US Water Alliance

THE Water Research FOUNDATION

National Blue Ribbon Commission
for Onsite Non-potable Water Systems

Making the Utility Case for Onsite Non-potable Water Systems

Preface

Letter from the Chair

Across the country, water leaders are embracing a new paradigm for water management: One Water. According to the US Water Alliance's *One Water Roadmap,* a promising One Water strategy for thriving cities, reliable and resilient water utilities, and competitive business and industry is the integration of smaller onsite systems that collect, treat, and reuse water within individual buildings or across nearby properties.

The National Blue Ribbon Commission for Onsite Non-potable Water Systems aims to advance the use of these innovative systems by sharing best practices, fostering a supportive policy and regulatory environment, and catalyzing interest in onsite reuse from local communities. The commitment from leading water organizations—the US Water Alliance and the Water Research Foundation—demonstrates rising national interest in these systems and the opportunity to forge progress in the field.

The support and collaboration from drinking water and wastewater utilities is essential to the success of onsite non-potable water systems. Created by and for utility leaders, as well as other interested stakeholders, this document encourages utilities to consider their role in advancing new ways to maximize the use of valuable water resources within buildings.

Paula Kehoe
Director of Water Resources, San Francisco Public Utilities Commission; Chair, National Blue Ribbon Commission

National Blue Ribbon Commission for Onsite Non-potable Water Systems

About the National Blue Ribbon Commission

The mission of the National Blue Ribbon Commission for Onsite Non-potable Water Systems is to advance best management practices that support the use of onsite non-potable water systems for individual buildings or at the local scale. We are committed to protecting public health and the environment, and to sustainably managing water—now and for future generations.

The National Blue Ribbon Commission is convened by the US Water Alliance and the Water Research Foundation, and chaired by the San Francisco Public Utilities Commission (SFPUC).

The commission is comprised of 35 representatives from municipalities, water utilities, and public health agencies from 11 states and the District of Columbia.

The goals of the commission are to:

- Serve as a forum for collaboration and knowledge exchange on the policies, best management practices, procedures, and standards for onsite non-potable water systems;
- Craft model policy guidance and frameworks for the management and oversight of onsite non-potable water systems (e.g., water quality criteria, monitoring and reporting requirements, and operational and permitting strategies);
- Develop case making resources for water utilities based on best practices and lessons learned in the design, development, integration, and operation of onsite non-potable water systems; and
- Identify additional research needs in the field.

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Table of Contents

6 **Introduction**

7 **Section 1.**
What is an onsite non-potable water system?

9 **Section 2.**
How are utilities using onsite non-potable water systems to meet One Water goals?

13 **Section 3.**
What are the key considerations for implementation of onsite non-potable water systems?

21 **Section 4.**
What is the role of utility leadership in deploying onsite non-potable water systems?

23 **Conclusion**

24 **Notes**

Introduction

Eighty percent of the US population lives in a city.[1] That number is expected to grow, increasing the stresses on dwindling water supplies. As our population becomes more urbanized, the social, economic, and environmental vitality of our cities is largely dependent on the sustainable management of water. All around the country we are seeing silo-busting examples of integrated and inclusive approaches to water resource management. These approaches exemplify the view that all water has value and should be managed in a sustainable way. We call this perspective One Water.

One promising approach to One Water management in the built environment is the use of onsite systems that collect, treat, and use alternate water sources for non-potable uses within individual buildings, for surrounding site amenities, or across multiple properties. In cities across the country and around the world, a great deal of research, experimentation, and innovation has given way to proven onsite non-potable water technologies. Many utilities are exploring how onsite non-potable water systems fit into their overall water supply and water resource management portfolio.

As with any emerging technology, the field of practice for onsite non-potable reuse is still taking shape. The case studies presented in this report demonstrate the benefits that onsite non-potable water systems can provide to the building owner, utility, and the broader community. From these demonstration projects we can also learn how water leaders have addressed a range of considerations that arise in the planning and implementation stages.

Onsite non-potable water systems are a vital part of the next wave of innovation in One Water management, especially for cities and large water-reliant businesses. The National Blue Ribbon Commission developed this report to help water and wastewater utilities, local government agencies, and other interested stakeholders understand the benefits and drivers behind onsite non-potable reuse, how other utilities have addressed potential challenges, and best practices for the ongoing operation of these systems. The purpose of this report is to inspire One Water leaders to consider this important and effective strategy in their long-term water resource and resilience planning.

This report is structured into four sections:

- Section One defines the scope of onsite non-potable water systems;
- Section Two highlights how utilities are using onsite non-potable water systems to meet One Water goals;
- Section Three presents the key considerations for implementing onsite non-potable water systems; and
- Section Four outlines the role of utility leadership in deploying onsite non-potable water systems.

Section 1.
What is an onsite non-potable water system?

Increased adoption of a diverse array of water recycling and reuse techniques maximizes valuable water supplies to meet the challenging water demands of the 21st century. The approaches depend on local needs and context, and can include municipal-scale recycled water projects, treatment and reuse at manufacturing sites, the use of recycled water to recharge aquifers and groundwater supplies, rain barrels and laundry-to-landscape systems in individual households, and more.

Onsite non-potable water systems (ONWS) are one strategy that represents a significant opportunity to transform the way water is managed in buildings. In cities throughout the world—New York, San Francisco, Seattle, Tokyo, Sydney, and many others—onsite water systems are being utilized to meet non-potable needs. These systems collect wastewater, stormwater, rainwater, and more, and treat it, as needed, so that it can be used in or near a building.

By matching alternate water sources with the appropriate end use, such as cooling buildings, irrigating landscapes, and flushing toilets and urinals, onsite non-potable water systems offset valuable potable water supplies and unlock untapped potential for more resilient and sustainable water management.

Definition of terms

Alternative water source: A source of non-potable water that may include any of the following: graywater, roof runoff, stormwater, blackwater, and any other source approved by a state or local agency.

