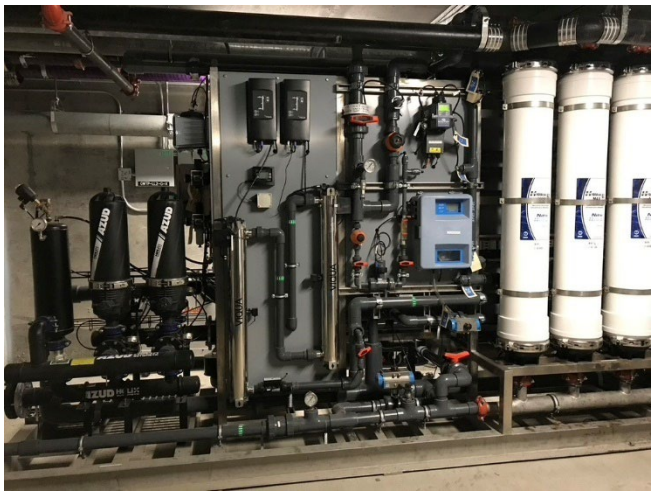
BILD
BUILDING INFRASTRUCTURE LOCALLY FOR DECENTRALIZED WATER SYSTEMS

Decentralized Water Systems:



Action Plan for Global Acceleration

February 2026

Note from the Executive Committee

Consistent, affordable access to safe water and sanitation is a significant global challenge. Many parts of the world rely on large-scale centralized systems with extensive piping networks to deliver treated drinking water and collect wastewater for treatment. This approach became common practice for protecting public health by providing clean sources of fresh water to consumers and discharging polluted waters away from humans. However, centralized water systems can pose economic, social, and environmental challenges to the communities they serve by limiting flexibility, adaptability, and overall resilience amidst emerging extreme events. In many parts of the world without existing infrastructure, development of water systems based on the centralized model may be impractical.

To meet these challenges, we must transform not only our water infrastructure, but how we think about water by creating opportunities to engage and mobilize local communities in more localized water management solutions. One promising approach is to incorporate decentralized water systems (DWS), also referred to as onsite water systems, that collect and treat diverse water sources for use and reuse within individual buildings and across multiple properties, thereby creating stronger, more efficient links between communities and their water systems.

To accelerate this transformation, in 2025 we established the collaborative global community of practice—Building Infrastructure Locally for Decentralized Water Systems (BILD)—to uncover opportunities, advance implementation, and spread transformative solutions related to DWS. During 2025, we initiated a process to identify priority actions to accelerate the deployment of DWS through practitioner-led meetings to share ideas and strategies among engineers, utilities, policy experts and scientists across the globe.

This document presents the findings of the BILD scoping meetings and includes priority actions addressing four impact areas: Public Health, Capacity Development, Sustainable Technology/Innovation, and Communications. It also points to the opportunities to be gained and critical next steps.

While some of the priority actions have leaders and partners that are already engaged and making progress, others still need leadership and resources to make them a reality.

We invite you to join in these efforts and help us make the impacts we collectively envision to advance decentralized water management approaches across the globe.

BILD Executive Committee:

- Paula Kehoe, BILD Co-Chair, San Francisco Public Utilities Commission
- Jay Garland, BILD Co-Chair, US EPA
- Sharon Nappier, US EPA
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Contents

