mark Millan (2010). *Public and Political Acceptance of Direct Potable Reuse*, WateReuse California, Sacramento, CA.

During each breakout session, two of the four groups addressed focus areas related to Treatment and Monitoring, and the other two groups addressed focus areas related to Regulatory and Public Acceptance, as follows:

Group	Focus of Breakout Session	
	Day 1	Day 2
Treatment/Monitoring 1	Treatment	Monitoring
Treatment/Monitoring 2	Monitoring	Treatment
Regulatory/Public Acceptance 1	Regulatory	Public Acceptance
Regulatory/Public Acceptance 2	Public Acceptance	Regulatory

The goal of each breakout session was to identify as many issues as possible under the focus area that need to be evaluated to address information gaps and develop direct potable reuse regulations. To prompt discussion, presentation slides were developed in advance of the workshop to highlight study issues raised in the white papers and WateReuse Research Needs workshop.

The individual groups discussed the tasks needed to resolve each study issue, as well as generated additional study issues and associated tasks. Each group had a Moderator to lead the discussion and a Scribe to capture comments about each study issue and its associated tasks.

Following the breakout sessions, all the workshop participants assembled in a plenary session, where each group summarized its top study issues.

3.4 Consolidation/Resolution

On the second day, following the conclusion of the breakout sessions, the two Treatment and Monitoring groups and the two Regulatory and Public Acceptance groups worked together to consolidate their respective study issues. Task lists for identical and similar study issues were combined, as appropriate, and priority issues were determined. At the end of the workshop, all participants met in a plenary session to review and clarify the consolidated study issues.

4. WORKSHOP SUMMARY

The consolidated study issues, with their associated lists of tasks, for the Public Acceptance, Regulatory, and Treatment and Monitoring focus areas include:

- ***Public Acceptance***
  1. Develop Appropriate Terminology
  2. Survey Stakeholders
  3. Develop Messages
  4. Develop a Communications Strategy
  5. Implement the Communications Strategy

- ***Regulatory Issues***
  1. Evaluate Existing Regulations
  2. Identify an Optimal Regulatory Scheme
  3. Develop a CEC Evaluation Approach
  4. Evaluate the Need for an Environmental Buffer
  5. Create a Source Control Strategy
  6. Develop a Communications Protocol
  7. Develop Treatment Performance Standards

- ***Treatment and Monitoring***
  1. Water Quality Treatment Performance Goals
  2. Performance Monitoring
  3. Substitution of the Environmental Buffer
  4. Monitoring for Public Health Assurance
  5. Define Direct Potable Reuse
  6. System Design Considerations
  7. Need for Enhanced Source Control
  8. Diversity of Treatment Barriers for Constituents
  9. Data Reporting
  10. Operational Guidelines
  11. Blending
  12. Concentrate and Residual Management
  13. Monitoring for Environmental Impacts

Each of these study issues, with their associated lists of tasks, is discussed in detail in the following sections.

5. PUBLIC ACCEPTANCE

Workshop participants identified the following tasks as the highest priorities in addressing public acceptance issues related to implementing direct potable reuse in California:

1. Develop Appropriate Terminology
2. Survey Stakeholders
3. Develop Messages
4. Develop a Communications Strategy
5. Implement the Communications Strategy

TASK 1 – DEVELOP APPROPRIATE TERMINOLOGY

Water recycling terminology should be developed that is understandable by stakeholders and consistent with regulations to instill credibility and product confidence.

- ***Product Water***. Terms such as "purified water," "new water," and (simply) "water" should be evaluated for applicability and appropriateness when referencing product water. Some participants suggested that terms such as "regenerated water" should be avoided because they may provide an inappropriate characterization of the process or water.

  In addition, how the water recycling industry currently describes nonpotable reuse creates a challenge for direct potable reuse that should be addressed. For example, California regulations require signage declaring recycled water unfit for human consumption (i.e., signs are required to state "Recycled Water - Do Not Drink"). Such messages are counterproductive to encouraging the acceptance of direct potable reuse.

- ***Direct Versus Indirect***. The need for terminology distinguishing between indirect and direct potable should be evaluated. While possibly needed in a regulatory context, the distinction between direct and indirect potable reuse may be unnecessary and possibly confusing when communicating with the public, stakeholders, and decision makers.

- ***Possible Resources***. WateReuse Research Foundation Project WRF-09-01 (Talking About Water: Vocabulary and Images that Support Informed Decisions About Water Recycling) is in progress and may provide ideas for developing the appropriate terminology. The goal of this project is to provide stakeholders with a common vocabulary to create a greater degree of understanding about water reuse and desalination. This project will identify words and images, and will develop a lexicon that enhances effective communication and open consideration of water reuse and desalination.

TASK 2 – SURVEY STAKEHOLDERS

Understanding and embracing the perspective of stakeholders is a critical foundation for planning and implementing a communications strategy to promote direct potable reuse.

2.1 Identify Stakeholders

Stakeholders may include:

- Water customers.
- Consumer protection groups.
- Environmental advocates, including environmental justice advocates.
- Water and wastewater professionals.
- Policy makers and elected officials at water agencies or other local agencies.
- Regulators.
- Others, as appropriate.

2.2 Determine the Purpose of Surveys

Stakeholder surveys can:

- Determine the extent to which the public differentiates between direct and indirect potable reuse.
- Evaluate public perception of the definition and need for natural treatment/environmental barriers.
- Identify any opposition to direct potable reuse, including opposition that may be different from indirect potable reuse.
- Determine why proponents support direct potable reuse projects.

Surveys are needed early in the process to understand stakeholder attitudes towards direct potable reuse and to target subsequent outreach activities and messages.

2.3 Develop Survey Questions

Potential survey questions may include:

- "What is the origin of your water?"
- "How is your water treated before it gets to you?"
- "Are you aware that your water agency/district conducts tests over and above what is required by regulatory standards to ensure the safety of your water?"
- "Would you support augmenting your drinking water supply with locally produced, sustainable recycled water?"
    - Do not ask if stakeholders are willing to "drink recycled water," since it is considered drinking water once it is delivered. Rather, ask if they are willing to use recycled water as a source of their drinking water.
    - Provide specific examples, such as, "Would you drink the water if we put it in your reservoir with "x" percent of dilution?"
    - As an agency, reach out to community leaders and conduct annual surveys and measure opinion trends over time.
- "Are the environmental and greenhouse gas implications of your drinking water important to you?"
    - Ask "contingency valuation" questions to determine price points; that is, questions to infer the value that consumers put on choices with respect to a public good.