Blackwater or domestic wastewater: Wastewater originating from toilets, urinals, and/or kitchen counters (i.e., kitchen sinks and dishwashers).

District-scale project: An onsite non-potable water system (ONWS) for a defined service area that covers two or more properties and may cross public rights-of-way.

Graywater: Wastewater collected from non-blackwater sources, such as bathroom sinks, showers, bathtubs, clothes washers, and laundry sinks.

Municipal system: A drinking water or wastewater system for an urban or suburban service area consisting of residential, commercial, and/or industrial activities.

Non-potable water: Water collected from alternate water sources that is not treated for consumption, but is treated and intended to be used on the project applicant's site or district-scale project and is suitable for beneficial use.

Onsite non-potable water system (ONWS): A system in which water from local sources is collected, treated, and used for non-potable uses at the building to district/neighborhood scale, generally at a location near the point of generation.

Roof runoff: Precipitation from a rain or snowmelt event that is collected directly from a roof surface not subject to frequent public access.

Stormwater: Precipitation runoff from a rain or snowmelt event that flows over land and/or impervious surfaces (e.g., streets, parking lots, and rooftops). Stormwater includes runoff from roofs with frequent public access.

Scope of onsite non-potable water systems

The design and operational complexity of ONWS will vary depending on the water source and end use. In all cases, the technology exists to treat water for non-potable uses within a small footprint and in a manner that protects public health. The alternate water sources and non-potable end uses addressed in this document are limited to implementation in multi-family buildings, commercial buildings, mixed-use buildings, or district-scale projects. The scope of this document does not address single-family residential dwellings, or centralized reuse systems such as large, municipal recycled water facilities.

Alternate water sources

Buildings, including commercial and multi-family residential buildings, generate several different types of alternate water sources that are suitable for onsite reuse. The most common types of alternate water sources produced by buildings are rainwater, roof runoff, stormwater, graywater, and blackwater.

Non-potable end uses

Alternate water sources can be used for a variety of non-potable uses within and outside a building. Replacing the demand for toilet and urinal flushing with non-potable water can offset approximately 25 percent of the total potable water use in a residential building, and up to 75 percent in a commercial building.[2] Other potential non-potable demands include irrigation, cooling/heating applications, process water, and clothes washing. Using ONWS to meet these demands can further reduce potable water demands by a total of 50 to 90 percent.[3]

Potential potable water offset by using non-potable water for toilet and urinal flushing:

25%	75%
Residential buildings	Commercial buildings

Additional Resources for Developing Onsite Non-potable Reuse Projects & Programs

There are a number of resources based on best practices and the most comprehensive research to date currently available to aid in the development of ONWS projects and programs.

- **Blueprint for Onsite Water Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems.** Developed by the San Francisco Public Utilities Commission, Water Environment Research Foundation, and the Water Research Foundation, the blueprint guides municipalities on how to implement and oversee onsite water treatment programs.

- **Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-potable Water Systems.** Published by the Water Environment & Reuse Foundation, the report establishes water quality treatment, monitoring, and reporting criteria for onsite non-potable water systems that are adequately protective of public health and based on best-in-class science and research.

- **A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems.** Developed by the National Blue Ribbon Commission for Onsite Non-potable Water Systems, this report provides a framework for state and local regulators and policy-makers to use in developing regulations, and oversight and management regimes for ONWS. The report includes policy templates and model management approaches for program implementation.

Section 2.
How are utilities using onsite non-potable water systems to meet One Water goals?

Onsite non-potable water systems are part of a One Water approach to managing life's most essential resource. Implementing ONWS projects requires a systems approach and partnership among water and wastewater utilities, public health regulators, other local agencies, the private sector, and other community and environmental stakeholders. By integrating ONWS into broader One Water planning, these systems can help leaders optimize the balance between their investments and the benefits they reap for ratepayers and their communities.

Utilities across the country face unique challenges and needs to meet the demands of diverse communities and contexts. Drivers for ONWS are extremely localized and based on the values, resources, and conditions of infrastructure in a community. A one-size-fits-all approach won't work. Each utility will have to work with local stakeholders to craft a unique ONWS approach. In this way, ONWS can significantly benefit communities, water and wastewater service providers, and the local environment in a number of ways.

Fostering system resilience

Centralized water and wastewater systems are one of the most significant public health advancements of our time. However, many were built nearly a century ago and for conditions very different than those cities currently face, leaving them often inflexible when it comes to adapting to rapidly changing conditions. By integrating ONWS in buildings, utilities can improve their ability to respond to disruptions in water service delivery that may come as a result of drought, increased storm events, or other impacts of changing climates. With added redundancy and flexibility, our water and wastewater systems can be more resilient and better equipped to reliably serve our communities in the future. Additionally, recent advancements in real-time controls can further increase predictability and resiliency benefits to communities.

> **"In a world where rainfall is getting more unpredictable and freshwater aquifers are increasingly stressed, systems that capture and reuse water onsite have a tremendous upside. The potential to capture both rainfall and greywater for reuse onsite can not only lower bills and create predictability, but also relieve demand on utilities that are trying to protect drinking water sources in the face of climate change."**
>
> —Josh Stanbro, *Chief Resilience Officer, State of Hawaii*

Diversifying and stretching water supplies

Whether driven by decreased water supplies or increased demands, utilities are proactively pursuing new strategies that combine water conservation and efficiency with untapped local supplies. As major water users, commercial and mixed-use buildings can reduce their water footprint and stretch water supplies by collecting and treating rainwater, stormwater, graywater, and/or blackwater onsite and reusing it to meet local demands. Diversifying and stretching water supplies helps utilities reduce system burdens in peak use times, be resilient in the face of drought, and defer costs associated with system expansions.

