

August 2025

NATIONAL BLUE RIBBON COMMISSION FOR ONSITE WATER SYSTEMS

Recommended Pathogen Reduction Targets for Onsite Water Systems



National Blue Ribbon Commission
for Onsite Water Systems



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ACRONYMS

ANSI	American National Standards Institute	MF	Microfiltration
ARCSA	American Rainwater Catchment Systems Association	NBRC	National Blue Ribbon Commission for Onsite Water Systems
DALY	Disability Adjusted Life Year	OWS	Onsite Water System
GSA	General Services Agency	QMRA	Quantitative Microbial Risk Assessment
IAPMO	International Association of Plumbing and Mechanical Officials	RO	Reverse Osmosis
ICC	International Code Council	UF	Ultrafiltration
LRT	Log Reduction Target	US EPA	United States Environmental Protection Agency
MBR	Membrane Biological Reactor	UV	Ultraviolet
		WRF	The Water Research Foundation

DEFINITIONS

Condensate: water vapor collected from air conditioning systems.

Foundation Drainage: nuisance groundwater from dewatering operations.

Graywater: wastewater from clothes washers, bathtubs, showers, and bathroom sinks.

Multi-family Building: residential building with 3 or more dwelling units.

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

Onsite Wastewater: wastewater originating from toilets, urinals, and/or kitchen sources, such as kitchen sinks or dishwashers, comingled with graywater, also known as blackwater.

Rainwater: precipitation collected from roofs and above grade surfaces, also known as roof runoff.

Stormwater: precipitation collected from at or below grade surfaces.

EXECUTIVE SUMMARY

This document outlines the current state of the science on risk-based treatment targets for onsite water systems (OWS) and provides guidance from the National Blue Ribbon Commission (NBRC) to determine the level of treatment, oversight and management for OWS for their application to commercial, multi-family and mixed-use buildings for non-potable end uses.

Water quality targets and example treatment trains contained in this document are intended to inform jurisdictions seeking to adopt new regulations for OWS. Some states and jurisdictions have already implemented or are proceeding with water quality regulations for commercial, multi-family and mixed-use buildings that may have slight variations from the recommendations contained within this report. In line with the NBRC's guiding principle of honoring local context and regardless of the slight differences in regulatory perspectives and assumptions, it is important to acknowledge that all approaches are guided by risk-based science.

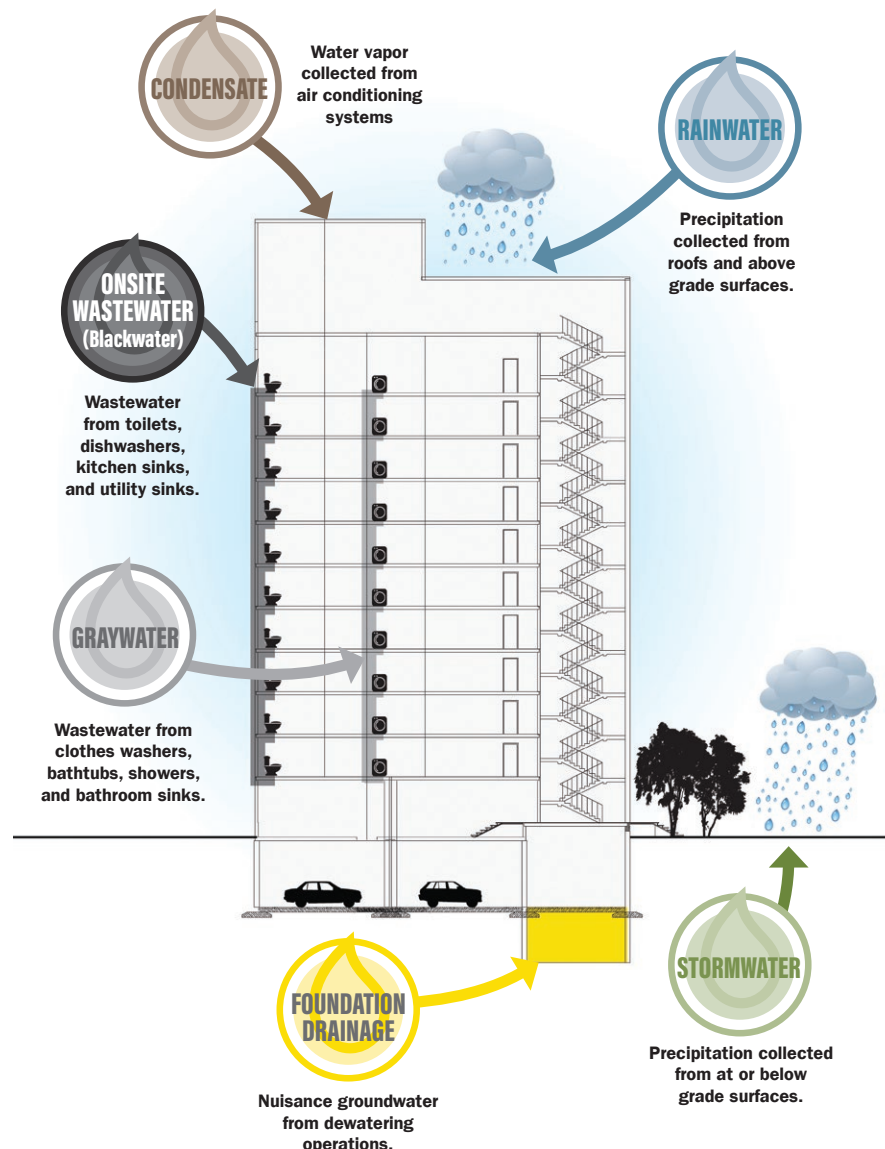
30 Otis is a mixed-use building in San Francisco that collects rainwater and graywater to meet the building's toilet flushing and irrigation demands. Photo credit: Andrew Pogue



INTRODUCTION

The National Blue Ribbon Commission for Onsite Water Systems (NBRC) advances best practices to support the implementation of onsite water systems (OWS) for individual buildings or at the neighborhood scale. Buildings produce several onsite water resources, including rainwater, stormwater, foundation drainage, graywater, onsite wastewater, and condensate. When collected and treated properly, these water sources can be used for non-potable applications such as toilet flushing, irrigation, clothes washing, and cooling towers. OWS can reduce potable water use up to 45% in multi-family residential buildings and up to 75% in commercial buildings for non-potable uses¹. Multi-family buildings are defined as residential buildings with three or more dwelling units.

