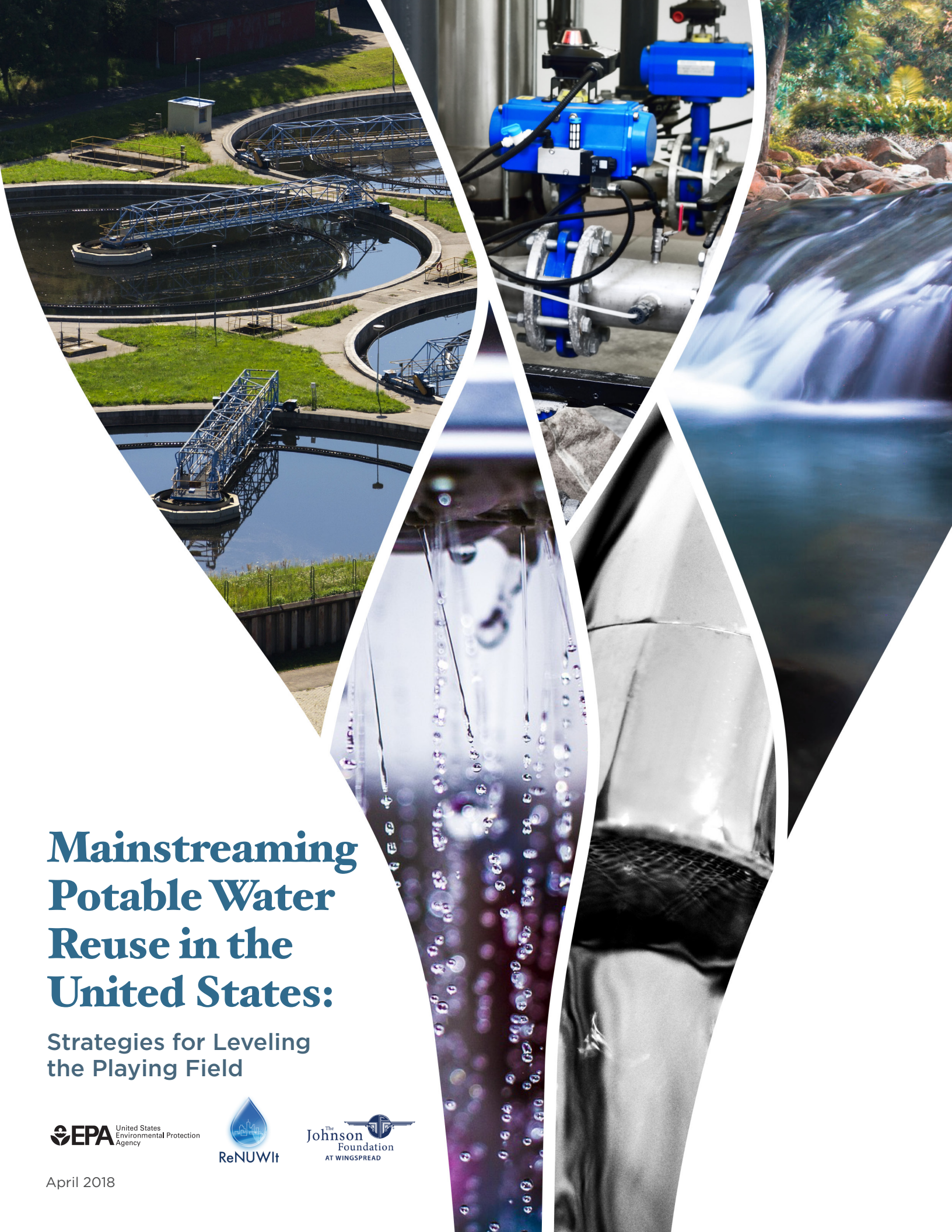


Mainstreaming Potable Water Reuse in the United States:

Strategies for Leveling the Playing Field

EPA United States Environmental Protection Agency

ReNUWIt

The Johnson Foundation AT WINGSPREAD

April 2018

Foreword: A Note from the Organizers

As interest in potable water reuse intensifies among municipal utilities, state and federal governments, researchers, and supporting organizations, significant effort has been focused on technical objectives related to ensuring system performance and reliability, documenting contaminant removal and public health protection, and reducing project costs. These efforts are paying off. Utilities in certain water-stressed regions are implementing successful water reuse projects, particularly in states with a long history of innovative water projects (e.g., California, Texas). Many states where interest in potable reuse is growing (e.g., Colorado, Oklahoma, North Carolina, Florida) could benefit from the experience and insights of those on the leading edge as they develop the expertise and mechanisms necessary to plan, regulate, and manage water reuse systems.

The technical and engineering capacity to safely reuse treated wastewater for potable purposes has been well documented. Professional societies and utility-sponsored organizations have helped researchers and utilities share technical knowledge about the latest developments in treatment technology, water quality, and monitoring. Meanwhile, case studies and expert forums indicate that these same stakeholders have encountered significant institutional hurdles in implementing potable water reuse projects, including planning, governance, legal/regulatory, financial, political, and sociological challenges. To date utility managers, technical experts, regulators, and other stakeholders have had few opportunities to discuss strategies for overcoming non-technical or institutional implementation challenges. As a result, communities that may benefit from potable water reuse but lack experience with the practice tend to be deterred from considering the practice to be a viable water supply option.

To address the issue of institutional hurdles to potable reuse, the U.S. Environmental Protection Agency (EPA), in partnership with the ReNUWIt (Reinventing the Nation's Urban Water Infrastructure) research consortium and The Johnson Foundation at Wingspread, convened a group of national, regional, and local leaders for an intensive workshop on October 25–27, 2017. Participants included diverse experts from across the U.S.—utility managers, state and federal regulators, water sector association representatives, environmental advocates, academics, researchers, and equipment and service providers—who generated the ideas and insights upon which this report is based. The group explored the institutional complexities and challenges associated with implementing potable water reuse projects and outlined practical strategies to elevate potable reuse to the same state of legitimacy and acceptance as established drinking water sources. The workshop did not address technical and public health dimensions of potable reuse.

This report is intended to inform the broader dialogue about water reuse through a specific focus on potable reuse. The goals are to help municipalities and utilities that are considering potable reuse develop their approach and to help advance the efforts of those who are ready to implement projects. Additionally, we hope to inform the U.S. EPA, state agencies, and other key stakeholders about how they can support the

expansion of potable water reuse across the United States. We hope the report is useful in your endeavors and strongly encourage other leaders in the field to invest in building capacity and thinking creatively about how to act upon the ideas presented here.

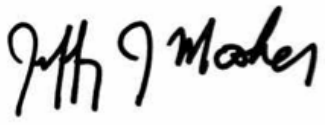
Sincerely,

Dave Smith
Manager, NPDES Permits Section
U.S. EPA Region 9

David Sedlak
Deputy Director, ReNUWIt
University of California at Berkeley

Roger Dower
President
The Johnson Foundation at Wingspread

Ed Archuleta
Director of Water Initiatives, Center for
Environmental Resource Management
University of Texas at El Paso



Jeff Mosher
Chief Research Officer
Water Environment & Reuse Foundation

Acknowledgments

U.S. EPA, ReNUWIt, and The Johnson Foundation at Wingspread would like to thank Jeff Lape at EPA's Office of Science and Technology for arranging project funding and Peter Grevatt, Director of EPA's Office of Groundwater and Drinking Water, for his active support for the workshop concept. We gratefully acknowledge the diligent work of the workshop planning team, as well as our speakers, to illuminate the challenges and opportunities the nation faces in expanding implementation of potable water reuse. We greatly appreciate the enthusiasm and engagement of all the participants, whose thoughtful involvement made the workshop a success and yielded the insights needed to develop this report. Finally, we also thank Meridian Institute and Paradigm Environmental for facilitating the planning and delivery of the workshop and coordinating development of the report.