  - Allow stakeholders to balance the environmental costs and benefits of water supply alternatives.
  - Evaluate ability and willingness to pay for sustainable, high quality, and reliable water.
  - Highlight the need for "the right water for the right use."
- "Would you prefer Option 1 at 'a' costs and 'b' benefits, or Option 2 at 'x' costs and 'y' benefits (and one of them is a direct potable reuse project)?"
  - Do not ask, "How much more are you willing to pay for water that is recycled?"
- For those opposed to potable reuse, ask: "Would you be more favorable if you knew that water supplies currently include wastewater effluent contributions from upstream treatment facilities?"
  - How would the findings of local public health officials and water quality scientists that have studied potable reuse increase support?
- "What questions would you have if a direct potable reuse project was planned for your community?"
  - A stakeholder question might be: "What happens if treatment fails?"

2.4 Other Suggestions

Other suggestions include:
- Survey the term "purified water" and other terms for product water.
- Measure the change in attitudes toward direct potable reuse over time by conducting periodic studies.
- Consider John Ruetten's work on the best practices for developing potable reuse projects[5] and Brent Haddad's work on public attitudes towards water[6] as a basis for formulating survey(s)
- Note that most stakeholders will oppose direct potable reuse when asked questions about direct potable reuse that are out of context.

TASK 3 – DEVELOP MESSAGES

Develop messages to address concerns and break down barriers to direct potable reuse. Include the terminology developed in Task 1 and stakeholder perspectives identified in Task 2.

3.1 Audience

Message recipients should include:
- Both supporters and opponents of direct potable reuse; however, these messages may vary.
- Both the broader water industry and the water recycling community.

3.2 Content

Messages should address:
- The status of existing direct and indirect potable reuse projects. Include successes and testimonials that focus on safety and quality.

[5] Best Practices for Developing Indirect Potable Reuse Projects, 2005 (WRF-004-01)
[6] The Psychology of Water Reclamation and Reuse, 2009 (WRF-04-008)

- Information on direct potable reuse as a viable option.
- Public health and safety concerns.
- Measures that compensate for the loss of the natural/environmental barrier's perception, treatment, and "time-safety" benefits.
- Sustainability of resources. For example, in California, 4-million acre feet of wastewater are discharged into the ocean every day. This wastewater provides a significant potential for additional recycled water.

3.3 Objectives

Messages should:

- Build on the existing trust between the utility and consumer.
- Acknowledge the source of the water, but focus on the technology/purification processes and monitoring approaches.
- Underscore the scientific and technical basis for recycled water.
- Address the predisposition that "natural is good" so, therefore, recycled water is questionable (or "bad").

3.4 Considerations

When developing messages:

- Consider "certifying" the product as "safe." Have the water backed by groups, including local organizations, that have credibility (perhaps a university or the U.S. Green Building Council, for example, but not a government agency).
- Develop a product name and/or a phrase to counter and replace "Toilet to Tap."
- Avoid the engineer's tendency to only include treatment and monitoring processes that demonstrate water quality benefits. Consider linking the level of treatment and monitoring to the level of safety needed. The water has to be safe from a public health point-of-view.
- Be informed by the bottled water experience – that which tastes good sells better than a "natural" spring water.

TASK 4 – DEVELOP A COMMUNICATIONS STRATEGY

A strategy should be developed to communicate the messages developed in Task 3 about direct potable reuse that takes into account the following considerations:

4.1 Be Proactive

- Start talking with communities before a specific direct potable reuse project is proposed. Talk about the problem that needs to be solved, potential solutions, and potable reuse.
- Conduct a feasibility study of all the alternatives. Include stakeholders in the process.

4.2 Consider the Alternatives

- Develop alternative project designs and include stakeholders. Communicate these options to broader stakeholders to demonstrate openness to possible alternative solutions.

4.3 Incorporate Prior Experience

- Use best practices learned from indirect potable reuse projects.
- Describe existing water recycling project experiences.

4.4 Understand Human Nature

- People have a high tolerance for uncertainty as long as they get to make the decision – they have little tolerance if somebody else makes decisions for them. Proposals for direct potable reuse projects need to describe uncertainty and be selected (or not) in a public process in which the stakeholders have an ownership stake.
- Embrace the "yuck" factor rather than evade it; it will not go away. However, the public tends to support the product water once they learn of its superior quality.
- In terms of public perception, the water utility should be viewed as the sponsoring utility. A wastewater agency should not be the water purveyor. If you are both a water and wastewater agency, put your water hat on.

4.5 Provide Useful Information

- Develop simple, accurate, and easy-to-understand communication messages about direct potable reuse.
- Develop methods of informing stakeholders about direct potable reuse that are not project specific.
- Educate the community about the water cycle. This effort may include developing advertisements and websites, and conducting outreach geared towards young people.
- Promote self-education and self-understanding about direct potable reuse.
- Create a website with information so individuals can assess the risks themselves.

4.6 Develop Trusting Relationships

- Maintain consistent and proactive transparency with the press and public.
- Communicate directly with community leaders. These leaders may include politicians, policymakers, and informal leaders, such as medical providers, church leaders, and teachers. Work with leaders at the Federal, State, and local levels. If your community leaders are convinced, then newspaper articles in opposition to your project will not be as relevant.

4.7 Use a Hands-On Approach

- Person-to-person contact is much more effective than other communication methods.
- Build upon the recommendations from other scientific and regulatory activities associated with trace organics in our water supplies.
- Show people the treatment facility and encourage them to touch and drink the water to demonstrate its safety.
- Place the advanced treated water in the hands of community members. Develop a bottled

water sample that can be distributed so people can try the water themselves.

4.8 Work with Opponents

- Identify opponents of direct potable reuse. Not all will be obvious. They could be opposed to direct potable reuse for different reasons, such as they have a different agenda. Respond to their agenda, or call them on it publicly.
- Do not be too quick to classify people as supporters and opponents; doing so can be divisive.
- Listen to and work with opponents of direct potable reuse. Learn what can be done to address their concerns.
- Educate the opposition and bring them on-board the project. Once opponents are educated, they become strong supporters.
- As there are no direct potable reuse projects currently underway, consider a collaborative approach rather than identify opponents. Ask, "Here is what we are thinking and why. What is your response?"
- Opponents to indirect potable reuse are plausible potential opponents to direct potable reuse.