> **"Minnesota is a relatively water-rich state, but we can still reap many benefits from onsite non-potable water systems. By reusing water onsite, we can protect our pristine groundwater supplies, manage our stormwater to better protect water quality, and reduce the need to expand our centralized water and wastewater infrastructure."**
>
> —Anita Anderson, *Principal Engineer, Minnesota Department of Health*

Managing stormwater and reducing pollution

Because onsite non-potable water systems reduce demand on wastewater infrastructure and divert runoff, they may help reduce surface flooding and prevent combined sewers from overflowing into and polluting local waterways. Many buildings that have ONWS also incorporate natural filtration systems, like rain gardens, wetlands, or green roofs, into the project. Unlike traditional pipes and pumps, these green solutions emulate the natural filtering process. These amenities play a dual role in managing water onsite: first by contributing to the onsite treatment process; and then, by serving as a second line of defense for capturing and retaining stormwater on the site. Onsite water systems can boost compliance with local stormwater management ordinances while simultaneously providing other water quality benefits to local receiving waters.

Meeting policy and regulatory requirements

Lawmakers set policy to protect public health, prevent pollution, encourage conservation, and promote sustainable development. For utilities and developers, ONWS can be a means of complying with new regulations while maximizing the social, environmental, and economic benefits of each project. For example, by using ONWS, buildings can quickly and cost-effectively reach conservation goals, achieve higher levels of green building certification, or meet stormwater management requirements. In addition, ONWS can be strategically placed to help mitigate flooding in flood-prone neighborhoods by reducing the loads on combined sewer systems or diverting runoff to reduce general surface flooding. When deployed at scale and combined with other strategies, this approach can be valuable in helping communities comply with sewer overflow consent decrees or other Clean Water Act obligations.

Deferring capital costs

Many urban and suburban areas continue to grow, and centralized infrastructure is straining to keep up. On top of that, most water and wastewater systems are aging and in need of significant upgrades. A decline in federal contributions to water infrastructure capital spending and increases in labor and materials costs have left local jurisdictions to shoulder nearly 98 percent of water infrastructure investments[4]. Major capital projects like building new dams or new treatment plants are not as financially feasible to ratepayers as expanding capacity of existing systems. ONWS can be a valuable tool in helping to extend system capacity, while reducing costs related to energy use, treatment, and delivery. These systems conserve water and use it efficiently, providing relief for strained potable water and wastewater systems. That relief may allow utilities to shift investment priorities to other infrastructure needs like upgrading wastewater treatment plants or replacing aging service lines and collection systems. In places where ONWS is deployed at scale, the reduced burden on the sewer system may reduce the size of needed water and sewer infrastructure, thus saving capital.

Generating environmental and community amenities

Many buildings with ONWS also integrate elements that restore the natural water cycle and capture water onsite, like rain gardens, wetlands, and green roofs. In some cases, these serve as an essential component in the onsite treatment process. In other cases, they are a separate green infrastructure asset that helps to manage water onsite. Along with treating wastewater or reducing pollution and managing stormwater onsite, these amenities can provide green streets, public open space, reduced heat island effects, improved air quality, and other environmental and community benefits, transforming corridors and connecting people with nature where they work and live. Where it makes sense designing ONWS to use green space for water treatment, these systems can transform hard urban landscapes, especially in underserved communities, into more vibrant natural public spaces.

Creating opportunities for public-private partnerships that meet market demands

Developers are responding to market demands as more people want to live and work in green buildings that have lower water, energy, and carbon footprints. Increasingly, developers are turning to the latest innovations in water in order to earn more green building credits for water-efficiency. The next generation of efficient buildings will need to incorporate onsite reuse at some level to meet this demand and bring forth the sustainable cities of tomorrow. In addition to water conservation, ONWS can provide opportunities to reduce energy footprint in a building through heat recovery via the onsite system. These market trends call on utilities and local governments to create an enabling environment to deploy these innovations. And in turn, cities will reap the benefits of attracting new business and housing developments without placing undue pressure on existing natural resources and water systems. This is also an opportunity for utilities to explore partnerships with developers to share costs and reach mutually beneficial goals.

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Water efficiency has been one of the foundational components in a green building since the very beginning. Onsite water reuse systems create opportunities to significantly enhance not only the performance of a building, but also deliver benefits to the water supply and wastewater treatment entities serving the building.

—Brendan Owens, *Senior Vice President, US Green Building Council*

Inspiring innovation in technology

The role of utilities is evolving. Across the country, public water and wastewater agencies are redefining what it means to provide water and wastewater service in the 21st century. With the deployment of new technologies and innovations, utilities and other water leaders are changing the way we view, value, and manage water across its lifecycle. As utilities embrace new and proven technologies for onsite non-potable water systems, they are charting a new course in One Water management and signaling to the private sector the innovative priorities for the future.

“”

30 years ago onsite water systems were an innovative way of solving individual water and wastewater problems at the local level. Aided by the tremendous success of the green building industry, it has evolved into a better way of addressing regional water resource management. Now with high degrees of performance confidence supported by 50+ existing projects, the market is clearly poised for this next generation of ONWS.

—Ed Clerico, *CEO Emeritus, Natural Systems Utilities*

Case Study

Battery Park City Paves the Way for Sustainable Urban Development in New York

Battery Park City, a 92-acre redevelopment area in New York City, set the precedent for onsite non-potable reuse in residential and mixed-use districts.[6] The Battery Park City Authority (BPCA) of New York City established environmental performance guidelines that were more advanced than LEED requirements to assure that forthcoming development projects achieve ambitious sustainability goals. One key aspect of these guidelines was water conservation and reuse.

As a result of the high performance environmental guidelines, six residential water systems were created to capture and treat wastewater and rainwater for reuse in eight residential and mixed-use buildings, including Millennium Tower and Tribeca Green. The systems, designed, built, and operated by Natural Systems Utilities, use hollow fiber micro-filtration membranes, ultraviolet light disinfection, and biological nitrogen removal to treat up to 165,000 gallons per day to standards suitable for reuse within the development area.[7] This required unique collaboration among BPCA, developers, Natural Systems Utilities, and the New York Departments of Buildings, Health, and Environmental Protection.

