National Blue Ribbon Commission for Onsite Water Systems

2024 NBRC Action Plan:

Accelerating Onsite Water Systems in Communities

The National Blue Ribbon Commission for Onsite Water Systems (NBRC) advances best management practices to support the use of onsite water systems (OWS) for individual buildings or at the neighborhood scale. The NBRC is committed to protecting public health and the environment, and sustainably managing water – now and for future generations.

The NBRC has created tools and resources that can support implementation of this sustainable water strategy and foster strong collaborations between water and wastewater utilities and public health agencies to ensure projects protect public health and meet water quality standards.

The NBRC builds upon years of work beginning in 2014 by several municipalities, water utilities, public health officials, the Water Environment & Reuse Foundation, the Water Research Foundation, and the US Water Alliance. At the White House Water Summit in 2016, the NBRC announced its commitment to accelerate the development of OWS. The NBRC has made significant research contributions and continues to advance policies and regulations for onsite water reuse.

The NBRC is comprised of representatives from municipalities, water utilities and public health agencies from 15 states, the District of Columbia, the city of Toronto, the city of Vancouver, US EPA, and US Army Engineer Research and Development Center. The NBRC is convened with support from the WateReuse Association and is partnered with the US Water Alliance and The Water Research

Foundation. It is chaired by the San Francisco Public Utilities Commission (SFPUC).

The NBRC has prepared several documents to help scale up OWS across North America and are available at www.watereuse.org/nbrc.

The NBRC historically has focused on onsite non-potable reuse in large commercial and multi-family buildings/districts. To unlock additional water supply and "fit-for-purpose" water, we have adopted a new name- the National Blue Ribbon Commission for Onsite Water Systems- to reflect an expanded focus beyond non-potable end uses.

Need to Accelerate the Adoption of OWS

The NBRC recognizes the need to accelerate the adoption of OWS. As infrastructure is aging, climate and weather patterns are changing, and urbanization is rapidly increasing, we need new solutions to manage water. In response, more and more communities across the world are embracing OWS as a safe and effective water management strategy.

Coupled with increasing adoption of the health risk-based framework, we are now approaching an inflection point. To continue to advance safe and effective implementation of OWS, we need more alternative approaches and new solutions to be adopted at a broader scale. By accelerating OWS we can actively transform our water infrastructure to tackle our water and sanitation challenges now and into the future.

How We Can Accelerate OWS

To broaden the acceptance of OWS in our communities, we must demonstrate to communities and stakeholders that water is a limited resource, locally treated water has value, and it is critical to incorporate the use of local sources of water to increase the resiliency of our water supply. This vision relies on engaging and mobilizing our communities, partnering with industry and utilities, increasing opportunities for more equitable implementation, and expanding the NBRC to partner with local and international organizations focused on OWS.

2024 NBRC Action Plan: *Accelerating OWS in Communities*

To accelerate the adoption of OWS in our communities, the NBRC has developed four thematic areas with new specific goals:

- **Public Health:**
  - Establish national health risk-based treatment guidance for OWS;
  - Expand and standardize the NBRC health risk-based framework to include additional end uses; and
  - Expand NBRC guidance to address single family water reuse applications.

- **Communications:**
  - Make the case for OWS;
  - Increase the adoption of OWS programs among states and jurisdictions; and
  - Broaden NBRC partnership with other organizations engaged in OWS.

- **Sustainable Technology/Innovation:**
  - Identify model treatment trains that allow for flexibility and innovation;
  - Maximize the energy efficiency potential of OWS; and
  - Promote nature-based treatment within OWS.

- **Capacity Building:**
  - Promote training and workforce development opportunities.