TASK 5 – IMPLEMENT THE COMMUNICATIONS STRATEGY

The communications strategy would be implemented consistent with the details developed in Task 4.

6. REGULATORY

Workshop participants identified the following tasks as the highest priorities in addressing regulatory issues related to implementing direct potable reuse in California:

1. Evaluate Existing Regulations
2. Identify an Optimal Regulatory Scheme
3. Develop a CEC Evaluation Approach
4. Evaluate the Need for an Environmental Buffer
5. Create a Source Control Strategy
6. Develop a Communications Protocol
7. Develop Treatment Performance Standards

TASK 1 – EVALUATE EXISTING REGULATIONS

The 2010 NWRI white paper, *Regulatory Aspects of Direct Potable Reuse in California*, identified (1) regulations applicable to direct potable reuse and (2) issues that need to be addressed for direct potable reuse to proceed in California. This evaluation of state and federal statutes, regulations, and policies should be expanded to more fully identify the limitations to implementing direct potable reuse (including water rights and concentrate/residual management system permits).

In particular, the following activities should be undertaken:

- Identify how existing statutes, regulations, and policies address indirect potable reuse via groundwater recharge and surface water augmentation to help understand how these statutes may be applied toward direct potable reuse.
- Determine how drinking water regulations can be used to evaluate the acceptability of direct potable reuse proposals. Submit the evaluation to the California Department of Public Health (CDPH) and Regional Water Quality Control Boards (RWQCBs) as an early step in considering direct potable reuse to augment drinking water supplies.
- To help define the beneficial use of recycled water, clarify the point at which water makes the transition from Water Code authority to Health and Safety Code authority. Issues to consider may include:
  - Determine where (or if) RWQCB authority must be replaced by CDPH authority, and vice versa.
  - Consider changes to the Memorandum of Agreement (MOA) or develop an alternative strategy between CDPH and the State Water Resources Control Board (SWRCB).
  - Drinking water standards would need to be met if the wastewater treatment plant discharges directly into the water distribution system. Determine which entity (RWQCB or CDPH) would be the regulator. A possible regulatory model would be the waste well provision in which CDPH holds public hearings and determines requirements, and RWQCB includes such requirements in the permit it issues. Determine if RWQCB has the authority to regulate "discharge" directly into a drinking water system.
- Determine if changes are needed to water rights regulations to protect beneficial uses and instream flow or to protect individual water rights.
- Determine what existing or new certification programs will be required by SWRCB and

CDPH for treatment plant operators of direct potable reuse systems.
  - What licensing is required for operating direct potable reuse systems? Include requirements for the types of treatments needed for direct potable reuse.
  - Encourage collaboration between SWRCB and CDPH committees (that work on operator certification) to discuss and determine whether operators need to be separately certified.
- Determine strategies for the proper disposal, treatment, and permitting of concentrate/residual.
  - Develop National Pollutant Discharge Elimination System (NPDES) permitting strategies and Clean Water Act amendments, as needed (especially if a new disposal system is needed or an existing outfall needs to be converted).

TASK 2 – IDENTIFY AN OPTIMAL REGULATORY SCHEME

Using the results of Task 1, identify the optimum and most appropriate regulatory scheme for direct potable reuse. This effort may include realigning CDPH and SWRCB authority.

TASK 3 – DEVELOP A CEC EVALUATION APPROACH

The scope of the SWRCB's Science Advisory Panel for Chemicals of Emerging Concern (CEC) should be expanded to include reservoir augmentation and direct potable reuse. The Panel's recommended approach for indirect potable reuse could possibly be adapted and applied to direct potable reuse projects.[7]

In addition, existing treatment process efficacies should be evaluated to determine if CEC reduction/removal and monitoring methodologies are adequate to evaluate and reduce risks, as well as to eliminate the need for the environmental buffer and retention time. The risk of failure with respect to CEC removal should also be evaluated. This effort could be accomplished by comparing Orange County Water District's treatment results to CEC removals being achieved, and by studying operational challenges and the frequency of failure in drinking water and wastewater treatment plants.

TASK 4 – EVALUATE THE NEED FOR AN ENVIRONMENTAL BUFFER

The environmental buffer represents the time and space that recycled water passes through between wastewater treatment and drinking water treatment (or, if no treatment of groundwater occurs, distribution as potable supply in indirect potable reuse projects). The environmental buffer is required in indirect potable reuse projects to provide reaction time to address treatment inadequacies for toxic substances and to allow for the attenuation of pathogens and constituents.

Direct potable reuse, by definition, has no environmental buffer. Available treatment process efficacies for constituent reduction/removal and monitoring methodologies should be evaluated to determine if (1) risks are adequately reduced and (2) the need for the environmental buffer and retention time is eliminated.

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[7] State Water Resources Control Board (2010). *Final Report: Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water, Recommendations of a Science Advisory Panel*. State Water Resources Control Board, Sacramento, CA. Download report at http://www.sccwrp.org/view.php?id=574.

The following factors should be considered or undertaken:

- Establish a water supply reliability standard and the role of the environmental buffer to achieve the standard.
- Evaluate the following: supply reliability; performance; and public perception of environmental buffers and alternative water supply reliability strategies.
- Identify regulatory and treatment options/alternatives to the environmental buffer; for example, critical control point monitoring and actions.
- Convene an independent advisory panel to investigate the need for an environmental buffer, as well as to identify knowledge gaps.
- Support research to address these knowledge gaps.
- Evaluate whether CDPH's "Policy Guidance for Direct Domestic Use of Extremely Impaired Sources" might apply to the direct potable reuse of municipal wastewater. In particular, consider Section 5 (evaluate the risks of failure of the treatment system and potential health risks) and Section 6 (identify alternatives to the use of extremely impaired sources and determine health risks to the community).

TASK 5 – CREATE A SOURCE CONTROL STRATEGY

A source control strategy should be developed as part of a multi-barrier approach to help assure the quality of potable reuse source water. This strategy could build on current "green chemistry" (i.e., extended manufacturer responsibility) research and source reduction concepts to control pharmaceuticals and personal care products, pesticides, and other constituents.[8] Current source control program requirements for pretreatment and for controlling potentially hazardous chemicals should be evaluated and adapted, as needed, to protect direct potable reuse source water.