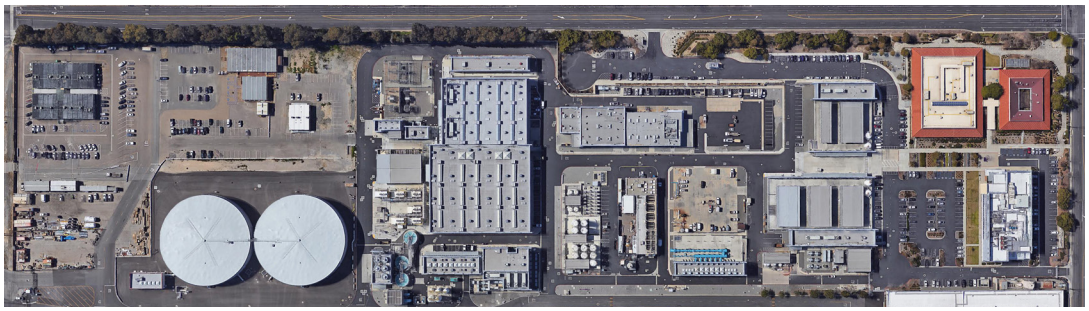
The Maturation of Potable Water Reuse

The practice of potable water reuse has evolved in important ways in the United States over the past 50 years, especially during the last 25 years. Prior to the 1990s, many cities and public health regulators recognized that municipal wastewater effluent accounted for a significant fraction of the surface water entering their drinking water treatment plants.[1] Wastewater utilities generally addressed this situation by treating and disinfecting effluent consistent with Clean Water Act permitting requirements and, where feasible, minimizing the fraction of wastewater in drinking water intakes. Because of concerns associated with the presence of wastewater and contaminants from other sources (e.g., industrial pollution, agricultural runoff), some cities began to upgrade drinking water treatment plants by installing advanced treatment technologies to provide enhanced safeguards for public health protection. As water availability and water quality issues became more prevalent in rapidly growing areas, water managers soon began to explicitly consider the use of wastewater effluent to augment water supplies.

What practices qualify as "potable water reuse"?

There is no single definition of potable water reuse, but the practice generally involves the planned use of treated municipal wastewater for augmenting drinking water supplies.[2] Potable water reuse is defined here as encompassing a continuum of applications ranging from different types of indirect potable reuse (e.g., systems in which communities use surface water or groundwater containing treated wastewater as a drinking water source) to flange-to-flange direct potable reuse (e.g., systems that introduce purified water directly back into an existing water supply system).[3] The ideas and strategies presented in this report are relevant for any project falling within this broad spectrum of potable water reuse practices. However, the report is designed to focus upon planned potable reuse practices.

Driven by these interests, a modest number of potable reuse projects were built during the 1960s through the 1980s. The earliest projects were built in Southern California, with treated wastewater used to recharge groundwater aquifers. Built in 1978 in Fairfax County, Virginia, the Upper Occoquan Service Authority was the first project in the United States to use effluent from an advanced treatment plant to directly augment a surface water reservoir.[4] During the 1980s two additional projects were developed successfully in Texas and Georgia.[5] As water scarcity became a more serious issue in the 1990s, other cities sought to replicate the practice with additional projects built in California, Georgia, and Arizona. However, the highly visible rejection of a handful of projects in California in the late 1990s and early 2000s cast doubt on the future expansion of potable reuse.

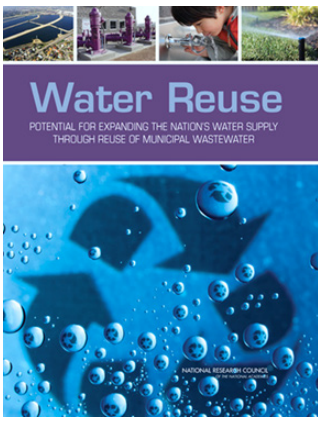


Orange County Groundwater Replenishment System. Courtesy of Orange County Water District.

Upper Occoquan Sewer Authority
Courtesy Upper Occoquan Sewer Authority. Courtesy of Stockholm International Water Institute.

Several developments since the late 1990s reflect evolving attitudes among water professionals about potable water reuse.
In 1998, a National Research Council (NRC) study, *Issues in Potable Reuse: The Viability of Augmenting Drinking Water Supplies with Reclaimed Water*, indicated that use of reclaimed water was safe to use to augment a water supply but should be a "solution of last resort."[6] This statement reflected questions and uncertainties about the practice that could not be resolved without more data from full-scale potable water reuse systems. Although several new potable water reuse projects were built in California, Arizona, and Colorado over the next decade, lingering doubts remained among regulators, practitioners, and members of the public. Shortly after publication of the 1998 NRC study, researchers began reporting the presence of trace concentrations of pharmaceuticals and ingredients from personal care products in wastewater effluent and effluent-receiving surface waters.[7] A lack of knowledge about the potential risks associated with exposure to these contaminants and an absence of information on the ability of potable reuse systems to remove the contaminants raised further concerns about the practice.

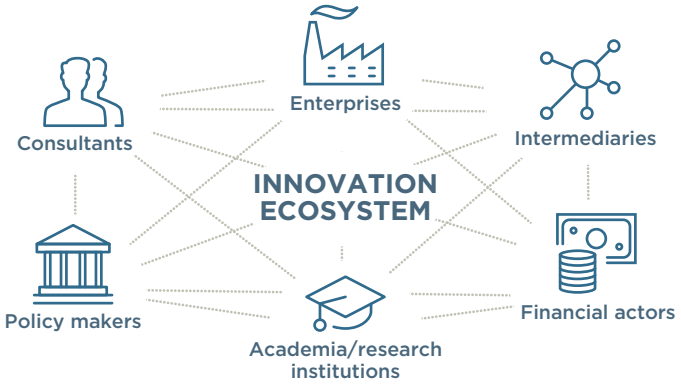
Over the next decade, advances in the science and technologies associated with potable water reuse helped reduce concerns about public health and boost confidence in and acceptance of the practice among both water professionals and the public. Operators gained experience with the technologies and researchers collected more data on the ability of plants to remove contaminants. Expert review panels organized by the National Water Research Institute (NWRI) helped vet, validate, and summarize the data.[8] In addition, proponents of potable reuse learned how to communicate more effectively with the public and decision makers about the safety and reliability of the practice. Public acceptance of alternative water supply sources has also increased as conventional sources have been adversely affected by recent severe drought in states like Texas and California, and demand has increased amid rapid population growth in different regions across the country.[9] For instance, the success of the Orange County Groundwater Replenishment System (GWRS) since 2008 highlighted the effectiveness of indirect potable reuse for bolstering drinking water supplies through groundwater replenishment in semi-arid Southern California.[10]



The 2012 NRC report *Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater* concluded that "[e]xpanding water reuse – the use of treated wastewater for beneficial purposes including irrigation, industrial uses, and drinking water augmentation – could significantly increase the nation's total available water resources."[11] This clear endorsement of reuse as an option to supplement and diversify drinking water supply by a science-based, expert body played an important role in convincing decision makers that the practice of potable water reuse was worthy of consideration in the water resource planning process. Building upon the NRC's positive assessment of the role potable water reuse can have in developing resilient water supplies, organizations representing water professionals increased their activities in support of mainstreaming the technology. In 2014, the American Water Works Association issued a policy statement endorsing the use of reclaimed water to replenish drinking water sources and manage aquifer levels, and suggested that direct potable reuse (i.e., the use of highly treated

wastewater as a water supply without the use of an intermediate environmental buffer) may be a viable option assuming appropriate treatment and public health safeguards.[12] Water sector professionals have also increasingly embraced potable water reuse as evidenced by participation in the WateReuse Research Foundation's Direct Potable Reuse Initiative, which raised $6 million from consulting firms and utilities in California from 2012–2016 and leveraged that funding into 34 research projects valued at $24 million.[13] Additionally, the membership of the WateReuse Association represents more than 200 communities and 60 million utility customers around the country and plays a critical role advocating for the practice.[14]

The growing interest in potable reuse has coincided with a broader trend in the water sector in which the management of drinking water, wastewater, and stormwater are becoming increasingly integrated. As part of this trend, the three most prominent research foundations in the water sector (Water Research Foundation, Water Environment Research Foundation, and WateReuse Research Foundation) have been integrated into a single organization, The Water Research Foundation.[15] Because potable reuse, and water reuse in general, is predicated on bridging the gap between wastewater and drinking water, these mergers and the broader trend toward integrated water management can be expected to further interest in potable reuse as a management strategy for addressing a variety of issues from water supply sustainability, to nutrient management and impacts from climate change.