PUBLIC HEALTH:

Goal 1: Establish National Health Risk-based Treatment Guidance for OWS

One of the most challenging aspects of OWS is to ensure the appropriate water quality for each end use to protect public health. In 2017, the NBRC's landmark report *Risk based Framework for the Development of Public Health Guidance for Decentralized Non-potable Water Systems* established a scale-appropriate, risk-based framework for defining and monitoring OWS treatment systems. Using Quantitative Microbial Risk Assessment (QMRA), the 2017 report centered on risk-based log reduction targets (LRTs) for the treatment of pathogens including viruses, protozoa, and bacteria. With the report, the NBRC reached consensus to develop an LRT table for a variety of alternative water sources (using an infection-based benchmark), including combined wastewater/blackwater, graywater, rainwater, and stormwater for indoor and outdoor non-potable end uses. The NBRC promotes risk-based treatment trains that meet the appropriate LRTs, along with critical control point monitoring, permitting, reporting, oversight, and management.

Since 2017, the health risk-based approach has been used to generate additional sets of LRTs. While each of these efforts used a risk-based approach and is scientifically defensible, new science and alternative perspectives led to differences in the modeled assumptions (e.g., datasets for raw water concentrations, reference pathogens used, and dose-response models). Additionally, several health benchmarks were evaluated in the updated risk analyses, including infection- and disease burden-based outcomes. The updated model assumptions and health benchmarks resulted in slightly different LRTs for the same end use applications. However, there is general consistency with the treatment trains needed to meet those LRTs. To facilitate future consistency, the EPA Office of Research and Development (EPA ORD) is currently preparing a *State of the Science* document that defines the best-available science for performing QMRA for onsite reuse applications and the resulting LRTs for both infection and disability-adjusted life year (DALY) health benchmarks. The expected publication date is late 2024.

Actions:

- Review EPA *State of the Science* report and define an updated set of recommended LRTs for new adopters
- Provide guidance on continuous monitoring approaches to ensure treatment targets are met without the need for end-point sampling
- Research and promote best management practices for control of environmental pathogens such as *Legionella* in OWS source waters and distribution systems

Leads:

- Paula Kehoe (SFPUC), Taylor Nokhoudian (SFPUC)

Partners:

- Utilities, regulators, codes and standards organizations, product manufacturers, US EPA ORD, Water Research Foundation (WRF)

Deliverable:

- NBRC updated LRT document (2025)

Goal 2: Expand and Standardize the NBRC Health Risk-based Framework to Include Additional End Uses

An important element of accelerating implementation of onsite reuse is by expanding beyond non-potable uses. Currently, the most common uses of water treated onsite in large multi-family residential and commercial buildings include toilet flushing, irrigation, cooling, and clothes washing. An opportunity exists to treat alternative sources of water in onsite systems for traditionally potable uses, such as drinking water and bathing, to further reduce potable water use.

For example, showering in multi-family buildings represents approximately 39% of indoor residential water use. US EPA ORD and Swiss Federal Institute of Aquatic Science and Technology (Eawag) have developed LRTs for showering

using treated graywater and wastewater, however, limited examples of this application exist today. This is one scenario that could unlock additional water supply and "fit-for-purpose" water. Currently, a pilot study is underway at the University of Alaska Anchorage applying graywater reuse for showering and handwashing in a town-house style dorm on campus. Building on this preliminary research, there is an opportunity to establish a new water quality standard for these technologies, understand the regulatory pathways, communication strategies, and address implementation considerations including the need for a backup potable water supply.

Likewise, treating water onsite for drinking water at the single family residential, building, or neighborhood scale could maximize water recovery and potentially improve ROI. Key focus areas include parts of the U.S. where direct potable use of rainwater and water vapor collections (e.g., air conditioning condensate or atmospheric water harvesting) may be feasible and in rural settings dealing with water quality and accessibility challenges.

Specific efforts are underway to address the production of potable water with onsite water systems. For example:

- Virginia Department of Health is developing statewide regulations for the use of rainwater for drinking water
- The Bullitt Center in Seattle, WA offers an example of a commercial building that has been harvesting rainwater for potable purposes for many years and can provide opportunities for learning about cost and operations
- The SFPUC has developed a chemical and pathogen control strategy to treat process water onsite at breweries for reuse in cleaning processes and producing beer
- The SFPUC is modifying its OWS to produce purified water at the building-scale to understand the feasibility of meeting drinking water standards
- The US military is studying decentralized graywater reuse projects to understand the health risks, monitoring requirements, and technology needs for showering and laundry

The NBRC's leadership is needed to advance these concepts more broadly in a safe manner while also increasing cost savings, sustainability, and resiliency benefits.