TASK 6 – DEVELOP A COMMUNICATIONS PROTOCOL

A communication protocol is needed to inform all involved agencies that off-spec water may have been (1) introduced into the potable supply distribution system or (2) was diverted, causing a supply interruption.

TASK 7 – DEVELOP TREATMENT PERFORMANCE STANDARDS

Regulating each potentially harmful compound is not feasible; therefore, the adequacy of direct potable reuse treatment should be evaluated using surrogate and indicator compounds. Prior research should be summarized and additional research undertaken, as needed, to identify a complete suite of suitable surrogate compounds.

[8] See: California Green Chemistry Initiative at http://www.dtsc.ca.gov/PollutionPrevention/GreenChemistryInitiative/index.cfm

7. TREATMENT AND MONITORING

Workshop participants identified the following tasks as the highest priorities in addressing treatment and monitoring issues related to implementing direct potable reuse in California:

1. Water Quality Treatment Performance Goals
2. Performance Monitoring
3. Substitution of the Environmental Buffer
4. Monitoring for Public Health Assurance
5. Define Direct Potable Reuse
6. System Design Considerations
7. Need for Enhanced Source Control
8. Diversity of Treatment Barriers for Constituents
9. Data Reporting
10. Operational Guidelines
11. Blending
12. Concentrate and Residual Management
13. Monitoring for Environmental Impacts

TASK 1: WATER QUALITY TREATMENT PERFORMANCE GOALS

The water quality treatment performance goals for direct potable reuse should be clarified. This effort would be made in addition to meeting drinking water standards (and includes protecting against unknowns).

The following is recommended to help clarify performance goals:
- Tie performance to public health protection.
- Consider flexibility and cost-effective alternative treatment processes.
- Assess the sustainability and energy input of direct potable reuse.

1.1 Process Monitoring

Process monitoring considerations include:
- Evaluate current wastewater treatment plant monitoring (e.g., turbidity, chlorine residual).
- Minimize the potential for fouling during advanced treatment.
- Develop a list of constituents for process monitoring, including: total organic carbon, characterization of organics, and others that may provide comparison of treatment effectiveness.
- Include membrane integrity monitoring for pathogens and chemicals (which is dependent upon the expectations of process performance).
- Evaluate the removal of CECs by membranes and advanced oxidation processes (AOPs).
- Incorporate online monitoring, where possible.
- Optimize advanced oxidation processes (AOPs) through monitoring.

Additional considerations include:
- Increased monitoring would be needed for performance and reliability, as well as for

membrane integrity and performance.
- In regards to testing membrane performance and breakthrough:
  - Consider using dye as a surrogate for viruses.
  - Note that CDPH currently does not give a significant log credit to membranes for virus removal because of difficulties in monitoring.
  - Evaluate whether CDPH should revisit virus log removal credit for reverse osmosis (RO).
- Examine the use of sidestream treatment rather than returning the untreated waste stream to the head of the plant and recycling constituents.
- Develop a rationale for regulators and the public as to why agencies are treating recycled water to a greater degree than other sources (because the source is from wastewater rather than surface water).
- Pursue sustainable options, such as partial RO and electrodialysis reversal (EDR).

Questions to consider include:
- Should the blend water be monitored? Should other source waters be monitored?
- How would future technologies be included?
- Are constituents being broken down into other potentially problematic compounds, and are they at levels of public health concern?
- Will different ultraviolet (UV) standards be needed for direct potable reuse?
  - Explore hydroxyl radical dose and the optimization of advanced oxidation.

1.2 Adequacy of Treatment

Determine if existing (1) treatment process efficiencies for constituent reduction/removal and (2) monitoring methodologies are considered adequate by CDPH to eliminate the need for an environmental buffer and retention time.

The following actions are recommended to help determine the adequacy of treatment:
- Define "adequate" in terms of treatment.
- Define the treatment objectives.
- Review the final report of the SWRCB's Science Advisory Panel for CECs regarding recommendations for treatment performance surrogates/indicators for CECs.
- Continue to conduct research on alternative treatment systems (non-RO/AOP) to meet CEC standards.
- Manage total dissolved solids (TDS) through treatment and brine management.
- Address treatment redundancy and emergency short-term storage.

Questions to consider include:
- We know what our treatment technologies can achieve, but how reliable are the technologies?
- Is RO/AOP adequate, or is it too much? Do not exclude other treatment processes that may come along.
- Is RO/AOP sustainable from an energy and carbon footprint point-of-view?

1.3 Water Quality Standardization

Evaluate the possibility of incorporating performance standards for advanced treatment to allow more confidence and lower the cost of the technology. Recommended actions include:

- Consider product water quality standardization instead of treatment standardization for all sources.
- Define water quality objectives.
- Provide flexibility for different source water qualities.

Questions to consider include:

- Should standard treatment be recommended for direct potable reuse rather than performance standards (i.e., water quality requirements)?

1.4 Justify the Monitoring Effort

Justify the level of monitoring needed by determining the value of the information gained and the level of investment. Other considerations:

- Include the costs and benefits of monitoring.
- Data is needed to operate the system and to demonstrate safety.

1.5 Monitoring Scheme Quality Assurance/Quality Control (QA/QC)

Characterize the robustness of the monitoring scheme, including:

- Availability of reliable methodologies.
- Appropriate levels of detection.
- Frequency of monitoring (once a month, once a year, etc.).
- Online monitoring (frequency of calibration, redundancy).
- Appropriate sampling and laboratory QA/QC protocols and procedures.
- Reporting.

TASK 2: PERFORMANCE MONITORING

Show how a combination of routine monitoring for indicators, automated monitoring for surrogates, and periodic monitoring for specific contaminants can provide assurance that treatment performance goals are being met on a continuous basis.

To clarify:

- ***Indicator:*** An indicator compound is an individual substance occurring at a quantifiable level that represents certain physicochemical and biodegradable characteristics of a family of trace organic constituents or a family of microbes that are relevant to fate and transport during treatment. It provides a conservative assessment of removal.
- ***Surrogate:*** A surrogate parameter is a quantifiable change of a bulk parameter that can measure the performance of individual unit processes (often in real-time) or operations in removing trace organic compounds.