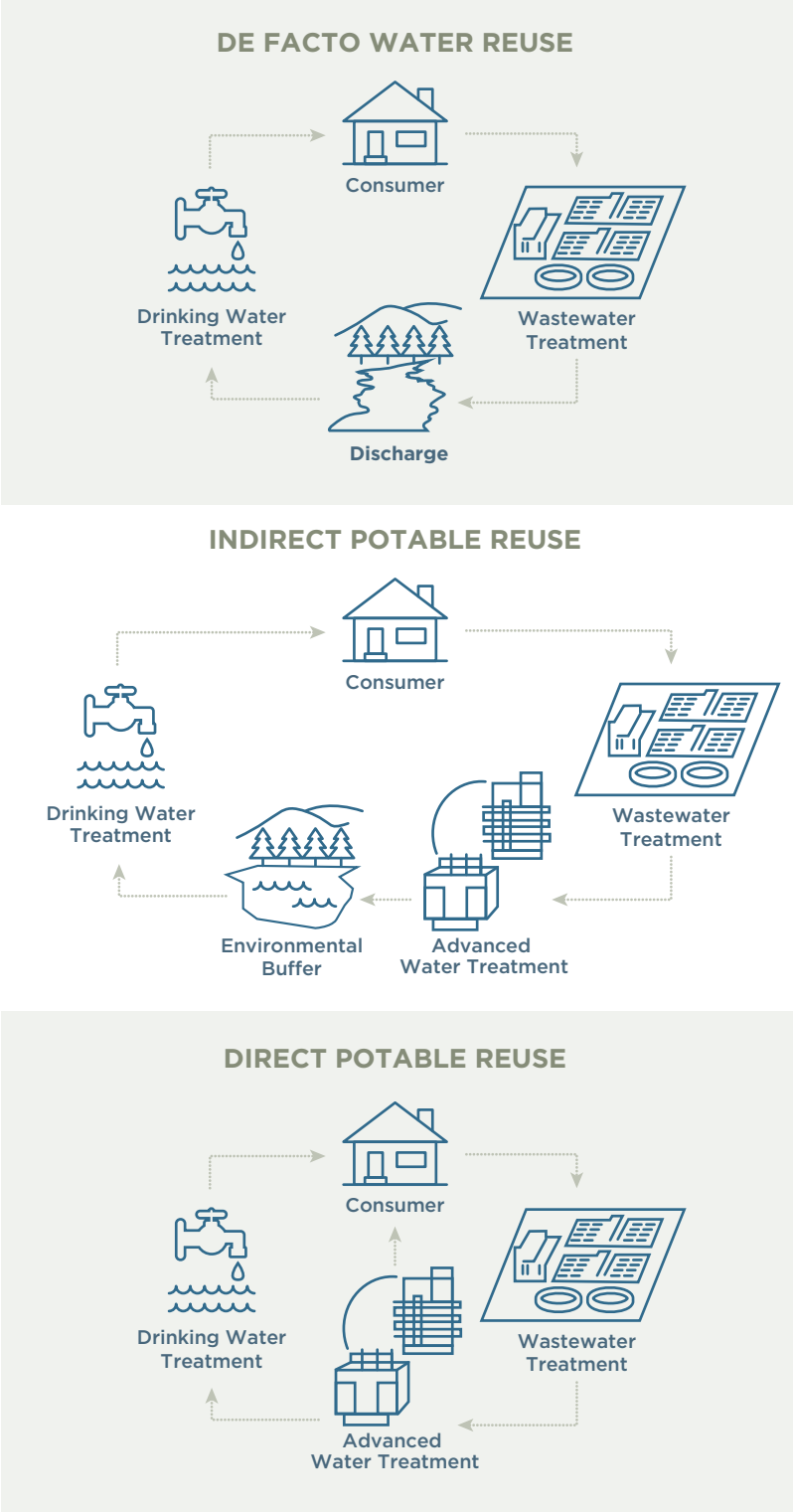
The recent trajectory of potable water reuse reflects the development of a community of practitioners who understand the ingredients necessary to successfully implement potable reuse projects along with greater acceptance among the public and decision makers. However, the current potable water reuse "innovation ecosystem" in the United States—the network of professionals with relevant knowledge and experience—remains generally limited to Southern California, Texas, and a few other cities in the Southwest, Southeast, and mid-Atlantic. Meanwhile, a growing number of states and water utilities in other regions are actively investigating potable water reuse projects, but a lack of experience among regulators, utility leaders, and consultants continues to pose challenges to project implementation. While public acceptance of potable water reuse has generally increased over the past 25 years, opinions still vary regionally. Communities that are familiar with the practice because of operational projects or ongoing discussion of it as an option tend to be more supportive. In places where the practice is still perceived as novel, more skepticism exists.

The present challenge centers on how best to extend the established trajectory of potable water reuse and accelerate diffusion of the practice to places where it could provide a solution to meet local needs. This report presents a synthesis of the ideas shared by the early adopters and thought leaders involved in the October 2017 workshop about how to build the legitimacy and advance the practice of potable water reuse nationally. It is one example of the knowledge transfer needed to overcome existing institutional challenges and expand the innovation ecosystem needed to safely expand the application of potable water reuse across the nation. The balance of this report highlights specific factors for successful implementation of projects, including strategies to build legitimacy, plan and develop projects effectively, and create an enabling policy environment so that potable water reuse will ultimately be considered a mainstream water supply option in the United States.

Potable Water Reuse as Part of a Diversified Water Supply

Potable water reuse is just one option among many in the development of a diversified, resilient water supply portfolio and should be considered alongside other more widely accepted water resource options such as conservation, imported water, desalination, and non-potable water reuse. As with the development of any water source, utilities and planners must carefully evaluate the potential costs, benefits, and drawbacks of potable reuse within a broader water planning and watershed management context. This requires understanding community values and priorities and examining how different supply options may affect or be affected by existing governance structures, wastewater and stormwater management systems, sustainability goals, and local or regional long-term planning processes.

Due to public health concerns associated with the status of potable reuse as a relatively novel practice and the inherent risks associated with employing wastewater as a water source, utilities must clear a particularly high bar to successfully implement and maintain potable water reuse projects in the U.S. As a result, potable water reuse projects are often subjected to more intensive treatment requirements, monitoring, and control than other water sources. In addition to developing a water source that is less susceptible to drought, the practice may produce water quality improvements at the watershed scale. In cases of indirect potable reuse, highly treated wastewater discharged into an environmental buffer (e.g., a groundwater aquifer or a surface water reservoir, lake,



Courtesy of WateReuse Association.

or river) may be of higher quality than the source water supplies. Other ancillary benefits could include reducing ecosystem impacts of surface water diversions and avoiding overdraft of groundwater aquifers. On the other hand, direct potable reuse systems may have unintended consequences such as reduced in-stream flows and related adverse water quality impacts because of less dilution of pollutants, as well as infringement on downstream water rights.