BILD Overview and Vision

As water supplies become more strained, environmental extremes persist, and populations grow, communities are looking for new ways to develop and manage local water supplies and increase the resilience of water and wastewater infrastructure (i.e., water systems). Decentralized water systems (DWS) collect locally available waters (including wastewaters from domestic or industrial activities and atmospheric water captured as condensate, roof-collected rainwater, stormwater, or graywater) and treat it so that it can be reused onsite or at the local scale for various end uses, including non-potable and potable. They range in scale from appliances and single-family homes; to residential, commercial, and industrial buildings; to multi-property reuse districts. DWS are expected to reduce stress on, and dependency upon, centralized water systems, thereby enabling localized management of water sources. In addition, DWS can enhance water resiliency in areas that don't have centralized infrastructure. DWS represent an alternative design for both new development, such as new residential communities or industries at the distal edges of centralized infrastructure (e.g., Bengaluru, India), or communities facing the limit of what existing services can provide (e.g., San Francisco, California). Moreover, DWS provide a consistent source of water without the vulnerabilities and costs associated with an extensive piping system, and can provide multifaceted environmental, social, and economic benefits (e.g., combined sewer overflow management, localized heat recovery, resiliency, increased green space) even in areas not experiencing water stress. Overall, we envision accelerated adoption of DWS along the paths laid herein generating innovation and expertise that lead to increased incorporation of DWS throughout the water industry.

Goals of BILD

• Convene practitioners to build relationships at a local, regional, and global scale, and to share and implement policies, best practices, procedures, standards, and technologies for DWS.

• Establish partnerships among non-profit organizations, operators, product manufacturers, research organizations, and academia to implement DWS projects

that are energy efficient, cost effective, and enable resource recovery.

• Develop and disseminate resources, such as reports and guidance documents, to support more rapid implementation of DWS addressing various water sources, end-uses, and scales.

• Address barriers to implementation, including improving access to funding, streamlining regulations, and promoting equitable distribution across all communities.

• Increase public awareness of DWS and adoption of DWS oversight and management programs.

• Further DWS training and workforce development opportunities.

BILD Guiding Principles

Protect public health

To secure a sustainable water future, we need diverse approaches to water management. We are committed to protecting public health and ensuring safe, secure, and reliable water use and reuse.

Honor local context

BILD sees great value in the implementation of DWS and at the same time, recognizes and respects that policy and infrastructure implementation will vary based on needs and context at the local level.

Develop and follow science-based policy

BILD projects will be driven by the best available knowledge related to risk-based assessment of exposure to potential contaminants, technology for treatment and monitoring, and life cycle assessment of different reuse scenarios.

Collaboration

Our partnerships are based on honesty, transparency, and respect that combine our strengths to meet our collective water goals.

Integrate best practices

The work of BILD fosters and is informed by best practices in the management, operations, and oversight of DWS.

Advance equitable water solutions

We advance solutions that support the needs of all people and engage local communities in the shared responsibility of water management.

BILD Impact Areas

BILD is structured around four Impact Areas addressing key aspects necessary to advance the implementation of DWS. The Impact Areas below guide our collective efforts to help achieve a future reality where DWS are more commonly incorporated into water management systems in communities across the globe.

Public Health: Ensure projects are protective of public health and support the integration of the latest science into regulations, policy, and industry standards.

Sustainable Technology/Innovation: Drive the development and adoption of sustainable technologies and innovative practices that include flexible treatment trains, resource recovery, and other energy efficient practices.

Capacity Development: Build the capacity to adopt DWS by supporting workforce development, providing technical assistance, and identifying financing opportunities.

Communications: Bolster communications, including tools and resources for public engagement and support the business case for DWS.

Engaging BILD Partners and Identifying Priority Actions

BILD was formed in early 2025 as a collaborative global community of practice working to uncover opportunities, advance implementation, and spread transformative solutions related to decentralized water systems that support the efficient use and reuse of water.

BILD began as an initiative of the National Blue Ribbon Commission for Onsite Water Systems (NBRC) and was formed to directly engage diverse stakeholders actively engaged in DWS beyond the North American agencies and utilities represented in the NBRC. Its roots can also be traced to the Onsite Water Reuse Summit hosted by the U.S. EPA, NBRC, and WateReuse Association in 2024.

Among DWS stakeholders, there is clear consensus that the field is at an inflection point, poised for rapid expansion. This conclusion aligns with recent success in clarifying regulatory guidance using the risk-based approach developed by the NBRC and is evidenced by the growing number of businesses effectively conducting non-potable reuse at building and district scales globally.