Serving an urban area that is plagued by combined sewer overflows and conveyance capacity limitations, the Battery Park City systems have consistently achieved greater than 50 percent water consumption reduction and greater than 60 percent reduction in wastewater discharged compared to buildings of similar size in New York City.[8] These water and wastewater savings are a direct result of the onsite reuse systems. Over the past 15 years in operation, Battery Park City has become the gold standard in onsite non-potable reuse and has served as a model for district-scale reuse in urban settings.

Case Study

Protecting Water Quality and Engaging the Public in Santa Monica, California

Stormwater and urban water runoff is considered the main source of pollution to the Santa Monica Bay. In an attempt to address these challenges and protect coastal waters for future generations, the City of Santa Monica and the City of Los Angeles partnered to develop the Santa Monica Urban Runoff Recycling Facility (SMURRF), which collects, treats, and reuses up to 500,000 gallons per day from dry weather runoff (e.g. non-stormwater) to irrigate landscapes and use in dual-plumbed interior systems.

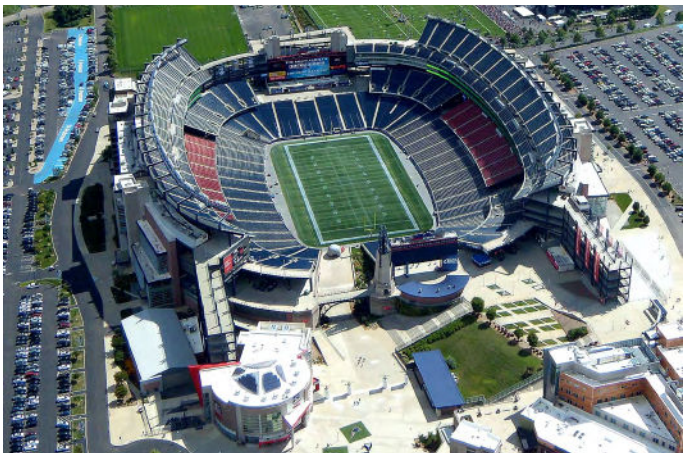
Placing a water treatment facility in a prominent tourist site is not typical for most communities. However, this provided a unique opportunity to incorporate educational exhibits to inform the public about how to reduce effects on the watershed. In fact, the City of Santa Monica mandated that the facility include significant public education components and be responsive to the immediate neighborhood. The unique, open design of SMURRF, developed in collaboration with artists, engineers, and City Public Works, allows visitors to see how water moves through the purification process.[5] An elevated walkway leads visitors on a self-guided tour where they can view the 5-stage treatment process (soon to be expanded to more advanced treatment, including salt removal) in sequential order before they exit to the beach or downtown Santa Monica shopping promenade adjacent to the facility. Signage and other art and architectural elements educate citizens on the urban watershed, water treatment, and ways citizens can help decrease pollution.

The City of Santa Monica is planning future investments that build upon this innovative approach to protecting the local bay. As part of the Sustainable Water Infrastructure Project (SWIP), the city plans to install a 1.5 million-gallon underground tank that will collect and feed stormwater to SMURRF to be treated for recharging local aquifers.

Section 3.
What are the key considerations for implementation of onsite non-potable water systems?

Onsite non-potable water systems can serve as a valuable tool for an integrated One Water future. Several utilities across the country have made progress in bringing that future to the present. In doing so, they have generated helpful models for how to tackle the central considerations required to responsibly and successfully approach ONWS from a utility perspective. This section outlines some of the key utility considerations and lessons learned for integrating ONWS into a broader portfolio of water management strategies.

Below, top: Santa Monica Urban Runoff Recycling Facility (SMURRF), Santa Monica, CA. *Photo courtesy of City of Santa Monica.*
Below, bottom: Gillette Stadium, Foxborough, MA. *Photo courtesy of Natural System Utilities.*
Below, right: San Francisco Public Utilities Commission headquarters building, San Francisco, CA. *Photo courtesy of San Francisco Public Utilities Commission.*



Protecting public health

Using non-potable water with varying degrees of treatment in places susceptible to human contact comes with a degree of risk. Therefore, appropriate and consistent water quality standards, system validation protocols, and monitoring regimes are needed to protect public health. Any utility that has implemented large-scale recycled water projects is familiar with water quality criteria for public health protection. When it comes to ONWS, the industry lacks consistent water quality and treatment standards, or monitoring and reporting requirements to guide or regulate these systems. Local health officials rely on state or municipal recycled water guidance, which is often not appropriate for onsite systems.

To address this, the Water Environment & Reuse Foundation, now the Water Research Foundation, worked with public health and water utility leaders to publish *Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems*[9] to establish consistent water quality and monitoring criteria for onsite reuse projects. The report, detailed in the case study, is a significant step in minimizing risk and ensuring public health protection.

> **Protecting the health of our communities depends upon establishing achievable and verifiable health based standards. The water industry needs more guidance for onsite non-potable reuse than current municipal-scale recycled water guidelines provide. This risk-based framework we have developed provides public health protection as we continue to scale and innovate in water reuse.**
>
> —Steve Deem, *Regional Engineer, Washington State Department of Health*

Case Study

Public Health and Water Utility Experts Join Forces to Develop a Risk-Based Framework for Onsite Water Reuse

Currently, there are no national water quality standards or guidelines for onsite non-potable water systems in the United States. While some states may have limited standards in place today, there is wide variation in existing water quality criteria. To address this unevenness in standards, leaders from public health agencies and water utilities, including agencies from California, New York, Hawaii, Oregon, Minnesota, Washington, and others, came together to develop *Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems,* published by the Water Environment & Reuse Foundation.[10]

Unlike current standards for onsite non-potable water systems that often rely on endpoint assessment of water quality, the report established an approach for pathogen reduction using a methodology widely accepted for potable reuse and drinking water practices.