For this task, the following actions are recommended:

- Develop a candidate treatment scheme(s) for a particular direct potable reuse scenario(s).
- Propose a combination of indicators and surrogates that can be used to confirm that each of the unit operations continues to do what it was designed to do.
- Equip a demonstration-scale process train with the proposed monitoring capability and operate it for a year, along with special supplemental monitoring designed to determine how it is performing.

This approach is consistent with what is provided in the final report of the SWRCB's Science Advisory Panel for CECs.

2.1 Assure Treatment Performance

Surrogates can be used to assure treatment performance by assessing water quality. However, research is needed to identify surrogates, and the surrogate process needs to be better understood.

2.2 Monitoring for a Hazard Analysis Critical Control Point (HACCP) -Type Program

HACCP is a management system in which safety is addressed through the analysis and control of biological, chemical, and physical hazards from source, treatment, distribution, to the finished product. HACCP was developed by the food industry, but is adaptable to other industries.

Define the specific monitoring elements associated with individual processes, including:

- Critical control points.
- Parameters for each critical control point.
- Failure mode (at what point has it stopped functioning?).
- Follow-up actions.
- Hazards in supply.
- Site-specific plans.

2.3 Real-Time Online Monitoring

Determine if real-time online monitoring can be achievable for constituents and/or parameters with existing technology. This process may include:

- Determine what, if any, surrogate parameters should be monitored.
- Determine the monitoring needs for chemical constituents and microbial pathogens.
- Define performance standards for real-time online monitoring.
- Develop online monitoring regimes.
- Validate regimes on pilot- and full-scale installations.

2.4 Rapid Feedback Methodology

In lieu of real-time online monitoring to compensate for the lack of an environmental buffer, consider the use of a methodology that provides very rapid feedback for parameters of interest,

including microbials, CECs, and other chemicals. Develop methods that are accurate, reliable, and capable of being integrated into Supervisory Control and Data Acquisition (SCADA) systems at water reclamation facilities.

2.5 Rapid Bioassay

Rapid bioassays are used to provide security against product water contamination and to promote regulatory and public confidence. The following actions are recommended:

- Evaluate the available fish and other bioassay approaches.
- Determine what actions need to be taken as a result of the test system response.
- Assess flow through and capture bioassays.

2.6 Process for Choosing Monitoring Approaches

Develop or identify possible monitoring approaches for risk-based and performance-based monitoring, or monitoring for public perception, including:

- Identify what you want to address from the monitoring program.
- Determine which chemicals (surrogates and indicators), at what locations, and at what temporal scale will be included in the monitoring.
- Characterize the source water quality for designing the treatment process.
- Define process performance criteria.
- Determine a list of final water quality requirements (validating the process).

TASK 3: SUBSTITUTION OF THE ENVIRONMENTAL BUFFER

Direct potable reuse projects do not use groundwater or surface water augmentation; therefore, additional treatment, time, monitoring, reliability, and response will need to be considered. Recommendations include:

- Identify the regulatory and treatment options/alternatives available to compensate for the loss of an environmental buffer:
  - Start anew on regulations instead of building off of indirect potable reuse regulations, which require an environmental buffer.
  - Define the level of treatment that the environmental barrier provides and what other types of treatment can replace the environmental barrier.
  - Establish metrics – are drinking water regulations adequate?
- Convene an independent advisory panel to investigate this issue and provide recommendations, as well as to identify knowledge gaps. Support research to address these knowledge gaps.
- Evaluate the loss of an environmental buffer and what may be required to compensate for this loss, including public perception of the barrier.
- Consider the question of how to substitute for the functions attributed to a buffer.
- One option is to tie the benefit of a buffer to soil aquifer treatment (from an engineering view). This approach will provide an approach for assessing any public health benefits of the

buffer.

Additional considerations include:
- Define "buffer" in terms of retention and reaction time, more treatment, dilution, etc.
- Note that: buffer + monitoring = time for correction.
- Direct potable reuse has less certainty from a public health point of view than indirect potable reuse due to less retention and reaction time and dilution associated with a buffer.
- The amount of time for agencies to react in an event of an issue is a critical factor.
- Trace organics, such as pharmaceuticals and endocrine disrupting chemicals are not necessarily removed through groundwater recharge efforts and that the travel time in the ground is meant for pathogen removal.
- Avoid incrementalism with respect to treatment; need to remove constituents regardless of source; use best available technology.
- Sustainability is an important consideration in evaluating water supply projects.
- Hold a dialogue with the drinking water community because TOC and Total Nitrogen could be regulated in drinking water.
- Wastewater treatment plants in Oregon are now responsible for compliance with regulations for several hundred constituents. How would this trend affect potential direct potable regulations including the use of an environmental buffer?
- Determine how to best manage CECs and nitrates, such as through source control and treatment, rather than relying on an environmental buffer.
- The final report of the SWRCB's Science Advisory Panel for CECs mentions four relevant CECs: NDMA, triclosan, caffeine, and estradiol.

Questions to consider include:
- Should direct potable reuse be equivalent to indirect potable reuse? Where useful, use current groundwater recharge reuse project regulations as a starting point
- Is a water treatment plant an "environmental buffer"?
- Under what circumstances should RO be used? Where is the balance between the use of advanced technologies and sustainability?
- Will systems continue to be repaired using the same technology or will the technology improve resulting in additional treatment benefits?

TASK 4: MONITORING FOR PUBLIC HEALTH ASSURANCE

Monitoring for public health assurance involves the following considerations:
- At a minimum, include drinking water monitoring requirements.
- For reporting, possibly add a column of additional monitoring in consumer confidence reports (CCRs) for drinking water.
- Consider continued biological sampling in the distribution system.
- Additional online, real-time monitoring may be necessary for public assurance.

Additional considerations include:
- Possible additional constituents for monitoring: coliforms, turbidity, lead, copper, disinfection byproducts.

- Frequency of monitoring for all constituents.
- The response plan should be the same as current drinking water standards; investigate all sources.
- From the public's perspective, the source of the contamination does not matter; just address it.
- Additional monitoring is recommended by the SWRCB's Science Advisory Panel for CECs.
  - The Panel found that only four contaminants pose significant health risk for indirect potable reuse; however, the report recommends additional monitoring for performance reasons.
- Identify applicable biological sampling.