Accelerating an Established Trajectory: Ingredients for Success

While potable reuse projects have slowly been proliferating across the nation as the technology has advanced and water scarcity has increased, institutional hurdles remain on several fronts. Although utilities have made great strides, many are still learning how best to engage the public and decision makers, build understanding, and gain support for new projects, as well as how to navigate regulatory and governance structures and approaches for financing projects. In addition, the external policy and professional landscape within which utilities operate continues to evolve on the issue of potable reuse. Regulatory and legal disincentives are beginning to diminish, new regulatory structures are being created, and researchers are documenting and reporting experiences with an array of potable reuse projects and approaches more widely. The following section of this report describes strategies that can contribute to the successful implementation of potable water reuse projects in places where it makes sense, as well as those that could help accelerate the trajectory of potable water reuse toward the mainstream.

Building Legitimacy

Research shows that reliance on traditional public relations or educational outreach is often not adequate to gain public and political support for potable water reuse projects, especially in cases where the utility has not already established trust among members of the public.[16] Instead utilities or communities interested in establishing potable reuse as a component of their water supply portfolio should take a tailored, robust, multipronged approach to planning and implementation geared toward establishing legitimacy rather than merely attempting to gain public acceptance of a specific project. Legitimacy is a concept that acknowledges that creating widespread trust in a technological innovation depends on strategies that target community values while also addressing sectoral and societal rules, norms, and conventions. In practice, legitimacy equates to a technology becoming "taken for granted" in society. The concept can be differentiated into three basic types, summarized as follows:[17]

- **Pragmatic legitimacy**: the innovation serves the self-interest of the consumer;
- **Moral legitimacy**: the innovation meets external standards set by institutions in which consumers have trust;
- **Cognitive legitimacy**: the innovation meshes with the cultural belief system and daily life experience of the consumer.

Achieving legitimacy in this robust sense goes beyond a typical public relations campaign to include other elements, such as demonstration of institutional competence and robust safety and public health protocols, stakeholder engagement in project development, and use of objective experts to provide unbiased advice. Ultimately, achieving legitimacy among community members and elected officials is the most important ingredient in the recipe because without it, a project can still fail even if a utility has addressed technological or permitting challenges.

Pure Water San Diego Facility. Courtesy of City of San Diego.

Leverage Excellent Reputation and Operations

Regardless of the size, complexity, or technical capacity of the water or wastewater utility, the reputation of the organization among community members, regulators, and other relevant governing bodies is a critical ingredient of a successful project. It is typically not sufficient to simply attempt to build trust around a certain project. Rather, a utility must have built trust over time through safe, reliable service and efficient operations to have a sound basis for pursuing potable water reuse with a good chance of success. If that is not the case, proposed projects may face moderate or intense opposition regardless of whether they are technologically sound.

For example, in the mid to late 1990s, the City of San Diego pursued its first attempt to implement a potable reuse project, which, after several years of planning, outreach, and initial environmental and some design studies, did not move forward for a variety of reasons. One of those reasons was that the project was led by staff from the wastewater division primarily because they had successfully constructed several facilities, including the treatment plant that was the proposed source of water for the potable reuse project. San Diego had been operating an advanced primary treatment process at the regional wastewater plant and receiving waivers from requirements to move to secondary treatment. While the wastewater staff interacted with some members of the environmental community, they had little regular interaction with the broader community and no noteworthy reputation among most residents. Hence, it appeared to many that the potable reuse project was a way for the city to reduce the volume of wastewater it discharged by putting it into the drinking water supply, keeping its waiver intact.

The misperception of the proposed San Diego project among the public was exacerbated by the introduction of the phrase “toilet to tap” in the local media, a term originally conceived by opponents of a different proposed potable reuse project in the state. In addition, media reports about contaminants in drinking water began to surface nationally and the proposed San Diego project was used as a wedge issue in local and state political races. The lack of visibility of the City of San Diego’s water division on the proposed project and a failure of the wastewater and water divisions to counteract misleading information in the media with proactive local community engagement exacerbated misperceptions engendered by the “toilet-to-tap” moniker. Ultimately the project stalled because of the wastewater division’s lack of reputation and the water division’s lack of visibility.

Years later, San Diego's Public Utilities Department revived the proposal as an indirect potable reuse project, coined Pure Water San Diego, to increase water supply resilience and reliability for the region, to reduce dependence on water imported from the Colorado River and northern California, and to reduce ocean discharges from a regional wastewater plant.[18] Pure Water San Diego has seen broad public support as the department has engaged in extensive community education and engagement, including tours and open house events at its demonstration facility where visitors learn about the science of the advanced technology and where tasting of the product water is actively encouraged. While every project is local, this case illustrates why it is important for managers contemplating whether to pursue a potable reuse project to reflect on their utility's historical service levels and standing among key stakeholders, keep policy makers informed with accurate information, and commit to a robust public outreach and education effort before delving too deeply into planning.

Enact a Robust Communications and Outreach Strategy

It is essential that utilities create and execute a comprehensive strategic communication, outreach, and involvement strategy to build credibility with the public and generate political will for the development of potable reuse projects. Planning should be informed by proactive and continuous communication with key parties—consumers, elected officials, regulators, advocacy organizations, media outlets, utility staff— before, during, and after project development. While education about the technology and proposed processes is important, outreach strategies need to offer authentic engagement and public involvement opportunities that go beyond messaging about the virtues of potable reuse and demonstrate responsiveness to the specific concerns and interests of local people and decision makers.[19] It is critical to create opportunities for diverse points of view to be fully represented in project planning, including both project proponents and parties who have significant concerns.

Outreach to Build Legitimacy: Essential Ingredients for Success

- Strong reputation
- Trusted messengers
- Continuous outreach
- Connection with local interests and values
- Multiple channels
- Tailored approaches for different audiences
- Authentic engagement
- Genuine public involvement opportunities

Courtesy of Hampton Roads Sanitation District.

Utilities should embrace diverse stakeholder perspectives while aiming to build a coalition of partners and supporters across different sectors. It is important for projects to have trusted, vocal champions both from within the utility (e.g., a well-respected general manager) as well as externally (e.g., public health experts, environmental advocates, community leaders, elected officials). Utilities should keep stakeholders apprised as projects are constructed, tested, and approved by regulators, along with updates once projects are operational. Once a utility commits to a project, a demonstration phase may be critical to ensure that the treatment system performs properly in a technical sense. It also provides stakeholders with an opportunity to become familiar with the process. Arranging tours of a new facility can be an especially powerful way to introduce people to the technology and demystify the process.

As part of its Sustainable Water Initiative for Tomorrow (SWIFT), the centerpiece of which is a groundwater replenishment system that injects highly treated wastewater into a regional aquifer, the Hampton Roads Sanitation District (HRSD) in Virginia used a multifaceted public outreach approach.[20] HRSD conducted a stakeholder mapping exercise to identify key parties for outreach and made stakeholder engagement a priority throughout the planning process. The utility conducted a webinar series and high-level staff traveled throughout the service area. Leaders of the utility personally delivered briefings and listened to stakeholder questions and concerns. HRSD also proactively engaged political leaders and educated them, making a case for SWIFT as a solution to multiple local water challenges and using regional and national examples to highlight anticipated direct and ancillary benefits of the project. Based on the stakeholder engagement process, HRSD identified and incorporated several goals into its planning process.[21] The HRSD experience illustrates the importance of being proactive and transparent, designing with co-benefits in mind as well as committing to a schedule and delivering dependably.

A robust communication and outreach strategy is critical enough that utilities considering a potable reuse project should also consider bringing on external communications expertise to support the effort. Among many benefits afforded by having expertise dedicated to managing communications and outreach, third-party support can be especially helpful in responding rapidly to (negative or positive) media coverage. This is particularly true for smaller utilities that might possess less in-house communications expertise or staff capacity to manage a multidimensional outreach strategy.