An Independent Advisory Panel of technical experts in the fields of risk assessment, microbiology, and water quality standards and regulations prepared the risk-based framework with the goals of evaluating existing water quality standards for alternate water sources, developing recommendations to help regulators implement oversight and management programs, and establishing uniform standards among states.

"ONWS have often been regulated to achieve water quality goals without consideration for the source water and end use combination. A risk-based framework provides an approach that promotes fit for purpose use of water to achieve desired human health outcomes. The approach takes into consideration source water quality and possible exposure from the end use, and focuses on health-based targets for treatment. This enables decision makers to achieve public health protection goals in a way that is appropriate for specific source water end use combinations. In addition, the risk-based framework provides guidance on monitoring onsite water systems that is pragmatic for the uniqueness of those systems," said Dr. Sybil Sharvelle of Colorado State University, chair of the Independent Advisory Panel.

Establishing programs for ongoing oversight

In addition to setting water quality and monitoring requirements, utilities and public health agencies will want to consider establishing structures for ongoing regulatory oversight to ensure compliance of onsite non-potable projects. The intricacies of ONWS—like coordination with local health, plumbing, building, and public works departments—require their own unique permitting and regulatory process separate from those of water and wastewater treatment plants, which are typically permitted through state regulatory agencies.

In cities where ONWS is gaining in popularity, like San Francisco, utilities have partnered with the local public health agencies and other city departments to institutionalize ONWS permitting programs as a means to enable additional projects. The considerations for establishing these oversight programs are documented in *A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems,* released by the National Blue Ribbon Commission in 2017.[11] The guidebook presents a concrete and actionable framework that states and localities can use for regulating and managing ONWS based on best-in-class science and research. Recognizing that implementation and management of ONWS will vary state by state and community by community, the guidebook provides policy templates and models for implementation and management at the local and/or state level to alleviate risk, and ultimately protect system integrity and public health. Having a consistent policy framework across cities and states is one of the best ways that we can support integration of onsite systems in a way that protects public health and meets our water needs.

> **Capturing, treating, and reusing water in our headquarters was unprecedented in our city and required a new way of doing business. By working collaboratively with other city agencies to establish a formal program and process, we were able to pave the way for other buildings to incorporate ONWS in the future and demonstrated our city's commitment to water security and stewardship.**
>
> —Harlan L. Kelly, Jr., *General Manager, San Francisco Public Utilities Commission*

Case Study

Institutionalized Citywide Program Sparks Increase in ONWS Projects in San Francisco

When the San Francisco Public Utilities Commission (SFPUC) was designing their new headquarters building in downtown San Francisco, they wanted it to be a reflection of the organization's mission to provide high quality, efficient, and reliable water, power, and sewer services in a manner that is inclusive of environmental and community interests, and sustains the resources entrusted to their care. One way to do this was to install an onsite Living Machine, to reclaim and treat all of the building's wastewater for toilets and urinals, resulting in 60 percent less water use compared to similarly sized buildings.[12]

As this was the first building in San Francisco, and one of the first buildings in the nation, to do onsite treatment of gray and blackwater, the utility was confronted with barriers to implementation given that permitting guidance did not exist. The SFPUC worked with the Department of Public Health (SFDPH), Department of Building Inspection (SFDBI), and San Francisco Public Works to develop San Francisco's Non-Potable Water Program to streamline permitting processes for onsite non-potable water systems. Together, the four agencies provide oversight and management for the use of treated non-potable water to ensure systems are protective of public health.

Under the leadership of the SFPUC, the City and County of San Francisco adopted the Onsite Water Reuse for Commercial, Multi-Family, and Mixed-Use Development Ordinance in September 2012. Commonly known as the Non-potable Water Ordinance, it allowed for the collection, treatment, and use of alternate water sources for non-potable uses in buildings. Since 2012, the Non-potable Water Ordinance has been amended to allow for district-scale projects, where two or more parcels can share alternate water sources. In 2015, it became a mandatory requirement for new development projects over 250,000 square feet of gross floor area to install and operate an onsite non-potable water system.[13] As of January 2018, approximately 80 projects were in the process of permitting and installing onsite non-potable water systems in San Francisco.[14]

Addressing potential revenue impacts

While onsite non-potable water systems can reduce a building's water footprint and ease the burden on wastewater systems, reduced water consumption can raise concerns about revenue impacts for some utilities, especially as ONWS grows in popularity and scale. Therefore, one of the key considerations for bringing new projects online is the effect it may have on revenue projections. Most onsite systems are required to connect to potable systems, so the utility does not lose customers; nor do these systems result in a complete loss of revenue from ONWS customers. In deploying onsite non-potable projects and programs, utilities have identified ways to divert costs, recover costs, and plan for demand reduction.

Studies have demonstrated that efforts to manage water demand, including conservation, efficient fixtures, and related measures, are the most cost-effective ways to manage or extend water supplies. ONWS is an emerging conservation measure that can also contribute to demand reduction, and therefore utilities should apply management philosophies and cost/benefit analyses similar to those used in planning for other demand reduction and conservation tactics. As utilities plan for ONWS in their communities, they should incorporate decreased per capita use into demand projections and set budgets and rates accordingly. Additionally, utilities across the country are beginning to engage in broader rate setting discussions and break away from traditional volumetric models in response to a new culture of conservation and demand reduction.

The implementation of regulatory oversight programs for ONWS can potentially generate new revenue streams for utilities. In the water and energy sector, efficiency standards have generated a new market for efficiency auditors, solar panel installers, water efficient fixture installers, and other services. ONWS will require operations and distribution staff, water quality laboratory services, permits, inspections, and other technical services in order to ensure systems are compliant and meet operating standards. For privately owned ONWS or those owned by other city departments, utilities are well positioned to develop a fee-for-service model that leverages existing utility staff and expertise, and that expands utility business into new areas of service.