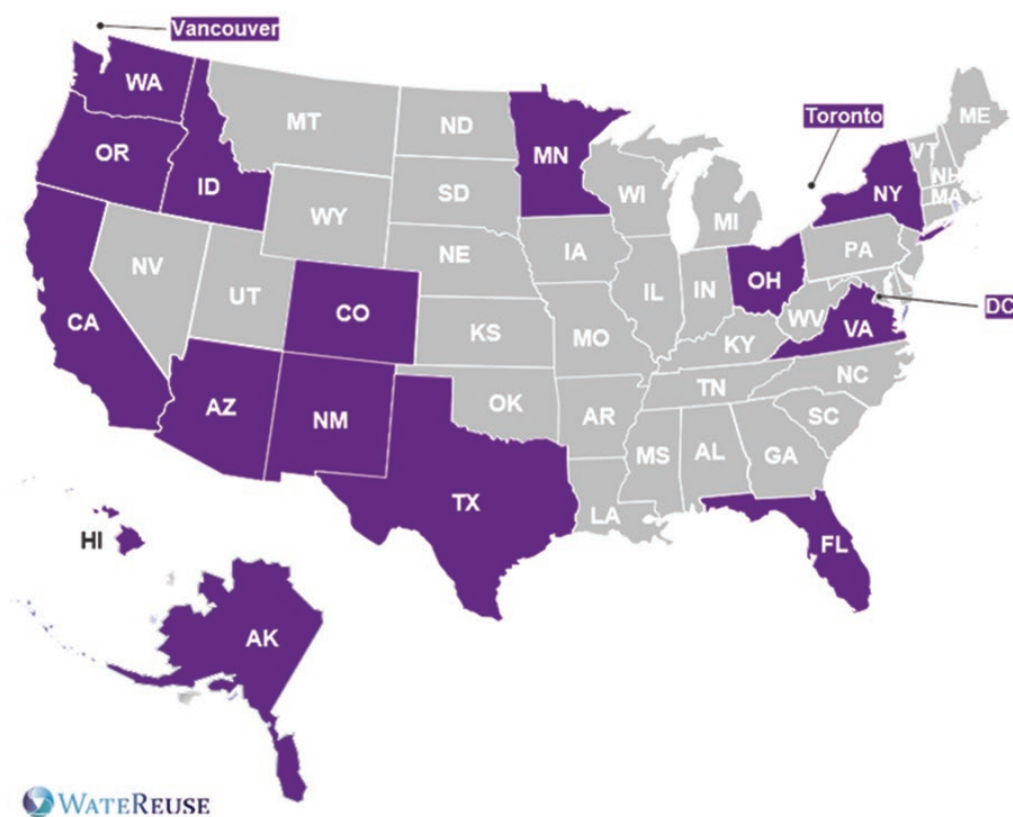
Figure 1. Types of Alternate Water Sources Produced by Buildings



¹ San Francisco Public Utilities Commission. Onsite Water Reuse Program Guidebook. https://www.sfpuc.gov/sites/default/files/documents/OnsiteWaterReuseGuide_April2025.pdf.

The NBRC is committed to protecting public health and the environment, and sustainably managing water – now and for future generations. The NBRC is comprised of representatives from municipalities, water utilities and public health agencies from 15 states, the District of Columbia, the cities of Toronto and Vancouver Canada, the United States Environmental Protection Agency (US EPA), and the US Army Engineer Research and Development Center (Figure 2). The NBRC is partnered with the WaterReuse Association, US Water Alliance and The Water Research Foundation. It is chaired by the San Francisco Public Utilities Commission.

Figure 2. Map of NBRC Partners



The NBRC advances best management practices to support the use of OWS within individual buildings or at the local scale. The NBRC has made significant research contributions and continues to advance policies and regulations for onsite water reuse, creating resources that support implementation of this sustainable water strategy and foster strong collaborations between water/wastewater utilities and public health agencies to ensure that projects manage risks effectively. The NBRC has prepared several documents to help foster OWS programs and scale up their implementation across North America (Appendix A). This current document builds upon those resources by highlighting the current scientific information on risk-based treatment processes and updating its associated recommendations for partner organizations seeking to develop new OWS programs. For more information, visit www.sfpuc.gov/nbrc.

NBRC GUIDING PRINCIPLES

1. PROTECT PUBLIC HEALTH

To secure a sustainable water future, diverse approaches to water management are needed. The NBRC is committed to protecting public health and ensuring safe, secure, and reliable water use and reuse.

2. DEVELOP SCIENCE-BASED POLICY

The NBRC is driven by risk-based science and research as it develops policy recommendations and guidance.

3. UTILIZE A CONSENSUS-BASED APPROACH

The NBRC believes that alignment of diverse experiences and expertise will lead to the best outcomes. The NBRC will seek consensus across all the work done together.

4. INTEGRATE BEST PRACTICES

The work of the NBRC is informed by the best practices in the management, operations, and oversight of OWS.

5. HONOR LOCAL CONTEXT

The NBRC sees great value in the development of policy and business models to support the effective adoption of OWS. At the same time, the NBRC recognizes and respects that policy and program implementation will vary based on needs and context at the local and state level.

6. COMMIT TO CONTINUOUS LEARNING

As the adoption of OWS evolves, the NBRC is committed to staying abreast of new science and new approaches and will gather input from interested stakeholders, learning together.

PROTECTING PUBLIC HEALTH

Figure 3



OWS = Risk-based Log Reduction Targets (LRTs) + Appropriate Treatment Technologies + Continuous Monitoring + Oversight and Management

NBRC APPROACH TO OWS

One of the most critical aspects of OWS is to ensure the appropriate water quality 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*² established a scale-appropriate, risk-based framework for implementing OWS within commercial, multi-family and mixed-use buildings.

The NBRC advocates an approach for OWS that includes meeting the LRTs with appropriate treatment technologies and continuous monitoring. This should be supported by proper management of the OWS and oversight by the local jurisdiction.

Risk-based Log Reduction Targets

Risk-based frameworks identify a target health benchmark and then calculate the level of treatment needed to achieve that goal, typically expressed as a certain number of $\log_{10}$ (i.e., tenfold) reductions in pathogen concentration (LRTs). Using Quantitative Microbial Risk Assessment (QMRA), the 2017 report centered on risk-based LRTs for the treatment of pathogens including viruses, protozoa and bacteria. With the report, the NBRC reached consensus on national guidance for OWS that included an LRT table for a variety of alternate water sources, including onsite wastewater, graywater, rainwater and stormwater for indoor and outdoor non-potable uses in commercial, multi-family and mixed-use buildings (Appendix B).

The health risk-based framework represented a significant shift from the typical end-point assessments of water quality that do not directly consider the input of different pathogen loads (i.e., bacteria, viruses and protozoa), to the treatment performance required for specific pathogen inactivation and/or removal to meet fit-for-purpose public health goals. The health risk-based framework, in conjunction with appropriate monitoring systems, provides regulators and other decision makers with a clear understanding of the

² Sharvelle, S., Ashbolt, N., Clerico, E., Hultquist, R., Leverenz, H. and Olivieri, A. (2017) [Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems: Final Report](#). Water Environment and Research Foundation, San Francisco Public Utilities Commission and Water Research Foundation, Alexandria, VA.

potential health risks associated with different source waters and end uses to ensure OWS are protective of public health. Additionally, the risk-based framework is rooted in peer-reviewed science and can be updated to incorporate new scientific information, promoting robust protection now and into the future. Since 2017, LRTs using the infection-based benchmark has been adopted by states such as Colorado and cities such as San Francisco in their respective regulations for OWS.