BILD held its inaugural meeting on March 5, 2025, which brought together regulators, public health officials, utilities, design engineers, product manufacturers, operators, research organizations, non-governmental organizations, and academia to cultivate active dialogue and introduce key challenges and opportunities across BILD's four Impact Areas – Public Health, Sustainable Technology/Innovation, Capacity Development, and Communications.

Following the March 2025 meeting, separate working groups on each of the four Impact Areas held virtual meetings throughout the spring and summer to achieve consensus on the key priorities, actionable next steps, and potential partners to lead or support the developed actions.

BILD held another full-team meeting in June 2025 to discuss the priority actions for BILD to advance DWS implementation. Over 230 participants have joined BILD and contributed actively to the discussions and development of this Action Plan.

Priority Actions

The priority actions described below are projects that BILD participants identified as critical to meet existing needs and advance the implementation of DWS. BILD practitioners engaged in a collaborative process within the Impact Area working groups to share their various perspectives and develop the priority actions represented below. Additional details about each action can be found in the Appendix.

In the time since BILD began and this document was released, some partners have already started advancing key milestones within the priority actions. However, many actions still lack leaders or partners to drive progress—this is where you or your organization can make a difference.

Each action description below includes a status indicating whether work is underway or if partners are needed to get started. If you're interested in leading or supporting a priority action, please contact the identified team or a member of the Executive Committee and join the effort to advance global understanding and implementation of DWS approaches.

Public Health Priority Actions

Goal: Ensure projects are protective of public health and support the integration of the latest science into regulations, policy, and industry standards.

PH 1: Develop a risk management framework for microbial and chemical contaminants in onsite potable and near-potable water reuse applications

Action Status: Partners needed to identify and fund an execution mechanism (e.g., expert panel)

There has been increasing momentum to extend existing non-potable uses of onsite-treated waters to potable and near-potable uses such as bathing. Despite the advantage of this approach for building resilient water supplies, this extension necessitates new risk management considerations that may differ from those for larger centralized systems. For this action, we will develop risk-based frameworks for onsite potable and near-potable water reuse applications by adapting existing microbial risk models to these applications and developing new ones to address chemical exposures that were not previously considered for non-potable use. In addition to building risk management frameworks, we will assess broader professional management requirements related to operation, monitoring, and regulatory compliance.

PH 2: Advance single family home water reuse technologies through attainable risk-based frameworks

Action Status: Partners needed to define and fund specific activities

Declining availability of adequate water supply to meet household demands due to factors such as drought or extraction of groundwater beyond its recharge capacity has prompted growing interest from water-conscious families and technology innovators in single-family and appliance scale water reuse systems (e.g., recirculating devices). However, this has presented challenges for local agencies given a lack of robust risk-based guidance. The proposed action will address this need by identifying gaps in existing public guidance, conducting research to fill the

gaps (e.g., determining pathogen reduction targets) or specifying criteria for future developments (e.g., new treatment and monitoring technologies), creating associated guidance information, and working with partners to translate resulting best practices into model codes, standards, and policies that create a pathway for states to allow approval of water reuse at the single-family level.

PH 3: Establish risk assessment methodologies for fit-for-purpose onsite industrial reuse

Action Status: Partners needed to identify and fund an execution mechanism (e.g., engineering consultant)

Onsite industrial water reuse provides resiliency and efficiency opportunities yet unclear risk management requirements have presented implementation challenges. This action will develop a risk-based framework for assessing potential industrial reuse configurations with a focus on worker safety and public health protection, including approaches for classifying water sources and end uses (both domestic and process-associated), identifying associated contaminants of concern, and selecting fit-for-purpose water quality and monitoring parameters. Outputs will be tailored to address both regulatory needs and facility design, enabling engagement between industry and regulators to accelerate the planning and implementation process. Existing reuse examples and an exemplary case study will be used to demonstrate the applied framework and highlight key decision-making considerations.