Actions:

- Expand and standardize the NBRC health risk-based approach for OWS to include showering as an end-use, including consideration of exposure risk from inhalation of shower mist
- Develop a roadmap for addressing onsite potable use including public health, regulatory, implementation, and communications aspects
- Research the role chemicals and pathogens play for OWS to produce potable water, including understanding the use of broad toxicity and biological activity indicators that can aid in assessing risks associated with trace contaminant mixtures and unknown contaminants
- Develop health risk-based frameworks, model treatment trains, monitoring strategies, and model policies for producing potable water from rainwater, atmospheric condensate, graywater, and combined wastewater/blackwater

Leads:

- Paula Kehoe (SFPUC), Taylor Nokhoudian (SFPUC), Jay Garland (US EPA ORD), Michael Jahne (US EPA ORD), Martin Page (US Army Engineer Research and Development Center), Anthony Creech (Virginia Department of Health)

Partners:

- US Army Research and Development Center, US EPA ORD, University of Alaska Anchorage, NAWI, WRF, WateReuse Association

Deliverable:

- NBRC updated LRT document (2025)

Goal 3: Expand NBRC Guidance to Address Single Family Water Reuse Applications

The NBRC historically has focused on large commercial and multi-family buildings/districts. However, the NBRC wants to expand its focus and consider single-family water reuse applications such as graywater systems, recirculating showers, recirculating clothes washers, and recirculating toilets.

To date, three studies have been conducted to address the public health considerations for single-family graywater systems, recirculating showers, and/or recirculating clothes washers. However, established and accepted water quality standards, treatment trains, oversight and management practices, and other policies associated with recirculating appliances and household systems are not widely available.

The SFPUC has established an Independent Advisory Panel to review health risk-based assessments for reuse applications in single-family settings and provide technical and policy recommendations for San Francisco on the feasibility of implementing single-family graywater, recirculating clothes washers, and recirculating showers. The expected publishing date is November 2024.

Likewise, the Gates Foundation has created a Reinvent the Toilet Program to safely treat human waste onsite, without the need for transport or later treatment. Designed to meet the International Organization for Standardization (ISO) 30500, prototype off-grid recirculating toilets are under development and plan to be deployed commercially, including possible implementation in North America.

Actions:

- Review the SFPUC and Gates Foundation studies and prepare NBRC document addressing single-family water reuse applications
- Expand NBRC health risk-based approach for OWS to include single-family water reuse applications including single-family graywater systems, recirculating showers, and recirculating clothes washers
- Review ISO 30500 standard for applicability in single-family homes

Lead:

- Paula Kehoe (SFPUC)

Partners:

- Codes and standards organizations, product manufacturers, SFPUC, Gates Foundation, Mark Jaeger (Seattle Public Utilities - retired)

Deliverable:

- NBRC updated LRT document (2025)

COMMUNICATIONS:

Goal 1: Make the Case for OWS

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 when conditions were very different from those that cities currently face, leaving them often inflexible when it comes to adapting to rapidly changing conditions.

By integrating OWS within buildings and neighborhoods, utilities can improve their ability to respond to disruptions in water service delivery that may result from drought, severe storm events, earthquakes, landslides, or other impacts of changing climates. OWS can add redundancy and flexibility to help our water and wastewater systems be more resilient. For example, in the aftermath of Hurricane Sandy in 2012, buildings with OWS remained occupied and had water to flush toilets, even though the centralized water supply was disrupted.

Over the past decade we have seen the market for OWS transform. More technology providers are available in the marketplace and more OWS are deployed across North America. The return on investment (ROI) is also improving as treatment systems become more modular and skid-mounted. However, we recognize that communicating the value of OWS remains a challenge. As the NBRC, we can use our leadership position to articulate a better story that highlights the multiple benefits of OWS. By communicating more effectively

about the value of onsite reuse, we can continue to build trust and legitimize OWS as a safe and effective water management strategy.