Questions to consider include:

- If the water is going into a drinking water treatment plant, which provides further treatment, how will this effect monitoring?
- Will additional monitoring expand to traditional drinking water sources?
- What type of monitoring has been done for the Orange County Water District's Groundwater Replenishment System?
- Is online monitoring needed? Evaluate to see if it is necessary, especially for public assurance.

4.1 Constituents of Emerging Concern

Identify CECs that should be monitored for directly or indirectly via the use of surrogates.

- Use a transparent process (like the SWRCB's Science Advisory Panel for CECs) to identify CECs to be monitored and the related monitoring methodology.
- Define the purposes of CEC monitoring (i.e., public health, treatment performance, etc.).
- Determine the appropriate CECs to be monitored.
- Define the applicable monitoring methods and detection limits.
- Examine the use of indicators and surrogates.
- Evaluate the use of a HACCP-type process for addressing CECs.

TASK 5: DEFINE DIRECT POTABLE REUSE

A clear definition is needed for "direct potable reuse," and a clear distinction is needed between what constitutes "direct potable reuse" versus "indirect potable reuse."

- Consider dropping "direct" from the term "direct potable reuse."
- Identify the treatment schemes that may be considered for direct potable reuse. Understand any regulatory implications of these various schemes.
- Determine what constitutes an environmental buffer and how that would impact direct potable reuse.
- Develop a standard, inclusive definition of "direct potable reuse." However, consider having different terminology for different scenarios.
- Develop a set of definitions that unambiguously address all direct potable reuse situations.
-

Additional considerations include:
- Emphasize that indirect potable reuse is not being abandoned for direct potable reuse.
- Leave options open for non-energy intensive treatment processes.

TASK 6: SYSTEM DESIGN CONSIDERATIONS

System design considerations are needed for direct potable reuse and may include the following:
- Online, real-time monitoring.
- Enough storage capacity to ensure a realistic amount of time between production and distribution to allow for diversion (should the plant experience a major failure).
- Built-in alternative emergency water supply (for short-term redundancy rather than long-term).
- Periodic testing and simulation of the diversion system.
- Security issues (U.S. EPA and Department of Homeland Security research).

Additional considerations include:
- Monitoring wells provide an alert, but the information will be publicly available and agencies would need to effectively communicate the results to the public.
- Consider both microbial and chemical constituents.
- The response time will be limited: for example, in an event of an issue, it could take 20 minutes just to shut a valve.
- Identify spikes in turbidity, pathogens, nitrogen, etc.
- Nitrogen is an important issue to the RWQCBs.

Questions to consider include:
- How do we replace monitoring wells from the indirect potable reuse process, which provided water quality assurance?
- Do we need a diversion to discharge in the event of an issue?
- What is the amount of time needed to be achieved through storage?

Note that this issue may be more applicable in pipe-to-pipe situations.

6.1 Use of Storage

Storage capacity provides the benefit of time to respond:
- Storage provides time to get monitoring results. The faster the monitoring, the smaller the storage.
  - Determine if online chemical monitoring can be used to make an assessment of water quality.
- Time is a critical issue for direct potable reuse. What compensates for the loss of retention/reaction time (i.e., 6-month requirement for indirect potable reuse)?

Additional considerations include:
- Storage will require investment.

- The system design is important.
- A continuous process of management is needed.

6.2 Process for Innovation

Determine the process (e.g., water quality, reliability) for new treatment innovations, including:
- Validation mechanism.
- Alternative methods of treatment providing an equivalent level of treatment and reliability.
- The path to show equivalent levels of treatment and reliability.

Review of the process by an independent advisory panel may be useful.

6.3 Immediate Response

Determine a means for immediate response to prevent the release of product water with unacceptable levels of microbials, CECs, and other chemicals into a drinking water supply. Consider the use of storage as a buffer.

TASK 7: NEED FOR ENHANCED SOURCE CONTROL

An enhanced source control program may be needed to reduce or eliminate certain chemicals (or other wastes) from entering the wastewater collection system. Recommended actions include:

- Review current source control program requirements for pretreatment and for controlling potentially hazardous chemicals.
- Determine who regulates (RWQCB or CDPH) the source control program (e.g., watershed protection efforts; treating the sewershed as the watershed).
- Consider online continuous source control monitoring (but address false positives).
- Assess the potential benefits of enhanced source control.

Additional considerations include:
- The industrial source control program can serve as a sanitary survey.
- A coordinated program is needed.
- Dual collection systems may be applicable to separate industrial waste and/or TDS.
- Address CECs that originate from hospitals and unused prescriptions.
- Is there a need for super-enhanced source control (i.e., over and above what is required for indirect potable reuse)?

7.1 Collection System Monitoring

Collection system monitoring involves the following considerations:
- Before monitoring, review the enhanced source control program to see if it is applicable for direct potable reuse.
- Articulate response plans.
- Explore alternative designs of the collection system.

- Create a HACCP, continuous in-system monitoring program. Rename to eliminate "hazard."
- Monitor for constituents that (1) could upset plant reliability, (2) may not be removed by the plant, and (3) are indicative of upstream industrial waste.
- Include failsafe disposal.

Additional considerations include:
- An expanded, more robust industrial waste pretreatment program may be needed.
- The permit holder is responsible for the contaminants and must provide an alternate source in case of an emergency.
- Can monitoring of the processes be conducted by the water agency?
- Can smart meters be used?
- Consider a mandatory source control program for all customers.
- What stops illegal dumping?
- Regarding homeland security, we must be able to divert part of flow in a collection system, but this is not currently built into current collection systems. Possible modification of the collection system may be needed.
- Consider in-system monitoring versus self monitoring.
- Examples of what would upset the plant include high COD, boron, and formaldehyde.
- Monitor for what could get through the plant and/or what would be toxic.

TASK 8: DIVERSITY OF TREATMENT BARRIERS FOR CONSTITUENTS

A diversity of treatment barriers provides reliability and is required to ensure constituents are reduced to acceptable levels in product water. Recommended actions include:

- Determine the number, type, and reliability of necessary treatment processes.
- Reexamine the definition of "multiple barrier."