PH 4: Adapt risk-based management structures for DWS to the European context

Action Status: Engagement with European entities is underway

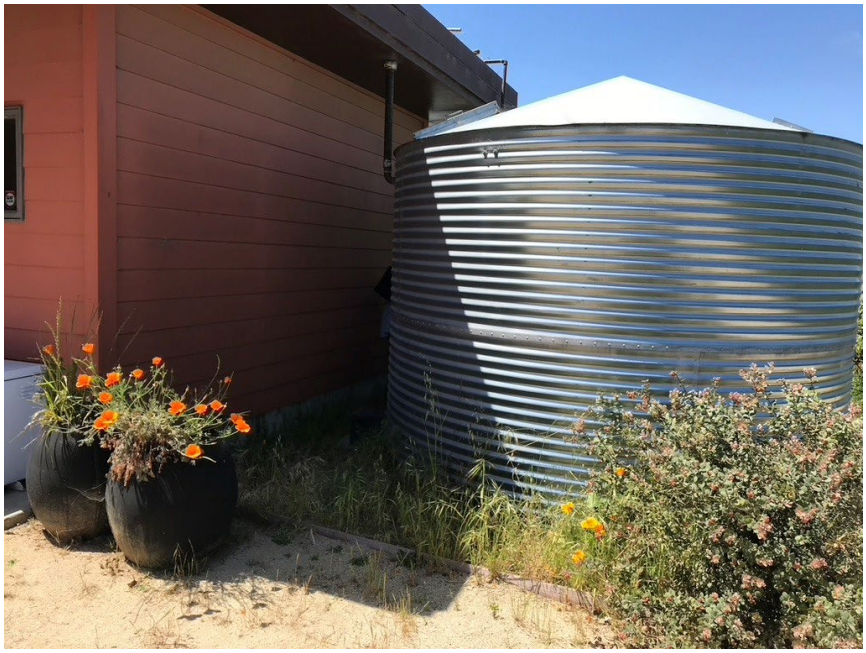
Implementation of DWS faces significant regulatory and operational barriers, which vary widely between countries. Existing regulations often differ in scope, stringency, and risk assessment approaches, creating fragmented frameworks that can slow adoption and innovation. This action group aims to identify the regulatory landscape and key barriers to decentralized water reuse across European countries, highlighting areas where national policies diverge or align. By exploring synergies

with ongoing efforts and comparing the European status quo with the U.S. risk-based framework, we will identify both challenges and opportunities for alignment.

PH 5: Further the science of microbial risk assessment to support its application in the risk-based management of DWS

Action Status: Analysis of monitoring approaches is underway and benchmark evaluation is at the scoping phase

This action aims to advance the science of quantitative microbial risk assessment (QMRA) for determining microbial treatment targets in DWS. Specifically, it will develop flexible approaches for establishing health-based benchmarks that can be applied in different contexts (e.g., socioeconomic conditions or reuse configurations) and integrated modeling techniques that address the variability in treatment performance to inform removal crediting frameworks and associated monitoring needs. The outcomes will be disseminated through journal publication as well as concrete recommendations intended for use by technology developers and regulators.



Sustainable Technology/Innovation Priority Actions

Goal: Drive the development and adoption of sustainable technologies and innovative practices that include flexible, multi-barrier treatment trains, resource recovery, and energy efficient practices.

ST 1: Develop a framework for pathogen reduction crediting that is adaptable to innovative technologies

Action Status: Drafting of framework underway with planned completion by end of 2027; networking for partnerships to conduct. subsequent validations on-going

Full implementation of the risk-based approach requires consistent approaches for ensuring that systems are performing as designed to meet risk-based treatment targets. Performance crediting involves validating the removal of pathogens by specific unit processes in relation to readily determined sensor data, thereby eliminating the need for costly and slow-response effluent monitoring (i.e., pathogens or indicators of their presence). While developing a clear, consistent process for performance assessment is needed for existing treatment technologies, it is of particular concern to facilitate crediting of new and innovative ones. This action will develop the integrated validation and monitoring framework and work with stakeholders for incorporation into existing (e.g., industry certification standards) and new (e.g., BILD Test Bed Action ST 2) applications.