The NBRC's report *Making the Utility Case for OWS* and WRF Project #5040 *Successful Implementation of Decentralized Reuse and Treatment Systems* have built a foundation, but additional analysis and quantification is needed. As we envision normalizing OWS as a common building practice, we need to address and quantify the benefits and costs of decentralized and hybrid systems to better understand their value propositions from utility and owner perspectives. WRF has identified a future priority research area to develop frameworks for the integration of centralized and decentralized systems and identify co-benefits in the broader hydrological context.

Actions:

- Partner with WRF to develop a framework for integration of centralized and decentralized systems including how utility business models may need to adapt
- Partner with Columbia University to research the beneficial integration of upstream non-sewered sanitation implementation on downstream sewered wastewater treatment through a process modeling approach (SFPUC project with Kartik)
- Create engagement plans for different stakeholders including developers, green builders, and end users
- Develop informational guide on OWS capital and O&M costs
- Develop case studies and clear messages that highlight the co-benefits of decentralized OWS within regional and local contexts, including water savings, resiliency, avoided costs, and social/environmental benefits
- Prepare case studies showcasing OWS integrated in affordable housing and the financing mechanisms utilized for cost-effective deployment
- Prepare case studies highlighting the use of diverse project delivery and financing models, including the use of financial incentives such as grant programs
- Host webinars to communicate the value of onsite reuse, share updates on NBRC activities, and maintain forums for ongoing dialogue with designers, product manufacturers, and other stakeholders
- Identify opportunities to improve green building incentives to promote OWS

Leads:

- Brian Good (Denver Water), Martin Page (US Army Engineer Research and Development Center), Alan Cohn (New York City Department of Environmental Protection), Paula Kehoe (SFPUC), Jocelyn Jones (Washington State Department of Health) , Chris Hilton (Seattle Public Utilities)

Partners:

- WRF, Columbia University, WateReuse Association, Water Environment Federation (WEF), American Water Works Association (AWWA), design engineers, utilities, US Green Building Council

Deliverable:

- NBRC marketing guide combining costs and case studies

Goal 2: Increase the Adoption of OWS Programs Among States and Jurisdictions

Over the last decade, model regulations prepared by the NBRC have facilitated the installation of OWS systems across the US. The NBRC model polices have enabled a shift in the perspective of many participating public health regulators as they now have the health risk-based framework and appropriate tools to develop regulations. Locations including San Francisco, CA, Austin, TX, and the State of Colorado have already adopted such rules. States such as California, Minnesota, Washington, and Hawaii are advancing regulations or policies supporting onsite reuse, while others including Texas, Alaska, Ohio, and Oregon are considering similar steps forward.

Additionally, the NBRC is partnered with key codes and standards organizations – International Code Council (ICC), International Association of Plumbing & Mechanical Officials (IAPMO), American Rainwater Catchment System Association (ARCSA), NSF, and the General Services Agency (GSA) – to align plumbing codes and standards with the established risk-based framework.

Actions:

- Identify and enlist states and jurisdictions to adopt NBRC health risk-based framework for OWS
- Adopt standards and codes that align with the NBRC health risk-based framework for OWS
- Partner to develop third-party certifications of treatment trains such as NSF that align with the NBRC health risk-based framework for OWS

Leads:

- Alan Cohn (New York City Department of Environmental Protection), Anita Anderson (Minnesota DOH), Nancy Rice (Minnesota DOH), Tiffani Kavalec (Ohio EPA), Paula Kehoe (SFPUC), Jocelyn Jones (Washington State Department of Health)

Partners:

- WateReuse Association, state and local health regulators, local building departments, ICC, IAPMO, ARCSA, NSF, GSA

Goal 3: Broaden NBRC Partnership with Other Organizations Engaged in OWS

The NBRC aims to create and foster powerful relationships with our members rooted in shared vision, purpose, and values, and share lessons learned across international initiatives. Water and sanitation challenges are felt across the world and the need for collaboration has never been greater. The world's emerging megacities offer an unprecedented opportunity to embrace OWS as a solution to growing challenges of affordability, equity, and access.