Engage External Experts

While an excellent reputation is essential to gaining consumer trust (i.e., moral legitimacy) in potable water reuse projects, a utility can further bolster its case by engaging external experts to provide review and oversight. Engaging a science-based independent advisory panel, such as those organized by NWRI to advise on the design and implementation of projects, is a useful step, particularly in places where there is substantial skepticism or opposition, or where experience with potable reuse is limited. Developed by NWRI to support the assessment and permitting of high-profile potable water reuse projects, the panels comprise leading water professionals, including academics, former regulators, and independent consultants who have considerable expertise in areas relevant to the project. To ensure the panel's independence and integrity, no panel members are associated with the project in a professional capacity. NWRI organizes and manages the panel on behalf of a sponsoring agency, with meetings held at or near the project location, allowing the panel to tour the sites and discuss operations with utility staff members. Each meeting results in a written report that provides findings and recommendations on the various technical, scientific, public outreach, and public health aspects of the project. The reports can be used to guide further studies and as background documents to inform elected officials, regulators, and the public.[22]

The use of NWRI panels or a corollary is strongly recommended because it builds confidence among regulators, as well as community members and elected officials. Panels may also provide a means for periodic expert evaluations of operational projects. For example, the Singapore Public Utilities Board convenes annual meetings of its expert advisory panel to assure that the project undergoes a process of continuous improvement by incorporating knowledge from other locations and responding to changing conditions. Including this element will be particularly important in places where people are generally unfamiliar with potable reuse, but perhaps less intensive efforts are necessary in states like California, Texas, or Arizona that now boast well-established projects. As regulatory agencies and organizations of

operators who manage potable reuse become more familiar with the technology and its oversight, these organizations may be able to assume similar oversight responsibilities in the future as an alternative to convening and maintaining expert advisory panels.

Project Planning and Development

Utilities should plan and evaluate new water supply projects in the context of integrated water management. With respect to potable water reuse, utilities must be able to articulate a convincing argument as to why this specific option is the preferred alternative. The ability to make that case stems from careful and thorough planning conducted in parallel with the type of robust communications and outreach strategy described above. On both fronts, it is important for utility leaders to articulate the need for the project and to outline a clear pathway to implementation.

Establish Need, Purpose, and Benefits

Initial planning steps revolve around developing and communicating a clear sense of the need, purpose, and benefits of a proposed project. This helps to establish the pragmatic legitimacy of the project. Planners should assess the community needs that drive consideration of a project and articulate how a proposed project responds to those needs and how different stakeholders may be impacted. Utilities must demonstrate understanding of other water supply options and show how potable reuse compares in terms of capital and operations and management costs, impact on rates, and safety and reliability. The planning process should align with broader environmental priorities and examine the social, environmental, and economic benefits that justify investment. For instance, utilities can use scenario planning methods to illustrate how potable reuse could enhance the resilience of the water supply to long-term climate change such as more frequent or extended droughts. Sound planning processes should also be transparent about both potential risks and adverse impacts, and approaches to ensure public health protection (e.g., monitoring system, redundant treatment processes, alarms and shutdown triggers, performance testing, and independent review).

Recognize and Manage Constraints

Due to a lack of familiarity with potable water reuse systems, stakeholders may have novel questions (especially in states where it is just emerging) associated with issues such as discharge permits, source water control, and water rights. Therefore, planners need to understand the applicable governance structures that will influence development of a project including legal and regulatory constraints so that they can navigate them effectively. As noted, it is important for utilities to take an integrated water management approach and clearly understand the motivating drivers in the watershed as well as how projects fit into their water supply portfolio.

The Peter D. Binney Water Purification Facility, Aurora Water Prairie Waters Project. Courtesy of Aurora Water.

Utilities need to articulate why potable reuse is desirable as a water supply alternative. They also need to identify who is currently responsible for discharges, the current water quality of receiving waters and how a potable reuse project might impact it, and the downstream users. In western states where the most potable reuse projects have been developed to date, utilities must carefully consider water rights as they influence all levels of planning.

Identify Financing Options

Securing financing for potable reuse projects may be challenging because the practice may be new to finance planners and not clearly fit eligibility criteria of existing funding sources. While financing strategies must be tailored for specific projects and states, a utility can follow best practices to help successfully secure financing. Similar to creating a communications and outreach plan at the outset, utilities should develop a comprehensive financing plan upfront that looks beyond a single project and takes into consideration community interests and long-term capital improvement and asset management needs. Potable water reuse projects ought to be included in standard capital improvement planning (CIP) processes as most will require public financing. As with all proposed investments, utility managers must study the potential impact of a new reuse project on rates and be transparent with ratepayers about the findings. Another potentially wise step is to reach out to bond rating agencies and educate them about potable reuse with an eye toward managing perceived risk and minimizing potential impact on bond ratings.

Capital planners should also evaluate how alternative financing mechanisms might apply to potable water reuse projects. For example, it may be necessary to work with state revolving funds or managers of other traditional funding sources (e.g., local bond underwriters) or EPA's new Water Infrastructure Finance and Innovation Act (WIFIA) program managers to demonstrate how potable reuse projects meet eligibility or underwriting criteria and/or expand eligibility criteria to enable potable reuse funding. Planners may benefit from demonstrating how potable reuse projects generate public benefits beyond increased short-term drinking water supply, a factor that federal, state, or local funders should consider in determining whether to fund projects. As noted above, utilities should highlight benefits such as enhanced resilience to drought and a more sustainable supply to meet future demand, both of which could avert substantial costs over the long term. Finally, to support potable reuse projects, planners should be aware that it may be possible to take advantage of non-traditional funding and financing mechanisms that may not be used for conventional supply development. Examples include EPA's Clean Water State Revolving Fund and Drinking Water State Revolving Fund, the Bureau of Reclamation under the Title XVI Water Reclamation and Reuse program, and the WaterSMART funding program.

Creating an Enabling Policy Environment

A variety of policy developments facilitate the advancement of the potable water reuse enterprise to mainstream status. "Policy environment" is defined broadly here to encompass everything from the creation of binding federal statutes; to statements or guidance issued by regulatory agencies, professional associations, or expert bodies; to state and local policy; to research designed to inform policy or regulations.

Establish Regulatory Standards

Establishing criteria or regulatory standards specifically for potable water reuse that are protective of public health is a critical ingredient needed to mainstream the overall enterprise. Water professionals hold a range of views regarding the scope and scale at which potable water reuse criteria or regulations should be established—national, regional, state, and/or local—as well as how proscriptive they ought to be. Due to the absence of federal regulations on potable reuse, state drinking water primacy agencies have taken initiative and established regulatory and permitting approaches tailored to the rules, needs, and stakeholder interests in their respective states. State-by-state potable reuse implementation appears to provide many advantages and has encouraged innovation that has resulted in the development of safe and reliable projects. Generally, state regulators have shown the ability to work with utilities interested in potable reuse and have successfully permitted projects without undo delays. The different approaches used by states have created an innovative environment supported by academic research, industry research, and pilot and demonstrations facilities at utilities. For these projects, the state approaches used existing Safe Drinking Water Act (SDWA) and Clean Water Act (CWA) regulations as a foundation for the potable reuse projects.

Texas and California have developed the most robust criteria and regulatory/permitting approaches to date. In Texas, the Texas Commission on Environmental Quality (TCEQ) oversees all aspects of planning, permitting, and monitoring to protect the state's water resources. Faced with an urgent need for additional water supplies in parts of the state, TCEQ has approved direct potable reuse (DPR) projects on a case-by-case basis in accordance with the innovative/alternative treatment clause in the Texas Administrative Code addressing public drinking water that allows "any treatment process that does not have specific design requirements" to be considered for permitting.[23] Although this approach allows for flexibility for considering water projects, TCEQ requires that significant pilot testing be completed before a project can achieve final approval. The Colorado River Municipal Water District's Big Spring facility, the only currently operating municipal DPR facility in the U.S., was permitted under this approach and has been operational since 2013.