ST 2: Develop test beds for advancing and validating new and innovative DWS treatment and monitoring technology

Action Status: Additional partners needed to develop the state of the science on test beds in 2027 to help build new funding mechanisms for test beds in the following year.

There is no current, pragmatic pathway for independent validation of DWS technologies, limiting commercialization of innovative technologies. Test beds are needed to facilitate advancement of both treatment and monitoring technology, particularly for innovations developed by smaller entities without in house access to significant testing facilities. Effective operation of these test bed operations requires the development of consistent approaches for performance assessment using the

risk-based framework, directly linking this action to ST 1. This action seeks to motivate the need for test bed facilities, identify funding mechanisms to support validation at test bed facilities, and ultimately provide resources that link technology developers to test bed facilities, technical advisors, and funding mechanisms.

ST 3: Improve monitoring protocols to enable autonomous control for DWS

Action Status: The need has been drafted, partners needed to write a state of the science document in 2027 for building future funding calls.

Sensor-based, critical control point monitoring of treatment performance is a key element of the risk-based approach for managing water reuse systems. The distributed nature of decentralized water systems amplifies the need for robust, autonomous monitoring and control approaches. This action aims to promote further research and development of both sensors and data analytic approaches which advance independent operation of decentralized water systems. A primary need is an assessment of the state of the science including monitoring technology, use of new pathogen surrogates, and data analytics and machine learning approaches for advancement of autonomous control. The key outputs envisioned are a concise description of the state of the science, including associated gaps for development, and a strategy for communicating these research needs to potential funders to create a pathway to enable advancements in the field.

Capacity Development Priority Actions

Goal: Build the capacity to adopt DWS by supporting workforce development, providing technical assistance, and identifying financing opportunities.

CD 1: Develop asset management checklist for building owners with DWS

Action Status: Underway, draft checklist complete

An asset management checklist is a tool to help building owners understand how to manage a DWS as a long-term asset. An asset management checklist would help building owners mitigate their operational and financial risks by supporting reduced downtime of the DWS, setting clear expectations of the ongoing financial needs, and supporting the DWS team and building staff in their roles. An asset management checklist outlines the steps beyond inventory management and includes other considerations, such as developing staffing plans and communication protocols. This action will develop an asset management checklist for building owners that will encourage proactive planning and management of the DWS. It will provide building owners a set of clear roles and responsibilities, and build capacity in the technical, financial, managerial, and human resource aspects of DWS.

The checklist is intended to also assist in institutional knowledge transfer so when a future building owner inherits a building they can understand what is needed to manage the DWS asset long-term.

CD 2: Conduct workshops to exchange knowledge of capacity building practices between the NRBC and European blackwater vacuum network

Action Status: Scope of work complete

Source separation blackwater vacuum systems collect blackwater separately to enable resource recovery and provide better barriers than conventional wastewater systems. European water utilities with source separation demonstration sites have jointly identified poor plumbing planning, installation and property maintenance in

buildings as bottle necks for source separation blackwater vacuum systems. However, they lack experience on how to work with private plumbing companies within private buildings. The NBRC has 10 years of experience with how to set up training programs for DWS in the U.S. Although practices differ, the methods applied to increase capacity development are likely similar and would greatly aid the European utilities in setting up a similar program in the EU region. Thus, information sharing focused on capacity development methods between selected partners within the NBRC and a handful European counterparts is needed. This action proposes four annual workshops with a published report of recommendations for the formation of a European capacity building program on blackwater vacuum systems in buildings.