Case Study

Water Conservation Lowers Utility Costs in Tucson

Conservation is creating a win-win situation for residents and utilities in Arizona. For the past 20 years, the City of Tucson, AZ has taken on conservation measures like appliance replacement, water efficiency programs, smart water metering, efficiency-oriented rates, green infrastructure strategies, building codes changes, and customer education. All combined, ratepayers now benefit from lower water bills while the utilities save on service delivery and infrastructure expansion.

For example, water use in Tucson has remained relatively unchanged since the mid-80s, despite a 40 percent population increase,[15] due to long-term conservation efforts that have reduced residential water use by 31 percent over that time. This has translated to significant savings for both ratepayers and the utility. Without conservation measures, ratepayer bills would be 13.3 percent higher.[16] With lower water production, the utility can secure, treat, and deliver less water and redirect those savings to other pressing utility needs. Significant conservation and efficiency initiatives during population growth helped local utilities save $350 million in water and wastewater infrastructure expansion.[17]

Similarly, utilities across the nation are investing significant funding in efforts to reduce water consumption and it's paying off. Onsite non-potable water systems provide another conservation measure that has the potential to yield similar results in terms of demand reduction and cost savings. By approaching ONWS with the same philosophy as other demand reduction programs, utilities can capitalize on these financial benefits.

> **"Utilities have invested millions in conservation programs, retrofits, landscape improvements, recycled water systems, and more—all to reduce consumption and stretch existing water supplies. ONWS are the next step in that effort, demonstrating smart urban water management through a One Water approach. With more uncertainty and risk in the world, we need to bring old business models into the future.**
>
> —Brian Good, *Chief Administrative Officer, Denver Water*

Managing wastewater flows and odors

Across the country, people and properties are using water more efficiently. An increase in conservation can result in a reduction in the amount of water available to maintain the flow in wastewater systems. When flow velocity gets too low, solid debris can accumulate in wastewater systems. Less water flowing through the wastewater system also means debris is less diluted and more pungent. Because onsite non-potable systems reduce the amount of wastewater released to the sewer system, utilities and property owners looking to implement ONWS have had to find solutions to restore wastewater flows and control odors where necessary. These solutions are nuanced and formulated to match their specific local context.

Utilities have mapped out flows in their service areas using hydraulic and odor modeling. Areas where the wastewater infrastructure is at capacity, or that suffer from flooding, are prime spots to install nearby onsite non-potable systems. ONWS can help reduce the burden on those systems and restore their capacity. Areas with low flows can also benefit from ONWS. In these areas, onsite non-potable system operators can release non-potable water to flush the sewer system as needed. To be able to do this, utilities need precise hydraulic modeling and system monitoring. In these areas where there may also be a higher concentration of odors, utilities and system owners can establish contracts for extracting solids and trucking them to a nearby wastewater plant. In either case, public and private partners must work together to create locally specific solutions. ONWS are designed to operate in conjunction with, not opposition to, centralized wastewater infrastructure, and thus it is possible to create synergies to reap the benefits of ONWS while minimizing effects on centralized wastewater infrastructure.

> **Our vision of integrating an onsite wastewater treatment and reuse system into a large scale residential development would not have been successful without working in partnership with the private developer, Portland Bureau of Environmental Services, and the local utilities. Together we were able to collaborate on developing a system that enhanced, rather than replaced, existing infrastructure.**

—Pete Munoz, *Senior Engineer, Biohabitats*

Case Study

The Largest Community Water Processing System in the US Redefines Green Living in Portland

Hassalo on Eighth, a new development within the Lloyd EcoDistrict, is a cluster of high-rise, residential, commercial, and mixed-use buildings situated across four city blocks in downtown Portland. It's also home to the largest urban community water processing system in the United States. Known as NORM, the Natural Organic Recycling Machine collects 100 percent of water from sinks, toilets, showers, and laundry, and treats it onsite to meet the highest quality standards for reclaimed water before directing it back into the community system to flush toilets and irrigate landscaping.[18] Any excess treated water is released into groundwater recharge wells. NORM prevents up to 45,000 gallons of water per day from entering Portland's sewer system and saves up to seven million gallons of potable water per year.[19] NORM also features wetlands and trickling filters. Both are integrated directly into the pedestrian streetscape, providing visibility to a process that is often out of sight and out of mind.

Because the project recycles the majority of its wastewater, the Portland Bureau of Environmental Services analyzed the effects the project would have on the city's combined sewer system. The review concentrated on how much overflow would be released to the wastewater system in times of emergency or maintenance when wastewater would bypass the ONWS. Analysis revealed that the volume would not overwhelm the city's infrastructure. To reduce the impact of solids and odors, the developer worked with a local utility, Clean Water Services, to develop an agreement that allows solids to be collected and transported to the Durham Wastewater Treatment Facility on a quarterly basis and turned into fertilizer and fuel. This result was a win-win for both the project and the utility.

Building a skilled workforce to meet the needs of ONWS

As the water and wastewater industry evolves to meet the challenges of the day, so must the workforce. As new, innovative approaches to water management—from green infrastructure to onsite non-potable water systems—grow and scale, the gap between demand and supply of skilled labor to install, maintain, and operate these projects grows. Research conducted by the Water Environment & Reuse Foundation, found that potable and non-potable reuse technologies include unique features that differ from traditional water and wastewater facilities, and therefore additional training is needed to prepare operators for these innovative systems.[19]

Cities and local officials can consider a range of approaches to cultivate a labor pool for ONWS. Given their industry expertise, utilities can participate in building a skilled workforce for ONWS either at cost or with modest returns. One way to do this would be to create a workforce development program, operator training, or certification program specifically focused on the nuances of ONWS. Utilities can then train their own workers and contract them out to private system owners, or offer training to other utilities or property owners who would pay to have their employees learn how to operate and manage ONWS. This represents an emerging business opportunity, especially for utilities leading the field in ONWS. In addition, new workforce development programs can present opportunities for cities and communities to create local jobs and bolster much needed job skills, especially for low-income and underemployed citizens.