In 2025, the US EPA produced a report summarizing new LRTs based on the same modeling framework and QMRA process. The Risk-Based Framework for Developing Microbial Treatment Targets for Water Reuse ^[3] used an updated and consistent set of input parameters to present microbial treatment targets for untreated wastewater, graywater, stormwater and roof runoff water used for potable use, indoor non-potable use and landscape irrigation applications across both onsite and municipal settings. Informed by the same experts that developed the 2017 LRTs, this update provides a current scientific resource to inform risk-based water reuse treatment programs, including those for OWS.

As presented in the US EPA report, the most prominent frameworks in the field of water reuse have utilized two benchmarks based on limiting either infections or disability adjusted life years (DALYs). Available guidance has now expanded to include the DALY health benchmark for consideration by jurisdictions seeking to adopt new OWS oversight and management programs. The infection-based benchmark and DALY health benchmark are both considered to be protective of public health yet manage for different public health endpoints.

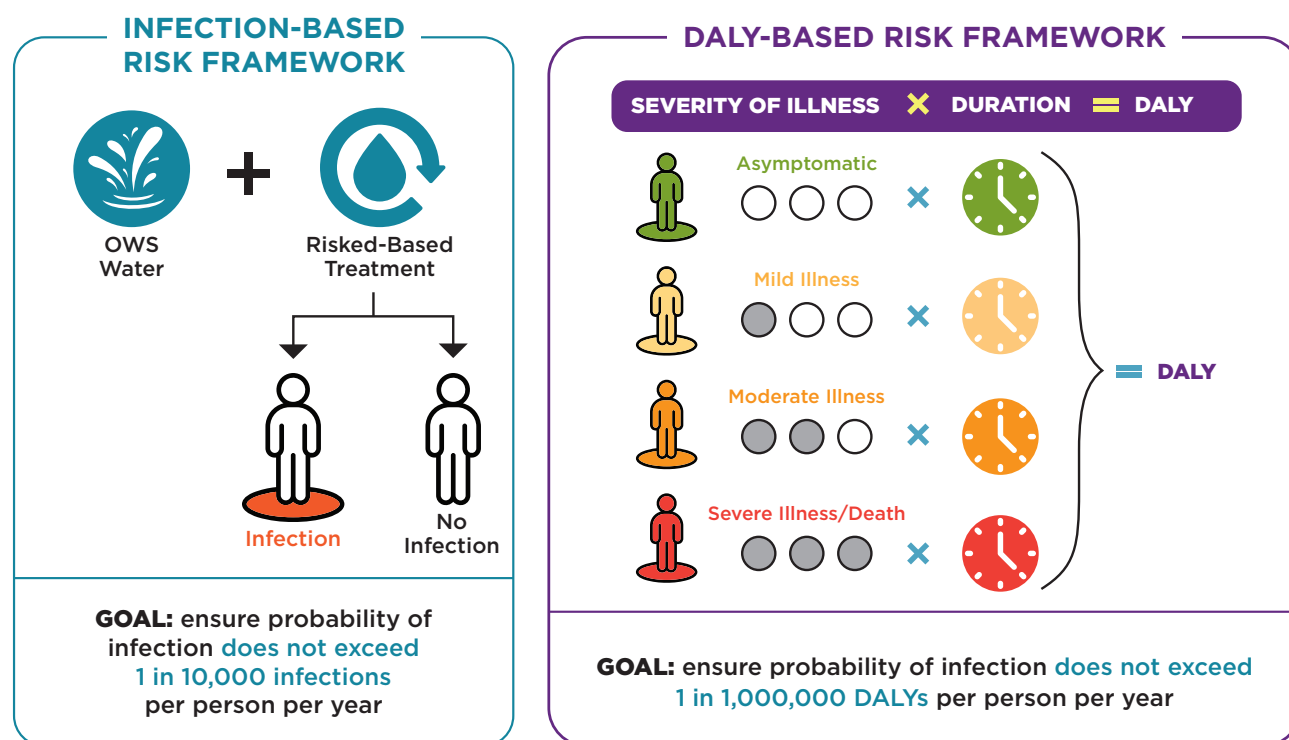
Denver Water Administration Building uses an engineered wetland treatment system to recycle the building's wastewater. Photo credit: Denver Water



3 U.S. Environmental Protection Agency. 2025. [Risk-Based Framework for Developing Microbial Treatment Targets for Water Reuse](#). U.S. Environmental Protection Agency, Office of Research and Development, EPA/600/R-25/009.

A comparison of the two frameworks is presented in Figure 3 and discussed in more detail in the NBRC’s Health Risk-based Benchmarks for Onsite Treatment of Water document. The infection-based benchmark (on which the NBRC’s 2017 recommendations were based) seeks to limit the number of infections in the exposed population. The DALY benchmark looks not only at the rate of infections, which may not always lead to illness, but also at the resulting degree of human health impairment. In doing so, the DALY framework evaluates how microbial risks impact the quality and quantity of life. Because different infections can have different health outcomes, the DALY framework includes a metric to weigh the disease burden associated with different illnesses. These outcomes are quantified in terms of DALYs where one DALY is equivalent to one year of healthy life lost. DALYs are widely used internationally, including in the World Health Organization’s guidelines for drinking water and water reuse.^{4,5}

Figure 4. Comparison of Infection and DALY Health Benchmarks and their Goals for Limiting Infections or DALY-based Health Burden⁶



4 World Health Organization. (2022). [Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda](#).

5 World Health Organization. (2013). [Guidelines for the safe use of wastewater, excreta, and greywater—Volume 2](#).

6 National Blue Ribbon Commission for Onsite Non-potable Water Systems. Health Risk-based Benchmarks for Onsite Treatment of Water. https://watereuse.org/wp-content/uploads/2023/11/WWE_NBRCONWS_2023-09-13.pdf.

NBRC RECOMMENDED LRTS

The NBRC has reviewed and considered the 2025 EPA report. As a result, the NBRC is updating its 2017 guidance for OWS used in commercial, multi-family, and mixed-use buildings for landscape irrigation and indoor non-potable use as shown in Table 1. The NBRC's recommendations for LRTs reflect updated information on reference pathogens and the most current reference pathogen dose-response models. The NBRC respects local context and both infection-based and DALY frameworks can be used by policy makers and organizations to implement scientifically defensible microbial treatment targets for a broad range of water reuse applications. Consistent with the 2017 guidance, LRTs are reported by pathogen class (viruses, protozoa, and bacteria); jurisdictions seeking pathogen-specific targets (e.g., for *Giardia* and *Cryptosporidium*, which are consolidated as protozoa here) may refer to the 2025 EPA report directly.