BILD is a new initiative brought by the NBRC to help build cross-sector coalitions to expand OWS. Expanding the diversity of participants, BILD emphasizes concurrent focus on operational, regulatory, and technical issues through open exchange of ideas and actionable advancement. BILD strives to build coalitions to enable real world operations of systems which advance scientific and technical

understanding, provide solutions to regulatory concerns, and streamline operations and maintenance.

Actions:

- Expand NBRC partners to include non-profit organizations, operators, product manufacturers, research organizations, and academia who are actively engaged in various aspects of OWS
- Explore opportunities to establish an umbrella advocacy coalition with international representation from Europe, India, and Australia and partner with existing initiatives for knowledge sharing and to develop joint advocacy activities
- Host in-depth specialty workshop on onsite water systems in partnership with WateReuse Association

Lead:

- Paula Kehoe (SFPUC)

Partners:

- Gates Foundation, EU ANCHOR, Eawag, Bangalore, Australia, South Africa, MULTISOURCE, International Living Future Institute, US Green Building Council, Denver Water

SUSTAINABLE TECHNOLOGY/INNOVATION:

Goal 1: Identify Model Treatment Trains That Allow for Flexibility and Innovation

The NBRC embraces a health risk-based framework that addresses not only LRTs and example treatment trains, but critical control point monitoring, permitting, and oversight and management of OWS. Common treatment trains utilized to meet the LRTs include membrane bioreactors (MBR), ultraviolet (UV) disinfection, and chlorine disinfection. Pathogen reduction performance from these treatment process and others have been have been documented in a unit process log reduction database for water reuse practitioners. Additionally, EPA's Small Business

Innovation Research (SBIR) Program is funding the development and commercialization of next generation technologies, including nature-based solutions.

To enable innovation and flexibility, the ability to use additional treatment trains should be identified. Despite existing research, there remain limitations on the availability of validated treatment trains due to a lack of accessible data for crediting the performance of alternative unit treatment processes with respect to virus, bacteria, and protozoa removal. Developing more crediting frameworks and improvements in real-time surrogate monitoring will help expand the types of treatment trains that can demonstrate their ability to reliably meet the LRTs and lead to more flexibility and innovation, including low-technology solutions that can reduce cost and energy use in this field.

Actions:

- Develop bacterial inactivation log removal tables for OWS
- Identify and validate real-time or near real-time surrogate monitoring methods for verifying continued performance of unit treatment processes
- Establish crediting frameworks for alternative technologies that link monitoring data and operational configurations to minimum log reductions
- Expand next generation technologies for OWS, including sensors for improved treatment process monitoring and alternative, scale-appropriate treatment technologies that are low in cost and energy intensity
- Leverage platform and laboratory spaces for testing new onsite water treatment technologies to propel technologies from research prototypes to market-ready products

Leads:

- Jay Garland (US EPA ORD), Michael Jahne (US EPA ORD), Anita Anderson (Minnesota Department of Health), Nancy Rice (Minnesota Department of Health)

Partners:

- National Alliance for Water Innovation (NAWI), Colorado State University, EPA's SBIR Program

Goal 2: Maximize the Energy Efficiency Potential of OWS

While aerobic MBRs have emerged as a robust component of OWS, the operating costs create systems that are carbon and energy intensive. There is a need to improve efficiency of a commonly used treatment train (MBR, UV, chlorine) to be energy neutral or energy positive and to develop alternative technologies that meet energy efficiency goals. Life cycle assessments have shown that the MBR is the most energy intensive component of the standard OWS treatment train. While MBRs are considered a foundational component of some treatment trains, we need to carefully consider overall energy demand and focus on identifying and integrating improvements to reduce the energy footprint, such as resource recovery and decreased aeration. Better understanding the water-energy nexus, including learning from building decarbonization programs such as the New York State Energy Research and Development Authority's Heat Recovery Program, will become increasingly important as we accelerate OWS under changing climate conditions.