On the other hand, workforce needs can be contracted out to the private sector. In places where ONWS are gaining traction, businesses are popping up to seize this market opportunity on the private side. In either case, there is an important role for utilities to play in recruiting future workers, developing training standards, and building workforce capacity to manage these systems.

Case Study

National Green Infrastructure Certification Program Demonstrates Robust Workforce can Accelerate Innovation

The water sector has dealt with the need to develop its workforce to meet the needs of emerging water management practices. As cities turn to green infrastructure projects to manage stormwater, the water sector has had to address the skills gap in the workforce. To help professionalize the field and address workforce needs, the Water Environment Federation, in partnership with DC Water and fourteen other public utilities, created the country's first National Green Infrastructure Certification Program (NGICP).[20] The program trains underserved, unemployed, and underemployed entry level workers on the best management practices for installing, maintaining, and monitoring bioretention swales, pervious pavers, and other types of green infrastructure. In its pilot phase, the program has already certified over 200 workers from eight utilities across the country.[21]

These kinds of programs prepare people with the skills the market will demand as more communities move towards realizing an integrated One Water future. The NGICP is a model that can be modified and applied to meet the nuanced workforce training needs of onsite non-potable water systems. Additional research on the workforce qualifications, training, and certification programs needed to advance ONWS projects around the country is needed and should build upon research conducted by the Water Environment & Reuse Foundation on operation and maintenance plans and operator certification programs for potable reuse.

> **Our research indicates that acceleration of innovative water reuse projects is dependent upon workforce training and development to operate and maintain them. When utilities invest to build a skilled workforce for reuse systems, it catalyzes more onsite non-potable water systems, while strengthening the utility workforce.**
>
> —Melissa Meeker, *Co-Chief Executive Officer, Water Research Foundation*

Balancing infrastructure investment

Across the country, water and wastewater utilities must make decisions about when and how to size and sequence significant infrastructure improvements and capital investments. Often these pressing capital projects have precluded utilities from considering new investments in onsite non-potable water systems. On the other hand, many leading utilities are finding that ONWS can serve as a tool to be leveraged in balancing infrastructure priorities, rather than seeing them as a competing priority. Especially when deployed at scale, ONWS can help maintain and optimize centralized water and wastewater systems. They can expand the capacity of existing systems, reduce the size or scale of planned replacement projects, and change the calculus of larger infrastructure investments. For example, some utilities that have deployed ONWS have seen reductions in the magnitude of large infrastructure investments they will need to make in the future.

Implementing a city-wide program for ONWS and implementing it in multiple buildings across a city or service territory could alleviate enough infrastructure pressures to delay things like treatment plant capacity upgrades or upsizing conveyance systems. Another opportunity utilities can take to implement ONWS is cost-sharing on infrastructure investments with private developers and property owners. Leveraging funds can take some of the burden off utilities, allowing them to set aside capital for other priorities.

> **Onsite water reuse systems can be a valuable component to both urban and rural water supplies. They can enhance property values, provide necessary water and wastewater infrastructure for small communities, and provide opportunities for business growth and development. They also provide ways to control nutrient cycling and better manage a community's water portfolio.**
>
> —Ben Stanford, *Senior Director, Water Research and Development, American Water*

Case Study

ONWS Helps New York Prepare for Future Infrastructure Investments

New York City is addressing leaks in the Delaware Aqueduct, one of the two main aqueducts supplying drinking water to the city. In 2022, the aqueduct will be closed for up to eight months as part of a multi-year repair process. To meet their level of service goals during that period and beyond, the New York City Department of Environmental Protection (DEP) has initiated a large-scale Water Demand Management Program targeting an overall reduction of 20 million gallons per day in water consumption citywide by the year 2022.[22] The program focuses on six primary strategies: municipal water efficiency; residential efficiency; non-residential efficiency; wholesale customer efficiency; water distribution system optimization; and water supply shortage management.

To further encourage water efficiency in the non-residential sector, DEP launched the Onsite Water Reuse Grant Pilot Program. The grant is a cost-sharing program that provides incentives for property owners to install ONWS and facilitate both single building projects and district-scale projects that span across multiple properties. DEP structured the grant program to achieve a total water demand reduction of one million gallons per day and provide benefits to New York City through: deferred capital costs of large scale infrastructure; reduced loading to sewers and water bodies; improved environmental stewardship; and increased capacity to manage water supply system demands.[23]

Case Study
ONWS Provides Large Scale Reuse at Gillette Stadium

In 2001, during planning of Gillette Stadium, home of the New England Patriots football team, engineers and city managers faced a challenge of supplying enough water for the stadium from limited supply aquifers and managing the wastewater flow from the stadium without harming sensitive local headwaters. To handle the anticipated 600,000 gallons of water/wastewater demand on game day would have required new sources of water supply and new wastewater facilities for this small New England community, which was then served entirely by individual onsite septic systems.[24]

To secure this highly valued economic development project while maintaining the town's village character, a creative and environmentally sustainable solution was cooperatively developed by the Town of Foxborough, Massachusetts, the Kraft Group (owners of the New England Patriots), and Natural Systems Utilities. The solution included integration of an onsite non-potable water reuse system capable of collecting, treating, recycling and recharging the hundreds of thousands of gallons of water used by up to 68,000 fans on game day and during music concerts/festivals, and other stadium events.[25]

The system, designed, built, and operated by Natural Systems Utilities, currently includes one million gallons of pre-treatment storage capacity to capture wastewater flows generated by game attendees, an onsite treatment plant that has the capacity to treat 250,000 gallons per day suitable for reuse, and a 500,000 gallon storage tank for reclaimed water.[26] In addition to producing high-quality reuse water for the stadium, the system also serves the nearby Patriot Place economic development area, which houses a wide array of mixed uses. Because of this innovative water reuse approach, Foxborough was able to avoid the need for a centralized wastewater system while continuing to supply potable water via existing aquifers and gaining the benefit of this significant economic engine.