In California, the State Water Resources Control Board (State Water Board) took the approach of developing regulations for potable reuse. In 2014, the State Water Board's Division of Drinking finalized groundwater replenishment regulations, which were incorporated in the state's recycled water-related regulations. In 2017, draft Surface Water Augmentation regulations were released for public comments with final regulations expected in 2018.[24] California also intends on developing regulations for DPR. In 2016, an expert panel determined that it is feasible for the state to develop recycled water criteria for DPR. In October 2017, Assembly Bill 574 (AB 574) was signed into law and establishes a deadline of December 2023 for initial DPR regulations.[25]

Other states, including Nevada, Colorado, Arizona, Washington, Oklahoma, and Florida, have also established or are exploring the development of potable water reuse regulations. While multiple states have successfully instituted regulatory schemes for potable reuse, some industry professionals see a need for federal regulations. Potential benefits of federal regulations include ensuring a minimum level of public health protection and perceived federal approval of the technologies and approaches. The creation of federal rules could also provide useful assistance to states and local utilities with less technical capacity that are considering potable reuse. However, state and local regulators may be opposed to federal oversight or perceive new federal regulations as undercutting existing state regulatory frameworks and undermining established local projects. It may be possible to address these concerns by establishing national guidance

that recommends potable reuse standards but allows individual states to determine workable regulatory approaches. It is also possible that national reuse guidance could be tailored to some degree to align with public perceptions of risk and varying levels of risk tolerance in different regions.

Develop Policy that Supports Mainstreaming Potable Water Reuse

With potable water reuse emerging in practice across the nation and a federal regulatory regime a distant (and possibly unnecessary) prospect, U.S. EPA can use other policy tools to help advance the enterprise in the near term. Several workshop participants indicated that EPA needs to articulate a clearer policy position supporting potable reuse and recognizing that it can be done safely. In January 2018, following the workshop, EPA released its *2017 Potable Reuse Compendium* (Compendium), which outlines key science, technical, and policy considerations for treating wastewater to drinking water standards.[26] The report supplements the 2012 EPA Guidelines by summarizing current practices and approaches in potable reuse, including the existing technical and policy knowledge base. The report presents the current state of practice in the U.S. to assist planners and decision makers considering potable reuse approaches. Importantly, the preface of the report includes policy statements from the EPA's Office of Ground Water and Drinking Water supportive of potable reuse. These statements include:

- *EPA supports water reuse as part of an integrated water resources management approach developed at the state and local level to meet the water needs of multiple sectors including agriculture, industry, drinking water, and ecosystem protection.*

- *EPA acknowledges the importance of potable water reuse and looks forward to working with our stakeholders as the practice continues to be developed and deployed as an important approach to ensure a clean, safe, and sustainable water supply for the nation.*[27]

These assertions are the clearest statements to date by EPA in support of the use and safety of potable reuse as a viable and needed approach for augmenting the nation's potable water supplies in all regions of the county. These statements from the federal level provide local utilities greater confidence to consider and pursue potable water reuse projects, and state agencies a stronger foundation to develop appropriate regulations.

> *"EPA supports water reuse as part of an integrated water resources management approach developed at the state and local level to meet the water needs of multiple sectors including agriculture, industry, drinking water, and ecosystem protection."*
>
> – **Peter Grevatt**, Director, U.S. EPA Office of Groundwater and Drinking Water

Based on the Compendium, EPA could develop additional guidance for state primacy agencies and/or utilities that could range in specificity from a general description of the essential components of a potable reuse regulatory framework to a specific set of potable reuse system engineering, operational, and performance elements. If formal regulations are not developed on a federal level, non-regulatory federal actions such as guidance could help shape public perception and bolster state and local efforts to ensure the safety of specific potable water reuse projects, as well as build the legitimacy of the overall enterprise.

Create Supportive Mechanisms at State and Local Levels

As more communities across the nation stand to benefit from potable water reuse and consider projects, a variety of steps can help lay the groundwork for successful implementation. Utilities, supporters, and advocates who believe potable reuse could be a useful and appropriate option should raise awareness about the current state of practice in state-wide or local water planning processes. Incorporation of supportive language into official planning documents creates a useful platform for advancing other elements necessary for leveling the playing field for potable reuse. For example, because of concerted outreach and education efforts, Colorado's first state water plan[28] includes a section on potable water reuse, which is enabling progress on the development of state-level regulations. At the regional and local level, watershed-based integrated resource management can help foster collaboration and integration among drinking water and wastewater utilities, which is an essential ingredient for long-term success. Business groups and nongovernmental and research organizations can effectively complement these efforts by incorporating statements supportive of potable reuse in their policies, publications, and outreach materials.

States that establish policy encouraging potable reuse need to allocate staff resources and/or funding to support the development of regulations and the permitting of projects. In California, the State Water Board developed regulations for groundwater replenishment and surface water augmentations and has convened two independent groups, an expert panel of scientists and engineers[29] and an advisory group of stakeholders[30] to provide advice on issues related to the investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse. The recommendations of the independent bodies established the foundation for the development of regulations by the State Water Board. These steps led to the passage of AB 574, establishing regulatory certainty for California communities that want to pursue direct potable reuse.[31]

In other states, the water community has engaged state agencies in implementing or considering potable reuse regulations. In Nevada, regulations for groundwater recharge were developed by the state in 2016 in response to interest by utilities in pursuing potable reuse projects. In Arizona, in response to increased interest by utilities in DPR, the Arizona Department of Environmental Quality made amendments to the state's reclaimed water rules (effective January 1, 2018) based on listening sessions to gather stakeholder input from across the state. In Colorado and Florida, state reuse organizations (WateReuse Colorado and WateReuse Florida) have instituted stakeholder-driven processes to develop recommendations for developing state-wide potable reuse regulations.

State drinking water and clean water revolving funds, local bonds, and other existing mechanisms offer opportunities to support the development of potable reuse projects. EPA's WIFIA loan guarantee program similarly can assist financing of potable reuse projects.[32] In California, several projects were developed with grants and loans under various propositions establishing General Obligation bond financing authority. For example, in 2014, voters approved the Water Quality, Supply, and Infrastructure Improvement Act (Proposition 1), which provided over $7 billion for California's water needs, including $625 million for recycled water projects.[33] In Texas, potable reuse projects are eligible for low-interest loans through the State Water Implementation Fund for Texas (SWIFT).[34]

In the water sector generally, there is a need to reform the policies of different funding agencies to allow or encourage the aggregation of funds among multiple utilities to develop potable reuse (and other water) projects that optimize environmental, social, and economic outcomes to local water challenges. It will also

be important to streamline and align the processes for seeking funding from multiple funding sources which currently have different schedules, application requirements, and eligibility criteria.