Actions:

- Research alternatives to traditional MBRs such as anaerobic MBRs to promote more energy efficient OWS by reducing energy use and producing methane for biogas heat production
- Standardize OWS policies that incentivize or require OWS to incorporate a thermal energy recovery component
- Assess existing OWS for opportunities to incorporate additional resource recovery technologies
- Communicate the benefits of incorporating resource recovery with OWS

Lead:

- Jay Garland (EPA ORD)

Partners:

- NAWI, University of South Florida, WRF, product manufacturers such as Cambrian, Epic Cleantec, Aquacell, and Natural Systems Utilities

Goal 3: Promote Nature-based Treatment Within OWS

As OWS treatment trains become more available, nature-based options should be part of the solution. It is widely understood that nature-based solutions can provide treatment to remove organics and nutrients. However, pathogen removal performance remains highly uncertain and the quantitative extent of these removals in association with specific operational configurations is not well established, precluding log removal validation and crediting. Additionally, more research is needed to quantify and promote the additional co-benefits when they are used in OWS. These co-benefits can include opportunities to increase green space in urban environments and improve the energy efficiency of systems. Some existing OWS, including systems implemented in Austin, TX and Denver, CO, have incorporated wetlands-based treatment systems and could provide opportunities for further research to develop standardized design criteria and understand the co-benefits that can be gained from these nature-based solutions.

Actions:

- Obtain additional data to support pathogen crediting frameworks for natural treatment systems including wetland treatment systems
- Summarize existing research and quantify the co-benefits of incorporating nature-based treatment systems in OWS
- Develop guidance, model treatment trains, and design standards for incorporating wetland treatment systems with or without MBRs and promote wetlands-based systems

Lead:

- Paula Kehoe (SFPUC), Jocelyn Jones (Washington State Department of Health), Chris Hilton (Seattle Public Utilities)

Partners:

- Product manufacturers, NAWI, design engineers, utilities, WRF, SFPUC, US EPA-ORD, Denver Water

CAPACITY BUILDING:

Goal 1: Promote Training and Workforce Development Opportunities

A critical component for the ongoing success of OWS is the availability of qualified and trained operators. Experience in San Francisco suggests that insufficient operator training and experience can result in prolonged system downtime and ongoing operational and compliance challenges. The primary challenge is that there are no existing operator certificate or certification programs for OWS that cover skill-specific knowledge and real-life experiences. Additionally, there is the need for specialized training for operators of OWS to accompany such programs. While the operational skills required to run these systems may overlap with existing water, wastewater, or building water system operator certifications, specialized training that focuses on onsite non-potable reuse skill-specific knowledge is needed. Likewise, simplifying the training and certification requirements for operators can remove implementation barriers and develop a broader pool of operators.

The NBRC is developing a knowledge-based operator training and certificate program for OWS, which we aim to complete in 2025. The goal of the operator certificate program is to build operator capacity and provide the unique training and skills needed to safely operate and maintain OWS. This program will give building owners, utilities, and public health regulators a high level of confidence that OWS are being operated in a manner that is protective of public health.

Actions:

- Finalize and promote the Operator Training and Certificate Program
- Seek opportunities to engage underserved communities in training and workforce development
- Host webinars with designers, operators, regulators, and other stakeholders to promote cross-sector collaboration

Leads:

- Katherine Jashinski (Austin Water), Robert Stefani (Austin Water), Chris Radziminski (City of Vancouver)

Partners:

- Utilities, workforce development organizations such as Baywork, public health regulators, Austin Water, WateReuse Association

Call To Action

The NBRC made critical progress in removing roadblocks to adoption of OWS by developing the risk-based framework. These initial steps brought the field to an inflection point; the NBRC, through the actions defined above, remains committed to enabling this next stage of accelerated adoption. It takes shared ownership and collaboration to achieve this vision for the future. The NBRC is seeking partners to assist with these initiatives to transform the water sector.