The NBRC has selected DALY LRTs for the following technical and practical reasons:

- The goal of the risk-based approach is to protect public health. Since DALYs capture the ultimate population-level burden of disease resulting from pathogen exposure, DALYs are an accurate metric for assessing the public health impact of water reuse management as they take into account illness and its subsequent negative consequences on public health.
- The DALY-based LRTs are equal to or lower than those based on infection. While a lesser treatment goal is not of itself a legitimate reason for target selection, using this set for broad guidance sets the “floor” for protective treatment; jurisdictions may decide to use the higher values due to either an infection benchmark preference or their desire for more stringent treatment standards in general. For example, some local and state governments within the United States rely on infection-based risk-based approaches for other water treatment decisions and may choose to do so consistently for these systems.
- DALYs are not limited to infectious diseases, therefore they can also be calculated for assessing chemical exposures (e.g., to disinfection byproducts) and other forms of risk. Incorporation of DALYs will allow a more ready comparison of health risks and benefits from non-microbial concerns associated with both ONWS and other public health activities moving forward, including life cycle impacts from energy use.

Table 1. 2025 NBRC Recommended LRTs for OWS

End Use	Source Water	Virus	Protozoa	Enteric Bacteria
Indoor non-potable use	Onsite Wastewater	10.0	6.5	5.5
	Graywater	7.5	4.0	3.5
	Stormwater	8.0	6.0	5.5
	Roof Runoff	n/a	1.0	3.5
Unrestricted irrigation	Onsite Wastewater	8.5	6.5	5.5
	Graywater	6.5	4.0	3.0
	Stormwater	7.5	5.0	4.5
	Roof Runoff	n/a	0.5	3.5

APPROPRIATE TREATMENT TECHNOLOGIES TO ACHIEVE LRTS

To meet the LRTs and other water quality requirements in commercial, mixed-use, and multi-family buildings, OWS should include an effective treatment train which may include the use of common treatment processes such as microfiltration (MF), ultrafiltration (UF), membrane bioreactors (MBR), ultraviolet light (UV) disinfection, and/or chlorination.

The NBRC recommended standard for demonstrating compliance with the LRTs is to require a treatment train in which unit processes are collectively credited to meet selected LRTs. Well-documented and established pathogen crediting frameworks should be used where possible to quantify pathogen reduction and assign log reduction credits through a treatment processes. Use of existing crediting frameworks streamlines implementation of OWS by quantifying reliable pathogen reduction and assigning specific log reduction credits to each treatment process based on what can be effectively demonstrated through performance monitoring surrogates. Pathogen reduction credits are based on established frameworks developed for drinking water, potable reuse, and non-potable reuse, as shown in Table 2. Other treatment goals that influence unit process selection include the reduction of organics, particulates, and nutrients and the need to deliver aesthetically acceptable water.

The George at 434 Minna Street is a residential apartment building in San Francisco that collects graywater and rainwater to supply both toilet and irrigation needs. Photo credit: Brookfield Properties



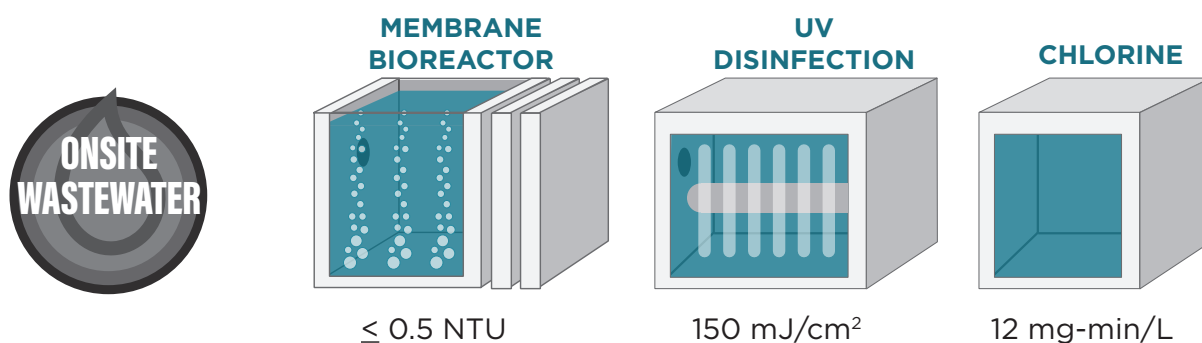
Table 2. Example Pathogen Crediting Frameworks for OWS

Example Treatment Process	Available Pathogen Log Reduction Reductions V/P/B Virus/Protozoa/Bacteria	Crediting Framework	Example Continuous Monitoring Methods
Microfiltration or Ultrafiltration	0 / 4 / 0	US EPA Membrane Filtration Guidance Manual	Effluent turbidity and daily pressure decay test to detect breach of 3 µm or larger
Membrane Biological Reactor	1 / 2.5 / 4	Membrane Bioreactor Validation Protocols for Water Reuse (WRF project 4997)	Effluent turbidity equal to or less than 0.2 NTU 95% of the time and always below 0.5 NTU
UV	Up to 6 / 6 / -	US EPA Innovative Approaches for Validation of UV Disinfection Reactors for Drinking Water Systems NSF 55 Class A validation	UV dose UV intensity Flow rate UV transmittance
Chlorine Disinfection	Up to 4 / 0 / 4	Australian WaterVal Chlorine Disinfection Validation Protocol	Crediting based on CT framework, which requires monitoring of chlorine residual, contact time (flow rate), temperature, pH, and turbidity
Ozone Disinfection	4 / 3 / -	US EPA Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual	Ozone residual Flow rate Temperature
Ozone Disinfection	4 / 3 / 4	Australian WaterVal Chlorine Disinfection Validation Protocol	Ozone residual Flow rate Temperature Turbidity Applied ozone dose

EXAMPLE TREATMENT TRAINS TO MEET LRTS

Figures 5-8 provide example treatment trains to achieve the NBRC's recommended LRTs as shown in Table 1.