CD 3: Building the workforce for DWS: mapping and strengthening personnel training/certification pipelines

Action Status: Underway, mapping of existing workforce pipelines complete

This action will design and implement a structured framework to identify, align, and strengthen existing workforce pipelines for the installation, operation, and maintenance of DWS. It will map current training and certification pathways for plumbers, water operators, and related trades; identify skill gaps; and propose targeted interventions such as cross-training, curriculum enhancements, and certification updates. The goal is to ensure a sustainable, skilled workforce to support the safe expansion of DWS.

Communications Priority Actions

Goal: Bolster communications, including tools and resources for public engagement and support the business case for DWS.

CM 1: Improve communication with the builder and developer community to support broader understanding, acceptance, and implementation of onsite reuse with decentralized water systems

Action Status: Underway, identifying community leaders

Developers, builders, and other professionals in the development community, such as local government/utility program staff and leaders, are key stakeholders that need to communicate and coordinate effectively to enable the implementation of onsite reuse systems. However, developers have not historically been engaged as partners on broader efforts in the U.S. to expand onsite reuse implementation. In this BILD action, leaders and partners will engage with the development/builder community to better understand their perspectives and needs related to decentralized water management approaches and onsite reuse implementation. This action will help create opportunities for knowledge sharing with developers and builders that have experience implementing DWS and those interested but who have questions about processes, benefits, challenges, and lessons learned. The action team will also share existing resources and develop new resources that explore important topics (e.g., permitting processes, incentives, timelines), which regulatory agencies and local government staff can use to better understand developers' perspectives to help enable adoption of DWS at the local level.

CM 2: Identify opportunities and establish protocols to foster trust and understanding of DWS among local governments, utilities, and elected officials

Action Status: Partners needed to kick off action

To effectively advance the implementation of DWS, it is important to build understanding and trust in their ability to help meet the water planning needs of utilities and local governments. In this action, action leaders and partners will share success stories that demonstrate onsite reuse as a cost-effective and reliable tool

to offset peak potable demand, helping utilities, local governments, and elected officials overcome the skepticism that has previously stalled projects.

CM 3: Foster engagement and acceptance of DWS for building and facility managers, maintenance staff, and occupants

Action Status: Partners needed to kick off action

DWS operations require a shift in how building and facility managers, maintenance staff, tenants and occupants interact with the water systems at their facilities and in their building. For managers, this could mean additional reporting requirements, increased coordination with the local water agency, increased coordination for DWS operation and maintenance, and increased engagement with occupants. Maintenance staff may be asked to depart from their standard work to operate and maintain DWS with little training or background. Tenants and occupants in buildings with DWS can be required to limit use of certain products (e.g., cleaning products) that may negatively impact performance of the treatment system and, if the building is owner occupied, be limited in renovations they can undertake which may impact the system. This action will aggregate lessons learned from the successful deployments of DWS to create a toolbox of targeted support for building managers, maintenance staff, and occupants.

CM 4: Developing a modeling toolbox for quantifying the multiple benefits of DWS

Action Status: Diverse group of modelers have actively engaged, with near term actions identified and mid term actions under development

Quantifying the cost and benefits of DWS is important for developing return on investment estimates to inform investors, decision-makers and other project stakeholders. Models have been developed to aid this decision-making for a range of reuse applications. These models vary in the extent of cost and impact estimates, particularly in their ability to capture the multiple co-benefits of DWS. The goal of this task is to bring together existing modelers within the BILD community to 1) assess the set of existing tools, 2) define reasonable extensions of the models which can be accomplished in the short and mid-term, and 3) evaluate strategies for managing a toolbox of these models for use by decision makers.