8.1 Multiple Barriers for CECs

Multiple barriers may be required to ensure all CECs are reduced to acceptable levels in product water. Recommended actions include:
- Determine the number, type, and reliability of necessary treatment processes.
- Convene an expert advisory panel to investigate and provide recommendations, as well as to identify knowledge gaps (e.g., the SWRCB's Science Advisory Panel for CECs will be helpful). Support research to address these knowledge gaps.
  - More research is needed on tracers/surrogate measures for CECs.
- Develop criteria for "sufficient" multi barriers, and validate the effectiveness of these barriers against the criteria.
  - To define "sufficient" multi barriers, we first need to define water quality objectives and know the source water quality.

Additional considerations include:
- The question of multi-barriers is a microbial issue, not a chemical issue.
- "Multiple barriers" is defined as several technologies to treat the spectrum of CECs, not

redundant technologies.
- Wastewater treatment plant requirements will need to be changed if direct potable reuse/indirect potable reuse is the end use.
- New vocabulary is needed to distinguish redundant versus different types of barriers.

This issue pertains to both indirect potable reuse and direct potable reuse.

TASK 9: DATA REPORTING

This task concerns the protocol of reporting data internally, to regulatory agencies, and to the public. One need is for internal use and another need is for compliance. Recommended actions include:
- Address internal data (information processed through the SCADA system).
- Demonstrate compliance.

9.1 Interpretation and Response of Monitoring Results

Understand and respond to the results of monitoring for the different purposes. Define the different triggers and responses (Maximum Contaminant Levels/benchmark, etc.). What is the decision logic?

TASK 10: OPERATIONAL GUIDELINES

Treatment plant system reliability is provided through monitoring and the control of key operational parameters. Recommended actions include:

- Identify the key parameters for measurement and control.
- Identify critical alarm conditions.
- Perform risk assessment through failure mode analysis.
- Use advanced water treatment technologies.

This task is related to HACCP concepts (it can be achieved through a HACCP program); that is, a continual process improvement program.

10.1 Operator Certification

A certification program for operating advanced water treatment is needed to help increase the confidence of regulatory agencies and the public. Determine what existing or new certification programs will be required by SWRCB and CDPH for treatment plant operators of direct potable reuse. Assess SWRCB funding possibilities.

10.2 Changes in Distribution System

Monitor potential changes in the distribution system, including:
- Microbial population.
- Corrosivity.

- Biofouling or biofilm detachment.
- Disinfection byproduct formation potential.

TASK 11: BLENDING

Although blending will not provide much additional public health protection, it should be considered for operational and aesthetic reasons. Recommended actions include:

- Analyze the impact of blending on raw and finished waters, as appropriate.
- Determine the treatment needed to compensate for reduced dilution.
- Evaluate the benefits of dilution related to the chemistry of the water.

11.1 Dilution

Determine if dilution will be required by CDPH as an added safety factor for direct potable reuse projects. If dilution is required, a regulatory decision will be needed as to whether recycled water must be mixed with other water or if the recycled water contribution can be determined based on total volumes of recycled water and diluent water introduced into a potable water distribution system over a specific time period.

Additional considerations include:
- Dilution may be helpful to meet regulatory levels and TOC regulations.
- Dilution is not always available in drought situations.
- Dilution could be handled on a case-by-case basis; that is, we do not want to lose the option to blend to reduce levels of certain constituents like NDMA.
- Dilution helps protect against unknown constituents.
- Dilution decreases corrosivity issues, and post-treatment stabilization efforts may not be needed.

Questions to consider include:
- Is there value in dilution for direct potable reuse?
- Will regulatory agencies become more comfortable with direct potable reuse as a water supply option if dilution is required?

TASK 12: CONCENTRATE AND RESIDUAL MANAGEMENT

The proper disposal and treatment of concentrate and residuals will be needed if non-destructive processes are used. Therefore, the following actions are recommended:

- Identify the need for additional treatment (a regulatory framework is needed to manage concentrate).
- Develop National Pollutant Discharge Elimination System (NPDES) permitting strategies and Clean Water Act amendments (e.g., the conversion of outfalls to brine lines).
- Define the proper disposal.
- Understand public health considerations.

- Consider heat recovery in wastewater.
- Consider cost issues.

Note that this issue pertains to all recycled water (not just direct potable reuse), and is related to source control efforts (residual management starts at the source). Managing salinity is also important.

TASK 13: MONITORING FOR ENVIRONMENTAL IMPACTS

Monitoring for environmental impacts involves the following:

- Residuals discharge monitoring (such as brine).
- Nutrients in product water, which could affect surface water augmentation.
- Fish toxicity from stabilized RO permeate (consider: chloramines, chemical quenching of UV peroxide).
- Chemical/cation balance.
- Total maximum daily load (TMDL) implications.
- Anti-degradation standards.
- Emergency diversion of water not suitable for drinking.

Questions to consider include:

- Regarding the oxidation of brine, should focus be placed on the quality of residuals?
- Could membranes become hazardous materials?
- What is the potential concentration of hazardous constituents like radionuclides in the concentrate?

8. NEXT STEPS

The Direct Potable Reuse Development Work Plan (Work Plan) will be developed based on the outcomes of the Direct Potable Reuse Workshop. The Work Plan will include, for each study issue, the candidate organizations and individuals to address the issue, possible funding sources, and appropriate timing.

A draft outline of the Work Plan includes:

1. ***Introduction/Background***
   a. Describe Case for Direct Potable Reuse
   b. Summary of Two White Papers
   c. Scope and Purpose of Direct Potable Reuse Work Plan
   d. Existing Regulations

2. ***Workshop Summary***
   a. Purpose
   b. Participants
   c. Structure
   d. Outcomes

3. ***Current Knowledge*** (current projects, studies)

4. ***Direct Potable Reuse Knowledge Gaps and Challenges*** (this section provides an overview of the general issues that the Work Plan addresses)
   a. Treatment
   b. Monitoring
   c. Regulatory
   d. Public Acceptance

5. ***Recommended Direct Potable Reuse Development Activities***
   a. Treatment
   b. Monitoring
   c. Regulatory
   d. Public Acceptance

6. ***Implementation Plan***
   a. Roles/Responsibilities (who should be responsible for various activities)
   b. Funding Sources
   c. Additional workshops
   d. Schedule