Figure 5. Example Treatment Train for Indoor Use of Onsite Wastewater in Commercial, Mixed-use and Multi-family Buildings for Non-potable End Uses



Pathogens	LRV Achieved by Treatment Process			Total LRV Achieved	LRV Required for Indoor Use
	MBR	UV	Free Cl ₂		
Enteric Virus	1.0	6.0	4.0	11.0	10.0
Protozoa	2.5	6.0	–	8.5	6.5
Bacteria	4.0	6.0	4.0	14.0	5.5

Figure 6. Example Treatment Train for Indoor Use of Graywater in Commercial, Mixed-use and Multi-family Buildings for Non-potable End Uses

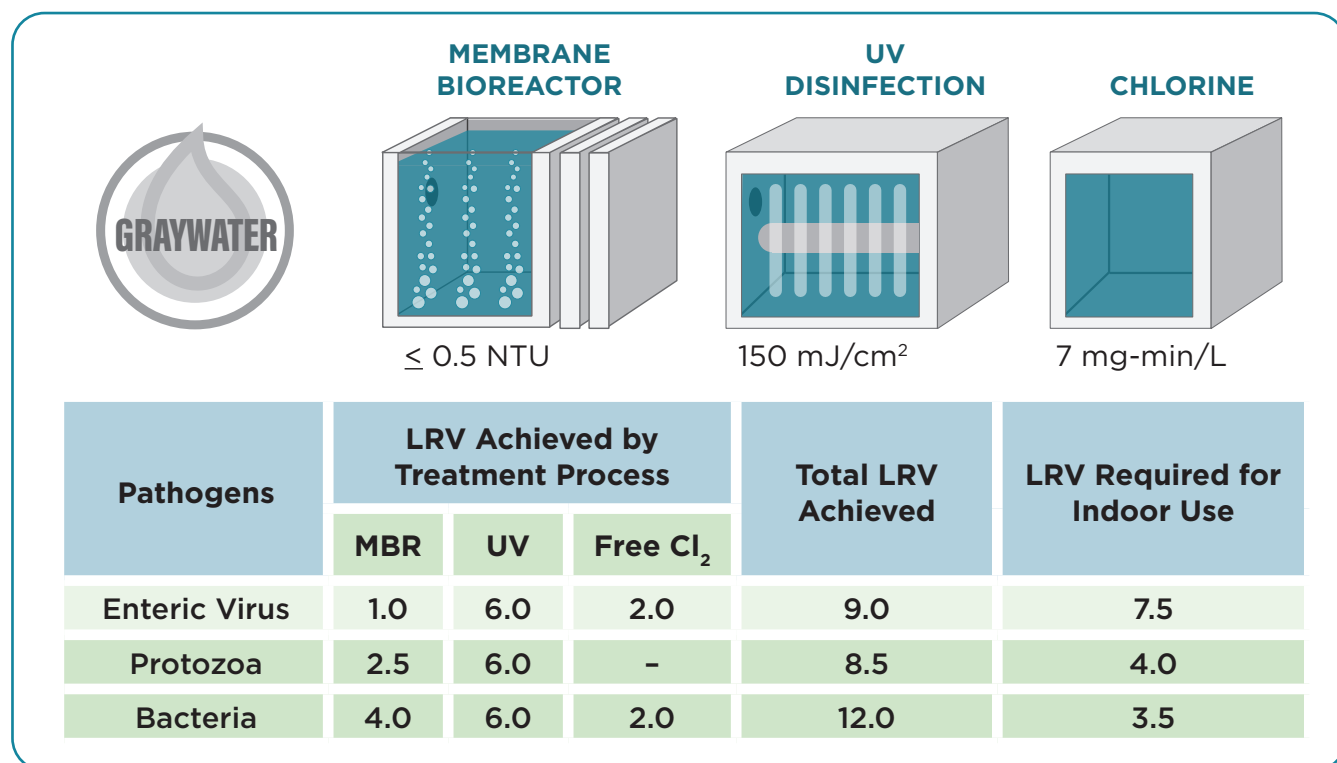


Figure 7. Example Treatment Train for Indoor Use of Roof Runoff in Commercial, Mixed-use and Multi-family Buildings for Non-potable End Uses

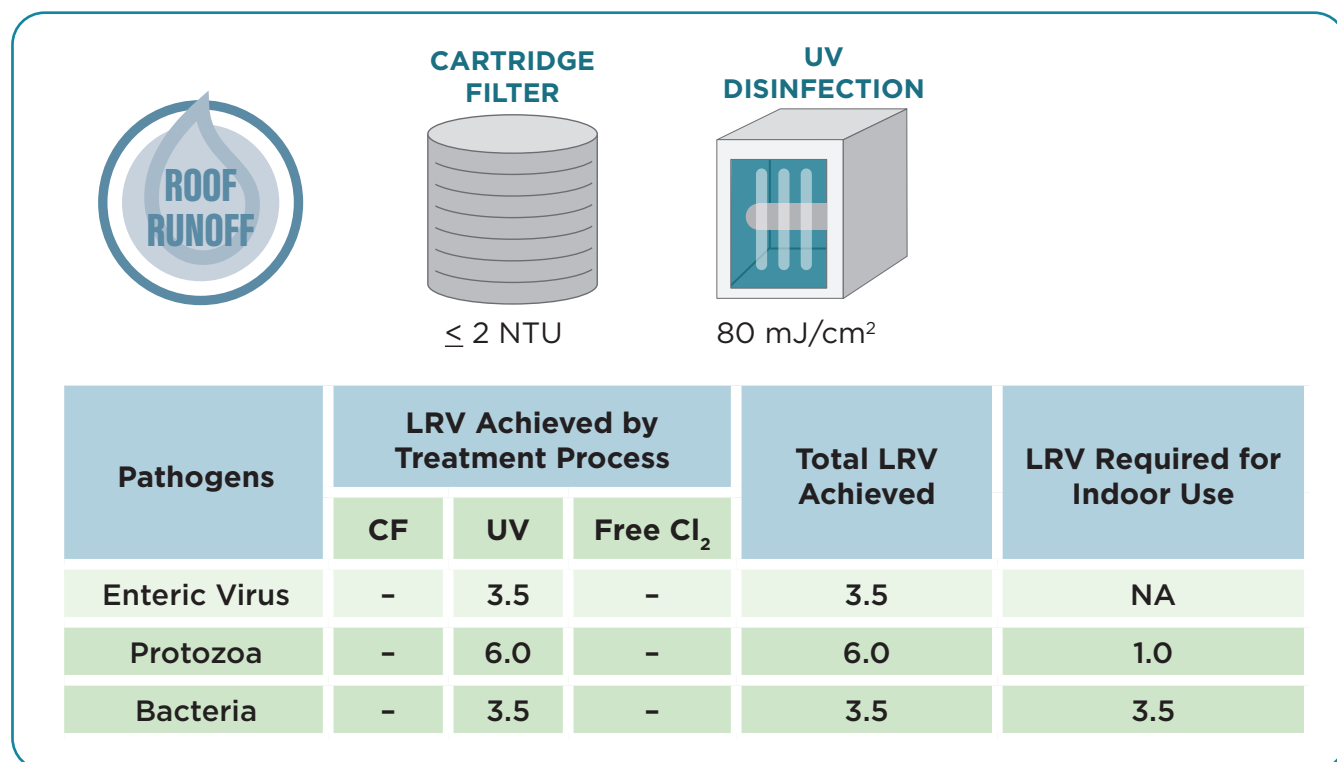
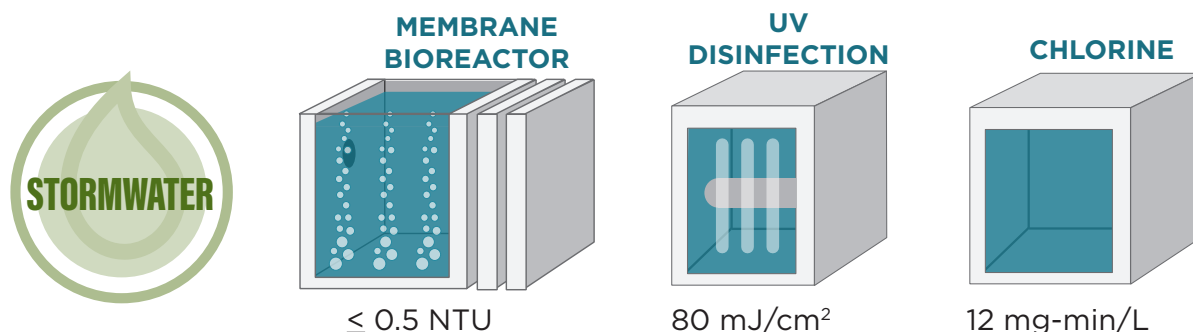
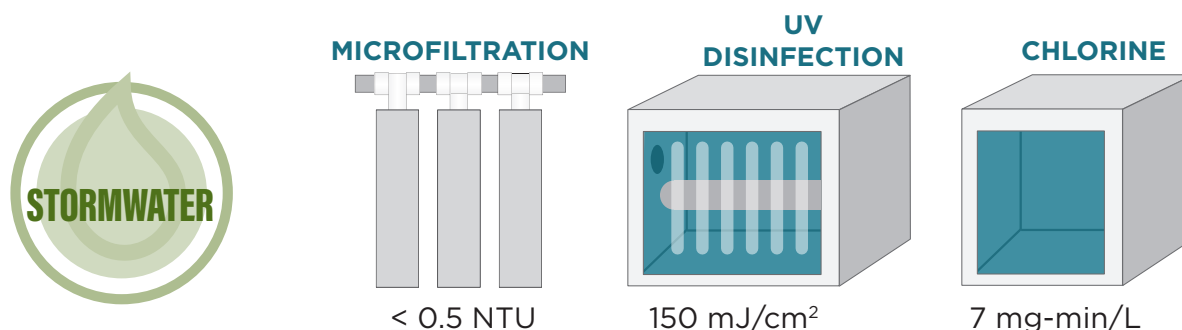