Table 1. Summary of the Status of Priority Actions	
Public Health Impact Area	
PH 1: Develop a risk management framework for microbial and chemical contaminants in onsite potable and near-potable water reuse applications	***Status:*** Partners Needed
PH 2: Advance single family home water reuse technologies through attainable risk-based frameworks	***Status:*** Partners Needed
PH 3: Establish risk assessment methodologies for fit-for-purpose onsite industrial reuse	***Status:*** Partners Needed
PH 4: Adapt risk-based management structures for DWS to the European context	***Status:*** Underway
PH 5: Further the science of microbial risk assessment to support its application in the risk-based management of DWS	***Status:*** Underway
Sustainable Technology/Innovation Impact Area	
ST 1: Develop a framework for pathogen reduction crediting that is adaptable to innovative technologies	***Status:*** Underway
ST 2: Develop test beds for advancing and validating new and innovative DWS treatment and monitoring technology	***Status:*** Partners and Funding Needed
ST 3: Improve monitoring protocols to enable autonomous control for DWS	***Status:*** Partners Needed
Capacity Development Impact Area	
CD 1: Develop asset management checklist for building owners of DWS	***Status:*** Underway
CD 2: Conduct workshops to exchange knowledge of capacity building practices between the NRBC and European blackwater vacuum network	***Status:*** Underway
CD 3: Building the workforce for DWS: mapping and strengthening personnel training/certification pipelines	***Status:*** Underway
Communications Priority Actions	
CM 1: Improve communication with the builder and developer community to support broader understanding, acceptance, and implementation of onsite reuse with DWS	***Status:*** Underway
CM 2: Identify opportunities and establish protocols to foster trust and understanding of DWS among local governments, utilities, and elected officials	***Status:*** Partners Needed
CM 3: Foster engagement and acceptance of DWS for building and facility managers, maintenance staff, and occupants	***Status:*** Partners Needed
CM 4: Developing a modeling toolbox for quantifying the multiple benefits of DWS	***Status:*** Partners Needed

The Journey Ahead

Throughout the BILD dialogues, a strong consensus emerged among participants that we need a global community of practice focused on DWS with continued collaboration at global, national, regional, and local levels to accelerate DWS implementation. BILD has helped create new connections between practitioners and other interested stakeholders and is continuing to drive progress using a strategic system building approach.

The following are envisioned next steps to further the success of BILD in advancing DWS implementation:

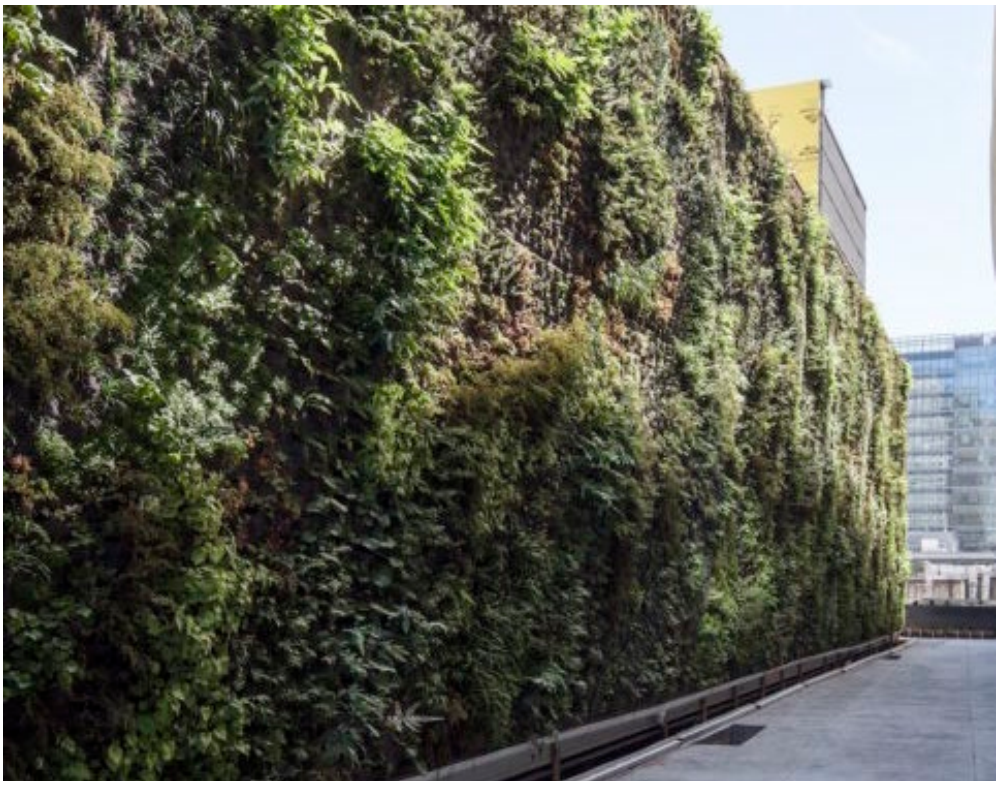
1. **Implement the Priority Actions Identified in the BILD Action Plan –** Some of the priority actions have leaders and partners that are already engaged and making progress, while others still need leadership and resources to make them a reality. We plan to continue to engage with interested stakeholders to help facilitate the successful implementation of the priority actions over the next several years. Please reach out to an identified lead/partner or member of the Executive Committee to get involved.