Set a National Research Agenda Aimed at Institutional Challenges

Source: Shutterstock

Research on institutional aspects of implementing potable reuse projects is needed to further inform the development of policy and regulations, strengthen professional practice, and propel the enterprise toward the mainstream at all scales. The National Academies of Science, Engineering, and Medicine, Water Research Foundation (WRF), and EPA are all key entities positioned to lead this work. The National Academies may be the most appropriate multistakeholder expert body to set a national research agenda to examine institutional challenges to potable reuse. WRF continues to fund a range of relevant research and could also contribute to agenda-setting as well as funding needed research, as could EPA. For instance, WRF received a $4.5 million grant in 2017 from the State Water Board that will be leveraged through utilities in California and across the nation to further advance the science and acceptance of potable reuse. Additionally, federal, state, and local agencies and other organizations supporting potable reuse may need to cooperate to secure funding to support research by the National Academies and other research organizations. Organizations like the Western Governors' Association and other nongovernmental organizations could also play important roles in advancing a focused research agenda. The following topics could form an initial basis for a national research agenda aimed at overcoming outstanding institutional challenges facing potable water reuse projects:

- **Existing regulatory approaches**: catalogue and publish a compendium capturing the range of existing state regulatory approaches to potable water reuse and their scientific bases;
- **Governance**: document and classify different approaches to overcoming governance fragmentation among drinking water and wastewater utilities such as consolidation, joint-partnership agreements, or virtual partnerships;
- **Water rights**: compile information about how water rights law helps or hinders potable reuse in different states;
- **Incentives**: explore the advantages and disadvantages of creating incentives for potable reuse projects, including an examination of the California and Texas experiences;
- **Unplanned reuse**: examine whether unplanned reuse (the practice of drawing drinking water supply from sources containing a significant amount of treated wastewater discharged upstream) poses public health risks and characterize the steps that should be taken to ensure such systems provide the same protection expected of planned potable water reuse enterprises (broadly defined);
- **Facility operations**: develop advanced water treatment certifications and training for potable reuse system operators based on existing drinking water and wastewater operator certification models;
- **Mainstreaming**: explore the meaning of mainstreaming and characterize the potential benefits and downsides associated with it for potable reuse; and
- **Success stories**: develop case studies of successful potable water reuse projects, detailing lessons learned about effective communications and outreach strategies, financing approaches, and overcoming other implementation challenges.

Conclusion: Recommendations for the Path Forward

Technological advances combined with changing environmental and demographic conditions have increased interest in potable water reuse as a drinking water source over the past two decades. When integrated carefully into a "one water" approach to water resource management,[35] potable reuse can be a smart, long-term water supply option that generates multiple benefits including drought resilience and sustainable drinking water for growing populations. The enterprise is on a promising trajectory that is clearly accelerating, but additional effort is needed to put potable water reuse on par with traditional drinking water sources.

In review, utility leaders and other proponents of potable water reuse are encouraged to explore and implement the following key strategies to advance individual projects and accelerate the mainstreaming of potable water reuse more broadly:

- → Assess the utility's reputation among customers and decision makers before investing in project planning;
- → Create and execute a comprehensive strategic communication, outreach, and involvement strategy to build trust and credibility (and consider enlisting the assistance of a communications consultant);
- → Use an external expert body to advise on the design and implementation, and support monitoring and evaluation of projects (especially in places where potable water reuse is still perceived as a novel practice);
- → Assess the community needs driving consideration of a project, articulate how a project responds to those needs, and how different stakeholders may be impacted;
- → Take an integrated water management approach, understand the motivating drivers, and be prepared to navigate applicable governance structures that will influence development of a project;
- → Develop a comprehensive financing plan that considers community interests, long-term capital improvement and asset management needs, as well as alternative financing mechanisms;
- → Work actively with state primacy agencies to establish workable regulatory approaches that are protective of public health;
- → Introduce potable water reuse as a potential water supply option early in state-wide or local water planning processes;
- → Foster collaboration and integration among drinking water and wastewater utilities through watershed-based integrated resource management processes;
- → Advocate for adequate state funding for the development of potable water reuse regulations;
- → Support development of guidance documents and mechanisms to share examples of successful approaches to addressing the needs listed above; and
- → Support a national research agenda to examine institutional challenges to potable water reuse.

Participants in the October 2017 workshop identified additional practical next steps to advance the legitimization and uptake of potable water reuse in the United States. First, ***establish common, widely accepted definitions*** of different types of potable water reuse that can be adopted and used consistently across the nation for the development of regulations and policy. The definitions outlined in California's AB 574 represent a useful starting point (see text box). Additionally, it is helpful to link the accepted definitions with easily understood educational materials depicting how reuse fits into the water use cycle for communication and outreach purposes.[36]

The water sector also needs to ***build an enterprise-scale innovation ecosystem*** spanning the drinking water and wastewater sectors as well as a range of disciplines. Existing local champions and regional experts must be identified and connected with other water professionals to share knowledge, provide mentoring, and build capacity around technical, planning, communications, regulatory, and operational dimensions of the practice. This effort will require a dedicated convenor and could occur through a variety of channels including a focused workshop series, virtual platforms, and/or professional conferences. The vision expressed at the workshop is to eventually develop a national roster of credible experts upon whom a utility in any region could call to review, validate, and help monitor potable reuse projects. Such a system would serve a similar purpose to current NWRI panels in terms of lending credibility and ensuring proper systems and safeguards are instituted but would be easier for utilities of all sizes and capacity levels to access. In the short term, the ingredients for success presented in this report can help individual utilities and states move projects forward. Over the longer term, leaders in the field need to continue developing and sharing institutional capacity and the skills necessary to build a national-scale innovation ecosystem to more rapidly legitimize potable water reuse as a mainstream drinking water source in the United States.

California Assembly Bill (AB) 574 Definitions

Direct potable reuse is the planned introduction of recycled water either directly into a public water system…or into a raw water supply immediately upstream of a water treatment plant. Direct potable reuse includes, but is not limited to, the following:

- **Raw water augmentation**: the planned placement of recycled water into a system of pipelines or aqueducts that deliver raw water to a drinking water treatment plant that provides water to a public water system.
- **Treated drinking water augmentation**: the planned placement of recycled water into the water distribution system of a public water system.
- **Indirect potable reuse for groundwater recharge**: the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system.
- **Reservoir water augmentation**: the planned placement of recycled water into a raw surface water reservoir used as a source of domestic drinking water supply for a public water system…or into a constructed system conveying water to such a reservoir.[37]

Participant List

Newsha Ajami
Director of Urban Water Policy
Stanford University
Palo Alto, CA

Ed Archuleta
Director, Water Initiatives
Center for Environmental Resource Management
University of Texas at El Paso
El Paso, TX

Rich Atwater
Water Resources Consultant
Metropolitan Water District of Southern California
La Canada, CA

Laura Belanger
Water Resources & Environmental Engineer
Healthy Rivers Program
Western Resource Advocates
Boulder, CO

Marlo Berg
Professional Engineer, Water Supply Division
Texas Commission on Environmental Quality
Austin, TX

Jeff Biggs
Administrator
Tucson Water
Tucson, AZ

Sean Bothwell
Policy Director
California Coastkeeper Alliance
San Francisco, CA

Marshall Brown
Director, Aurora Water
City of Aurora
Aurora, CO

Jason Dadakis
Executive Director of Water Quality & Technical Resources
Orange County Water District
Fountain Valley, CA

Glen Daigger
Professor of Engineering Practice
Civil and Environmental Engineering
University of Michigan
Ann Arbor, MI

Roger Dower
President
The Johnson Foundation at Wingspread
Racine, WI

Ralph Exton
Chief Marketing Officer
Suez Water Technologies & Solutions
Trevose, PA

Denise Fort
Professor Emerita
University of New Mexico
Santa Fe, NM

Daniel Gerrity
Assistant Professor, Department of Civil and Environmental Engineering and Construction
University of Nevada, Las Vegas
Las Vegas, NV

Peter Grevatt
Director, Office of Ground Water and Drinking Water
Office of Water
U.S. Environmental Protection Agency
Washington, DC

Ted Henifin
General Manager
Hampton Roads Sanitation District
Hampton, VA

Participant List (cont.)