Figure 8. Example Treatment Train for Indoor Use of Stormwater (10% Wastewater Contribution) in Commercial, Mixed-use & Multi-family Buildings for Non-potable End Uses



Pathogens	LRV Achieved by Treatment Process			Total LRV Achieved	LRV Required for Indoor Use
	MBR	UV	Free Cl ₂		
Enteric Virus	1.0	3.5	4.0	8.5	8.0
Protozoa	2.5	6.0	-	8.5	6.0
Bacteria	4.0	3.5	4.0	11.5	5.5

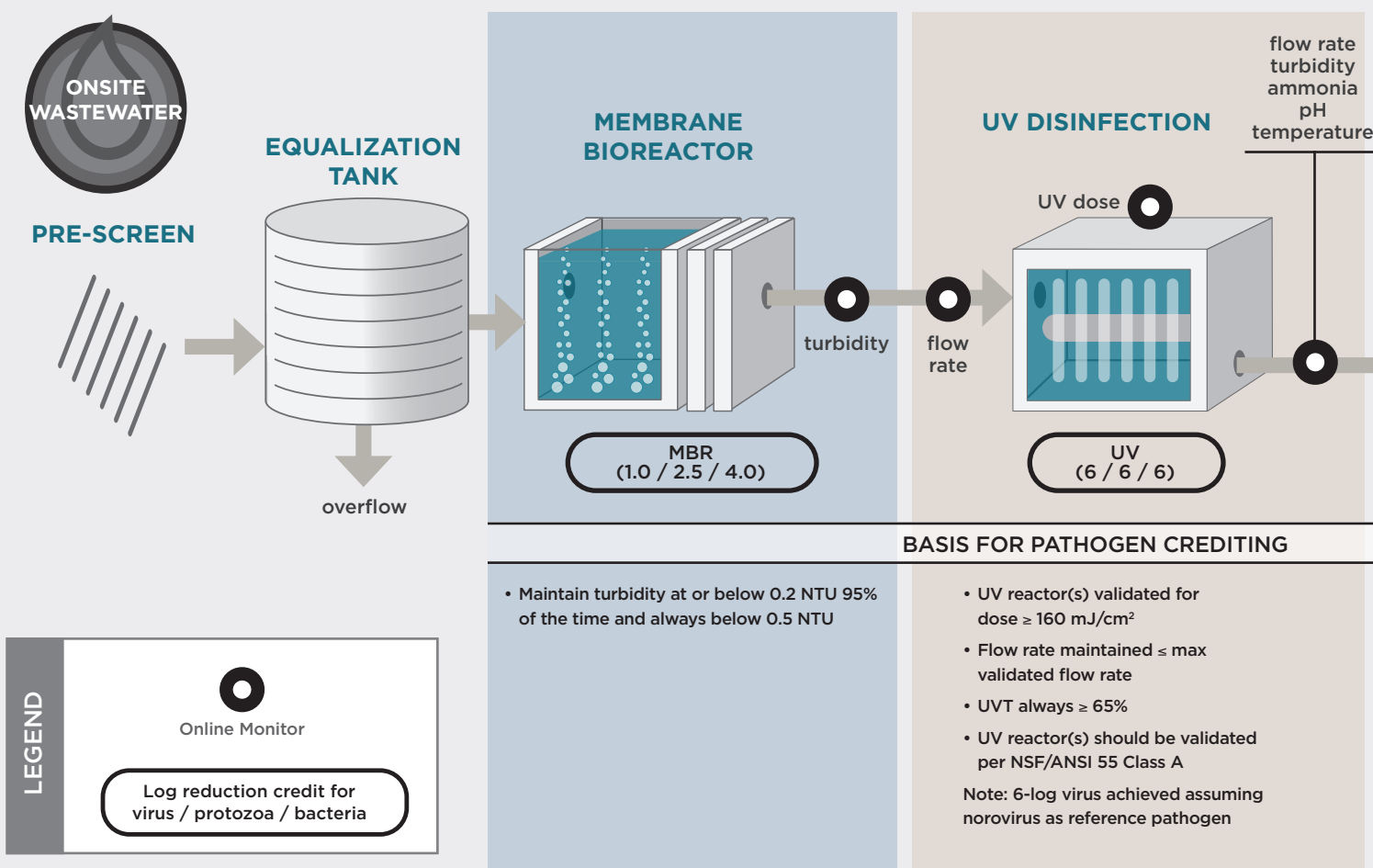


Pathogens	LRV Achieved by Treatment Process			Total LRV Achieved	LRV Required for Indoor Use
	MF	UV	Free Cl ₂		
Enteric Virus	-	6.0	2.0	8.0	8.0
Protozoa	-	6.0	-	6.0	6.0
Bacteria	-	6.0	2.0	8.0	5.5