7. ***Appendix***
   a. White Papers
   b. Workshop Report

APPENDIX A: WORKSHOP AGENDA

Start Time	Agenda Item		Speaker/ Discussion Leader
Monday, April 26			
10:00	Welcome, workshop goals, process		Dave Smith, Jeff Mosher, Ernie Avila
10:15	Discussion of Regulatory Issues		Jim Crook
11:00	Discussion of Public/Political Acceptance Issues		Margie Nellor, Mark Millan
11:45	Foundation Research Needs Workshop summary		Wade Miller
12:00	Review breakout process, purpose, ground rules		Dave Smith, Jeff Mosher
12:15	Lunch: Global perspective on potable reuse		Ian Law
1:15	Breakout Session 1		
	Group	Focus	
	Treatment/Monitoring 1	Treatment	Tom Richardson
	Treatment/Monitoring 2	Monitoring	Jeff Mosher
	Reg/Public Acceptance 1	Regulatory	Dave Smith
	Reg/Public Acceptance 2	Public Acceptance	Mark Millan
4:00	Report and Discussion		Jeff Mosher
5:00	Adjourn		
Tuesday, April 27			
8:00	Breakout Session 2		
	Group	Focus	
	Treatment/Monitoring	Monitoring	Tom Richardson
	Treatment/Monitoring	Treatment	Jeff Mosher
	Reg/Public Acceptance	Public Acceptance	Dave Smith
	Reg/Public Acceptance	Regulatory	Mark Millan
11:00	Report and Discussion		Jeff Mosher
12:00	Lunch		
12:45	Consolidation (Two Groups)		Dave Smith, Jeff Mosher
2:00	Plenary Session		Dave Smith, Jeff Mosher
3:00	Adjourn		

APPENDIX B: WORKSHOP ATTENDEES

Potable Reuse Workshop - Sacramento, CA

Attendee List -- April 26-27, 2010

Last Name	First Name	Title	Affiliation	Address	City	State	Zip	Email
Atwater	Richard	Chief Executive Officer	Inland Empire Utilities Agency	6075 Kimball Ave. Bldg. A	Chino	CA	91710	atwater@ieua.org
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Potable Reuse Workshop - Sacramento, CA

Attendee List -- April 26-27, 2010

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Spath	Dave	Chief, Drinking Water & Environmental Management	California Department of Public Health	P.O Box 997377	Sacramento	CA	95899	Dave.Spath@cdph.ca.gov
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Tchobanoglous	George	Professor Emeritus	University of California, Davis	662 Diego Place	Davis	CA	95616	gtchobanoglous@ucdavis.edu

Potable Reuse Workshop - Sacramento, CA

Attendee List -- April 26-27, 2010

Last Name	First Name	Title	Affiliation	Address	City	State	Zip	Email
Tremblay	Ray	Assistant Departmental Engineer	Los Angeles County Sanitation District	1955 Workman Mill Rd	Whittier	CA	90601	rtremblay@lacsd.org
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Wildermuth	Ron	Manager, Public & Government Affairs	West Basin Municipal Water District	17140 S. Avalon Blvd., Ste. 210	Carson	CA	90746	ronw@westbasin.org

APPENDIX C: BREAKOUT GROUP ASSIGNMENTS

Treatment/Monitoring - Group 1		
Ernie	Avila	California Urban Water Agencies
Jean	Debroux	Kennedy/Jenks Consultants
Jayne	Joy	Eastern Municipal Water District
Audrey	Levine	US Environmental Protection Agency (U.S. EPA)
Mike	Markus	Orange County Water District
Hoover	Ng	Water Replenishment District of Southern California
Pankaj	Parekh	Los Angeles Department of Water and Power
Cathleen	Pieroni	City of San Diego
Dave	Requa	Dublin San Ramon Services District
Tom	Richardson*	RMC Water and Environment
Andy	Salveson	Carollo Engineers
Julia	Sorensen**	Kennedy/Jenks Consultants
Dave	Spath	California Department of Public Health
George	Tchobanoglous	University of California, Davis
Ray	Tremblay	Los Angeles County Sanitation Districts
Anthony	Van	City of San Diego
Treatment/Monitoring - Group 2		
Bob	Cooper	BioVir Laboratories
Joe	Cotruvo	Consultant (Retired U.S. EPA)
Jorg	Drewes	Colorado School of Mines
Bob	Hultquist	California Department of Public Health
Raymond	Jay	Metropolitan Water District of Southern California
Helene	Kubler	RMC Water and Environment
Mark	LeChevallier	American Water
Bruce	Moore	Southern Nevada Water Authority
Jeff	Mosher*	National Water Research Institute
Joan	Rose	Michigan State University
Shane	Snyder	Southern Nevada Water Authority
Rhodes	Trussell	Trussell Engineering
Mark	Umphres	Helix Water District
Gina	Vartanian**	National Water Research Institute
Mike	Wehner	Orange County Water District
Regulatory/Public Acceptance - Group 1		
Richard	Atwater	Inland Empire Utilities Agency
Jon	Bishop	State Water Resources Control Board
Jennifer	Burke**	City of Santa Rosa, California
Jim	Crook	Consultant
Monica	Gasca	Los Angeles County Sanitation Districts
Ian	Law	Consultant
David	Mauier	Planning and Conservation League
Adam	Olivieri	EOA, Inc.
John	Rossi	Western Municipal Water District
John	Ruetten	Resource Trends, Inc.
Dave	Smith*	WateReuse California
Bill	Steele	Bureau of Reclamation
Marsi	Steirer	City of San Diego Water Department
Gary	Yamamoto	California Department of Public Health

Regulatory/Public Acceptance - Group 2		
Steven	Book	California Department of Public Health
Celeste	Cantu	Santa Ana Watershed Project Authority
Deepti	Chatti**	Carollo Engineers
Martha	Davis	Inland Empire Utilities Agency
Miles	Ferris	City of Santa Rosa, California
Mark	Gold	Heal the Bay
Liz	Haven	State Water Resources Control Board
Mark	Millan*	Data Instincts
Wade	Miller	WateReuse Association
Jonas	Minton	Planning & Conservation League
Margie	Nellor	Nellor Environmental Associates
Mary Grace	Pawson	Winzler & Kelly
Toby	Roy	San Diego County Water Authority
Ron	Wildermuth	West Basin Municipal Water District

* Moderator
**Scribe