Amber Kim
Policy Director
WateReuse Association
Alexandria, VA

Jeff Lape
Deputy Director, Office of Science and Technology
Office of Water
U.S. Environmental Protection Agency
Washington, DC

Justin Mattingly
Research Manager
Water Environment & Reuse Foundation
Alexandria, VA

Ellen McDonald
Principal
Alan Plummer Associates, Inc.
Fort Worth, TX

Christina Montoya
Marketing & Communications Manager
El Paso Water
El Paso, TX

Daniel Nix
Utilities Operations Manager
City of Wichita Falls, Texas
Wichita Falls, TX

Christine Owen
Director of Water and Reuse Innovations
Senior Associate
Hazen and Sawyer
Tampa, FL

Darrin Polhemus
Deputy Director, Division of Drinking Water
California State Water Resources Control Board
Sacramento, CA

David Sedlak
Professor, Civil & Environmental Engineering
University of California, Berkeley
Berkeley, CA

Dave Smith
Manager, NPDES Permits Office
U.S. Environmental Protection Agency, Region 9
San Francisco, CA

Patricia Tennyson
Executive Vice President
Katz & Associates
San Diego, CA

Facilitators

Molly Mayo
Senior Partner
Meridian Institute

Kelsey Semrod
Associate Water Quality Analyst
Paradigm Environmental

Brad Spangler
Senior Mediator and Program Manager
Meridian Institute

End Notes

[1] M. Swayne, G. Boone, D. Bauer, and J. Lee, "Wastewater in Receiving Waters at Water Supply Abstraction Points," U.S. Environmental Protection Agency, EPA/600/2-80/044 (NTIS PB81111007, 1980), https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=47239.

[2] U.S. Environmental Protection Agency, *2012 Guidelines for Water Reuse*, ed. Office of Water, Office of Wastewater Management (Washington, D., 2012), https://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf. The full set of definitions are available in the EPA 2012 guidelines.

[3] American Water Works Association, *Potable Reuse 101* (2016), https://www.awwa.org/Portals/0/files/resources/water%20knowledge/rc%20reuse/Potable%20Reuse%20101.pdf.

[4] National Research Council, *Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater* (Washington, DC: The National Academies Press, 2012), 42, https://www.nap.edu/catalog/13303/water-reuse-potential-for-expanding-the-nations-water-supply-through.

[5] National Research Council, *Water Reuse*, 40.

[6] National Research Council, *Issues in Potable Reuse: The Viability of Augmenting Drinking Water Supplies with Reclaimed Water* (Washington, DC: National Academy Press, 1998), https://www.ncbi.nlm.nih.gov/books/NBK230192/pdf/Bookshelf_NBK230192.pdf.

[7] U.S. Geological Survey, "Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance," *Environmental Science & Technology* 36, no. 6 (2002), http://dx.doi.org/10.1021/es011055j.

[8] National Water Research Institute, NWRI Independent Advisory Panels, http://www.nwri-usa.org/panels.htm.

[9] The Johnson Foundation at Wingspread, *Charting New Waters: Ensuring Urban Water Security in Water-Scarce Regions of the United States* (Racine, WI: Author, 2014), http://www.johnsonfdn.org/sites/default/files/conferences/whitepapers/14/05/19/cnw_urbanwatersecuritymay2014.pdf.

[10] Orange County Water District, GWRS - new water you can count on, https://www.ocwd.com/gwrs/.

[11] National Research Council, *Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater* (Washington, DC: The National Academies Press, 2012).

[12] American Water Works Association, Reclaimed Water for Public Water Supply Purposes, Policy Statement, https://www.awwa.org/about-us/policy-statements/policy-statement/articleid/211/reclaimed-water-for-public-water-supply-purposes.aspx.

[13] The Water Research Foundation, Direct Potable Reuse Research Initiative, http://www.werf.org/i/ka/Water_Reuse/Direct_Potable_Reuse/c/KnowledgeAreas/WaterReuse/Potable_Reuse_Research.aspx.

[14] WateReuse Research Foundation, Vision, Mission & Values, https://watereuse.org/about-watereuse/vision-mission-values/.

[15] The Water Research Foundation, The Foundation: Integration News, http://www.waterrf.org/the-foundation/Pages/Integration_QA.aspx.

[16] Sasha R. Harris-Lovett et al., "Beyond User Acceptance: A Legitimacy Framework for Potable Water Reuse in California," *Environmental Science & Technology* 49, no. 13 (2015), https://pubs.acs.org/doi/abs/10.1021/acs.est.5b00504.

[17] Harris-Lovett et al., "Beyond User Acceptance," 7553.

[18] The City of San Diego, Pure Water San Diego, https://www.sandiego.gov/water/purewater/purewatersd.

[19] WateReuse Research Foundation, "Model Communication Plans for Increasing Awareness and Fostering Acceptance of Direct Potable Reuse," (2015), http://www.werf.org/c/KnowledgeAreas/WaterReuse/ProductsToolsnonWERF/Reuse-13-02_Product.aspx.

[20] SWIFT (Sustainable Water Initiative for Tomorrow), SWIFT: Sustainable Water Initiative for Tomorrow, http://swiftva.com/.

[21] Ted Henifin, "Political Resistance as a Barrier to Potable Reuse: SWIFT" (Workshop presentation, October 26, 2017).

[22] National Water Research Institute, NWRI Independent Advisory Panels, http://www.nwri-usa.org/panels.htm.

[23] Texas Commission on Environmental Quality, "30 TAC §290.42(g) Texas Administrative Code: Rules and Regulations for Public Water Systems, Water Treatment, other treatment processes," Texas Administrative Code (2015).

End Notes (cont.)

[24] California State Water Resources Control Board, Division of Drinking Water's Recycled Water Information, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/RecycledWater.shtml.

[25] State of California, Assembly Bill 574 (AB 574) Chapter 528, (2017) http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB574.

[26] WateReuse Research Foundation, EPA Reaffirms Its Support for Potable Reuse as Part of Integrated Water Plan, https://watereuse.org/watereuse-congratulates-epa-on-release-of-potable-reuse-compendium/.

[27] U.S. Environmental Protection Agency, *Potable Reuse Compendium*, ed. Office of Ground Water and Drinking Water (2017), https://www.epa.gov/sites/production/files/2018-01/documents/potablereusecompendium_3.pdf.

[28] State of Colorado, Colorado's Water Plan (2016), https://www.colorado.gov/pacific/cowaterplan/plan.

[29] California State Water Resources Control Board, Recycled Water - Expert Panel to Advise on Developing Uniform Recycling Criteria for Indirect Potable Reuse via Surface Water Augmentation and on the Feasibility of Developing Such Criteria for Direct Potable Reuse, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/RW_SWA_DPRexpertpanel.shtml.

[30] California State Water Resources Control Board, Recycled Water - Advisory Group on Feasibility of Developing Criteria for Direct Potable Reuse, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/RW_DPR_advisorygroup.shtml.

[31] California Coastkeeper Alliance, California Just Untapped a Drought-Resilient Water Supply: Direct Potable Reuse, https://cacoastkeeper.org/race-top-will-pioneer-direct-potable-reuse/.

[32] U.S. Environmental Protection Agency, Water Infrastructure Finance and Innovation Act (WIFIA), https://www.epa.gov/wifia.

[33] California Natural Resources Agency, Bond Accountability Proposition 1 Overview, http://bondaccountability.resources.ca.gov/p1.aspx.

[34] Texas Water Development Board, State Water Implementation Fund for Texas (SWIFT), http://www.twdb.texas.gov/financial/programs/SWIFT/index.asp.

[35] US Water Alliance, *One Water Roadmap: The Sustainable Management of Life's Most Essential Resource*, (2017), http://uswateralliance.org/sites/uswateralliance.org/files/publications/Roadmap%20FINAL.pdf.

[36] The Water Research Foundation, Water Reuse 101, http://www.werf.org/waterreuse101.

[37] State of California, Assembly Bill 574 (AB 574), Chapter 528 (2017), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB574.

"EPA acknowledges the importance of potable water reuse and looks forward to working with our stakeholders as the practice continues to be developed and deployed as an important approach to ensure a clean, safe, and sustainable water supply for the nation."

– 2017 Potable Reuse Compendium

Report prepared by Meridian Institute and Paradigm Environmental.

Graphic design by Weirdesign.

Copy editing by Full Circle Communications.