CONTINUOUS ONLINE MONITORING

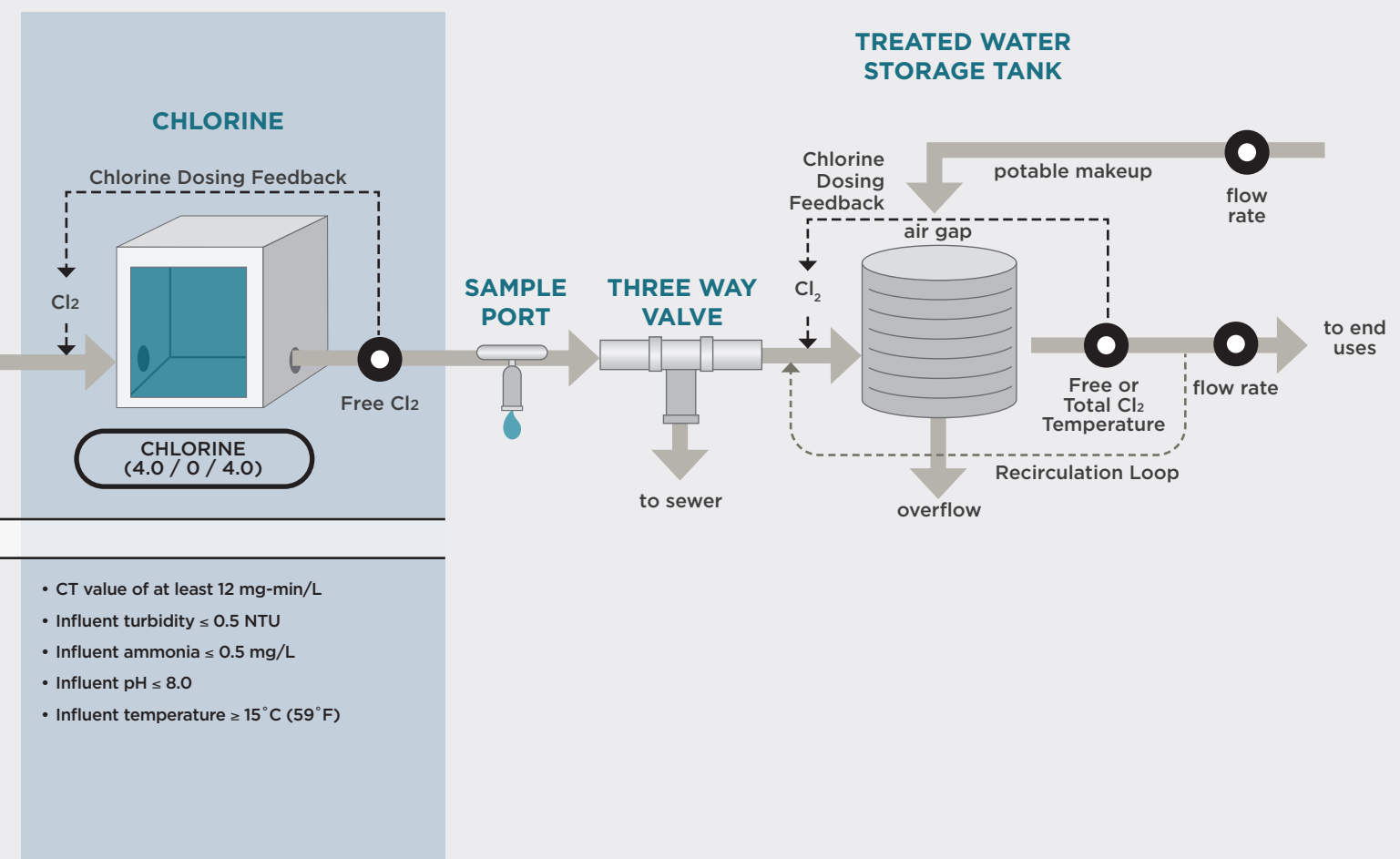
Along with LRTs and the associated treatment trains to achieve them, the risk-based framework embraced by the NBRC requires continuous online monitoring as it determines if a treatment system is operating within the design specifications and provides a continuous evaluation of system performance to ensure ongoing reliability that the LRTs are met. Therefore, when an OWS is operating, the performance of each treatment process is continuously monitored using microbial, chemical, or physical indicator(s) or surrogate parameter(s) (Table 2) and the system automatically shuts down if/when the design specifications are not met. For example, effluent turbidity may be used to measure membrane bioreactor performance and disinfectant residual may be used to quantify the degree of pathogen inactivation when using chlorine disinfection. Notably, this shifts treatment monitoring from burdensome effluent water quality testing (e.g., daily coliform tests) to these automated systems.

Figure 9. Example Treatment Train with Continuous Online Monitoring



OVERSIGHT AND MANAGEMENT

The NBRC supports oversight and management programs for OWS in commercial, mixed-use, and multi-family buildings for ongoing protection of public health. Oversight and management programs can be implemented at the local or state level may vary based upon local context. For example, in California, local jurisdictions adopt programs to permit OWS and the state is prohibited from taking over a local program. In Colorado and Washington, oversight of OWS is done at the state level.



FUTURE RESEARCH PRIORITIES

To accelerate the adoption of OWS in our communities, the NBRC developed the 2024 NBRC Action Plan consisting of four thematic areas: public health, sustainable technology/innovation, capacity building, and communication. The 2024 Action Plan serves as the basis for a new initiative called Building Infrastructure Locally for Decentralized Water Systems (BILD) that is a collaborative global community of practice working to uncover opportunities, advance implementation, and spread transformative solutions related to decentralized water systems to support the efficient use and reuse of water. BILD is developing initiatives and action plans to advance key priorities for OWS. Within public health, one of the priorities includes expanding and standardizing the health risk-based framework to include additional end uses and scales such as single-family water reuse applications. BILD is seeking steps to streamline implementation of the risk-based approach for water reuse and leverage the ability of OWS to address key goals beyond water scarcity (e.g., energy efficiency, nutrient management, cost, and nature-based solutions). For more information on BILD, visit www.sfpuc.gov/bild.

Mission Rock's district-scale blackwater treatment system is the first of its kind in San Francisco. The system will meet all of the demands for toilet and urinal flushing and irrigation.