Section 4.
What is the role of utility leadership in deploying onsite non-potable water systems?

There is a range of ways utilities can advance ONWS in their service areas. In creating a program for onsite non-potable reuse, utilities have options in defining the level of involvement they want to have in the promotion, planning, implementation, and management of ONWS. This allows utilities to develop a program that fits their water supply priorities, staff capacity, and the broader interests of large building owners, public officials, and civic and community stakeholders.

Educational outreach and leadership

Many water and wastewater agencies offer educational and technical services to customers and provide them with how-to guides, conduct water efficiency audits, and inform them about best management practices. With increased interest in ONWS, utilities are uniquely positioned to provide both regulatory and technical guidance to property owners, non-potable system users, and others interested in onsite reuse systems. Utilities can provide education and outreach to support ONWS by:

- Developing and distributing information on the benefits and best practices of ONWS to property owners, developers, and local government leaders;
- Creating tools to help customers assess their potable water offset potential, such as a calculator to quantify available non-potable water sources on a property, and potential non-potable demands;
- Performing audits where utility representatives identify onsite reuse opportunities for property owners or developers;
- Identifying and vetting trusted ONWS vendors and providing a list to interested customers; and
- Setting up innovative educational forums and demonstration projects to show customers what solutions like onsite reuse systems, green infrastructure, and rainwater harvesting look like and showcase their benefits.

Utilities have a wealth of knowledge in how to effectively operate water and wastewater systems, from operations to monitoring, maintenance, and much more. As customers and others in their service territory are exploring onsite reuse projects, utilities can be one of the best resources for planning and implementing them. Beyond providing outreach and education to developers, commercial customers, and property owners, utilities can champion ONWS by building public and political support through education of the general public and government officials.

Figure 1
A spectrum of utility involvement in ONWS

Regulatory and permitting oversight

Oversight is essential to protect public health and sustain safety and reliability by meeting regulatory standards and permit requirements. Oversight happens at many levels, but utilities cultivating the use of ONWS should be involved from initial planning and design phases to ensure qualified professionals are developing appropriate reuse systems that meet local requirements and prevent adverse effects on existing municipal systems. Once the onsite systems are installed, utilities and public health agencies can remain in contact through the permitting and inspections process. Throughout an onsite reuse system's lifecycle, regulatory and permitting oversight programs help maintain customer confidence by keeping the utility engaged with private ONWS operators.

Operation and maintenance

One area where utilities are uniquely positioned to accelerate innovation and adoption of onsite reuse systems is by providing operation and maintenance guidance. While the application of ONWS is still in its infancy, property owners, developers, and private companies face the challenge of developing the operator experience and capacity to design and operate these systems. Utilities and health departments are uniquely positioned to assist private entities with fulfilling operational requirements. Utility operators are the ideal candidates to operate and maintain ONWS or provide technical assistance to onsite staff.

To prepare for this role, utilities are teaming up with major organizations like the Water Environment Federation (WEF) and the American Water Works Association (AWWA) to develop training programs for reuse operators. While many of these trainings are currently hosted by professional organizations or third-party consultants at a national or regional level, utilities could adapt this model uniquely for ONWS and offer them for a fee for-service, tailored to address the needs of the local service area. Local utilities and health departments are intimately aware of the potential challenges and benefits of implementing ONWS within their existing infrastructure system and regulatory framework. Therefore they are best suited to train, guide, or oversee property owners, building managers, and operators in the proper operation and maintenance of ONWS.

System integrator or owner

Utilities will interface with private ONWS systems in many ways, but they may also choose to evolve into a role as integrators or owners of all onsite systems within their service area. While this shifts a significant risk onto the utility, many utilities may find that full system ownership provides the best opportunity for the utility. Widespread adoption of OWNS and district-scale systems may be the next frontier of water and wastewater service. In the future, municipalities may develop citywide non-potable water infrastructure where systems from different buildings can supply treated non-potable water among sites through a centrally operated network of pipes. In this scenario, utilities would be integrators optimizing the system by tracking where water is generated and distributing it to where it's needed in real time.

Conclusion

Securing a sustainable water future requires bold leadership in exploring the next wave of innovation in the way we use, and reuse, precious water resources. Onsite non-potable water systems can serve as valuable tools for One Water management. Their success hinges on a supportive and engaged water and wastewater utility partners.

A number of water and wastewater utilities and public health agencies have paved the way for the adoption of onsite non-potable water systems by demonstrating the benefits of these systems and developing model projects, programs, and standards to foster implementation. The lessons learned from these innovators provide a solid foundation for the advancement of onsite non-potable reuse. While there is a need for additional research and field-building among practitioners, there is existing research and a significant opportunity to build on this progress and accelerate the adoption of ONWS. We hope this document and the work of the National Blue Ribbon Commission for Onsite Non-potable Water Systems inspires the forward-looking leadership necessary to catalyze advancements in the field of onsite non-potable water systems.

Natural Organic Recycling Machine (NORM) at Hassalo on Eighth, Portland, OR. *Photo courtesy of Jim G. Maloney/Biohabitats, Inc.*

Battery Park City redevelopment area, home to six residential water reuse systems, New York, NY.

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On the cover

Second from left: Whole Foods mixed-use development using onsite non-potable water systems, San Francisco, CA. *Photo courtesy of San Francisco Public Utilities Commission.*
Far right: Rendering of large redevelopment project incorporating onsite non-potable water reuse, San Francisco, CA. *Photo courtesy of San Francisco Public Utilities Commission.*

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