REFERENCES

- 1 San Francisco Public Utilities Commission. Onsite Water Reuse Program Guidebook. https://www.sfpuc.gov/sites/default/files/documents/OnsiteWaterReuseGuide_April2025.pdf.
- 1 Sharvelle, S., Ashbolt, N., Clerico, E., Hultquist, R., Leverenz, H. and Olivieri, A. (2017) [**Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems: Final Report**](#). Water Environment and Research Foundation, San Francisco Public Utilities Commission and Water Research Foundation, Alexandria, VA.
- 3 U.S. Environmental Protection Agency. 2025. [**Risk-Based Framework for Developing Microbial Treatment Targets for Water Reuse**](#). U.S. Environmental Protection Agency, Office of Research and Development, EPA/600/R-25/009.
- 4 World Health Organization. (2022). [**Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda**](#).
- 5 World Health Organization. (2013). [**Guidelines for the safe use of wastewater, excreta, and greywater—Volume 2**](#).
- 6 National Blue Ribbon Commission for Onsite Non-potable Water Systems. Health Risk-based Benchmarks for Onsite Treatment of Water. https://watereuse.org/wp-content/uploads/2023/11/WWE_NBRCONWS_2023-09-13.pdf.

APPENDIX A: NBRC Policy Impacts & Resources

The NBRC has made significant research contributions and advanced policies and regulations for onsite non-potable water reuse over the past several years.

Blueprint for Onsite Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems (2014): Describes ten key steps for considering and implementing an ONWS program.

Risk-based Framework for the Development of Public Health Guidance for Decentralized Non-potable Water Systems (2017): This landmark report establishes scale-appropriate LRTs and monitoring for ONWS. The research was funded by WRF and led by the National Water Research Institute.

A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems (2017): To help develop LRTs and monitoring for ONWS and present pathways for implementation and management of these systems at the local and/or state level.

Model State Regulation for Onsite Non-potable Water Programs (2017): Provides a template for state legislation for establishing regulatory programs for ONWS.

Model Local Ordinance for Onsite Non-Potable Water Programs (2017): Provides a template for local ordinance for establishing regulatory programs for ONWS.

Model Program Rules for Onsite Non-potable Water Systems (2017): Provides specific details on implementation of an ONWS, including system design criteria, permitting, cross-connection control, reporting, notification, and enforcement.

Making the Utility Case for Onsite Non-potable Water Systems (2018): A report to help utilities and other stakeholder understand the benefits and drivers behind onsite reuse, how other utilities have addressed potential challenges, and best practices for the ongoing operation of these systems.

Guidance Manual and Training Materials for Onsite Non-potable Water Systems (2020): Develops a design and permitting training for onsite non-potable water systems to identify the skills and knowledge required to design and permit treatment systems that meet the LRTs.

Health Risk-based Benchmarks for Onsite Treatment of Water (2023): Outlines the current state of the science for determining the level of treatment required for OWS.

Successful Implementation of Decentralized Reuse and Treatment Systems (2024): Collects the system-level details for 310 onsite and distributed water reuse systems (ODWRS) and develops a case study compendium that identifies common factors in successful ODWRS implementation.

Operator Certificate Program for Onsite Non-potable Water Systems (2025, anticipated): Develop an operator certificate program to safely operate and maintain onsite non-potable water systems.

APPENDIX B: 2017 NBRC LRT TABLE

	Enteric Viruses	Parasitic Protozoa	Enteric Bacteria
ONSITE WASTEWATER			
Outdoor use	8.0	7.0	6.0
Indoor use	8.5	7.0	6.0
GRAYWATER			
Outdoor use	5.5	4.5	3.5
Indoor use	6.0	4.5	3.5
ROOF RUNOFF			
Outdoor use	N/A	N/A	3.5
Indoor use	N/A	N/A	3.5
STORMWATER			
Outdoor use	3.0	2.5	2.0
Indoor use	3.5	3.5	3.0

Source: Example treatment trains are listed in the following document: [Health Risk-based Benchmarks for Onsite Treatment of Water \(2023\)](#).

APPENDIX C: Plumbing Codes & Standards

State and local plumbing codes govern the delivery and quality of both potable and non-potable water within a building. Historically, plumbing codes have focused on water delivery characteristics such as flow and pressure. As implementation of onsite water treatment systems increases, there have been several efforts underway to update plumbing codes and standards with the latest research on the risk-based framework. The NBRC has partnered with codes and standards organizations to encourage the inclusion of risk-based frameworks.

ARCSA

ARCSA creates design standards for stormwater and rainwater catchment systems and provides third-party certification training for designers, installers, and inspectors for these systems. ARCSA is incorporating the risk-based framework into their standard development process.

GSA

General Services Agency (GSA) is a federal agency in charge of the building codes and standards for all federal buildings in the U.S. GSA's P100 is the design standard for designing and renovating federal buildings. GSA has proposed revisions to P100 to require that 15% of potable water must be reused within federal buildings. The proposed P100 also considers the risk-based framework for reusing water onsite within federal buildings.

IAPMO/ANSI

The International Association of Plumbing and Mechanical Officials (IAPMO) incorporated the risk-based LRTs into the Water Efficiency and Sanitation Standard (WE-Stand) for onsite wastewater and stormwater reuse. Additionally, IAPMO created the standard IAPMO/ANSI Z1324-2022 for Alternate Water Source Systems for Multi-Family, Residential, and Commercial Use (IAPMO, 2022). The standard covers systems intended to process water from alternate water sources such as graywater, rainwater, stormwater, air conditioning condensate, and other non-potable reuse applications not specifically listed, for use in subsurface and/or surface irrigation, cooling tower makeup and toilet/urinal flushing applications, or other similar reuse applications and specifies requirements for materials, physical characteristics, performance testing, and markings. The standard includes rigorous testing and creates an avenue for systems to achieve third-party certification. IAPMO/ANSI Z1324-2022 includes the 2017 risk-based LRTs for graywater systems installed in large commercial and multi-family residential buildings. NBRC is participating in the process to amend WE-Stand to incorporate the recommended LRTs.



Allianz Field at Midway Development District in Saint Paul, Minnesota has a district-scale rainwater system. Photo credit: City of Saint Paul

ICC

The International Code Council (ICC) develops model codes and standards and building safety solutions that include product evaluation, accreditation, technology, training, and certification. In 2024, ICC updated the water reuse provisions in the International Plumbing Code (IPC) and International Residential Code to incorporate the LRTs and provide guidance on the level of treatment for onsite water systems. The IPC references NSF/ANSI 350, which includes the risk-based framework in Annex N-2 for commercial graywater and onsite wastewater treatment systems.

NSF/ANSI

NSF/ANSI 350 was initially published in 2011. This internationally recognized water reuse standard is titled Onsite Residential and Commercial Water Reuse Treatment Systems. The standard established minimum criteria for component materials, design and construction, and performance or water quality treatment requirements for onsite residential and commercial water reuse treatment systems for non-potable applications.

NSF/ANSI 350-2023 published in April 2024 updated the standard to incorporate the risk-based framework in Annex N-2, including LRTs for commercial onsite wastewater and graywater. The LRTs are based on the work of Schoen et al. (2023) and utilize a risk benchmark of 10^{-6} DALY pppy. Annex N-2 is an optional certification for multi-family residential and commercial systems. This means manufacturers can get certified to NSF/ANSI 350-2023 and also have the option to get certified to meet the LRTs in Annex N-2.



National Blue Ribbon Commission
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