2. **Share Outputs and Communicate Progress –** As key milestones are completed or outputs are created from priority actions, we envision that action partners will help communicate their progress through various platforms including their organization's communication channels, professional networks such as LinkedIn, and speaking opportunities at conferences and other meetings. BILD will also share key accomplishments through the National Water Reuse Action Plan (WRAP) and continue to make updates to the existing BILD website (www.watereuse.org/bild).

3. **Foster a Global Community of Practice through BILD –** A global community of practice supports collaborations, creates knowledge-exchange networks that address gaps in local capacity, and develops best practices for communities. BILD envisions having periodic virtual meetings to share progress, identify new needs, and enable practitioners to learn from each

other, stay connected to case studies and leading practices, and collaborate on future initiatives.

This Action Plan marks the start of a sustained collaboration to strengthen the resilience of our water infrastructure by accelerating the global deployment of DWS.



Appendices

BILD Partners

BILD Action Plans

BILD Partners

The team would like to thank the following partners, without whose participation this Action Plan would not have been possible.

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Alex Lin	Geosyntec Consultants
Amanda Darling	Environmental Protection Agency
Amanda Hatherly	Building Performance Institute
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Andreas Bichler	Dehoust GmbH
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Katherine Jashinski	Austin Water
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Kristina Stark Fujii	SVOA
Kristopher Haycook	Ecovie Water Management
Lana Pillsbury	Hazen and Sawyer
Laura Erban	US EPA
Lauren Forbes	Cactus Rain LLC
Lee Gaeddert	Arizona State University
Lena Xue	Eawag
Linda Strande	Eawag
Lisa Aboud	US Navy
Lisa Reiheld	International Code Council
Lynn Broaddus	Broadview Collaborative, Inc.
Madara Jayatilake	Department of the Navy
Marc Verhougstraete	University of Arizona
Marco Hartl	alchemia-nova
Maria Lennartsson	Stockholm City
Mario Wolf	Bauhaus-Universität Weimar, Bauhaus-institute for infrastructure solutions (b.is)
Mark Jaeger	Retired Formerly Seattle Public Utilities and NBRC Commissioner
Mark Robbins	Santa Clara University
Mark Valentini	PHCC
Mark Wax	Biohabitats and Rainwater Alliance
Martin Gambrill	World Bank / Newcastle University
Mary Schoen	Microbial Risk Analytics
Mathew Lippincott	University of Michigan
Matt de la Houssaye	Bioenergy Devco

Matt Kallevant	Black & Veatch
meagan mauter	stanford
Megan Thomas	Epic Cleantec
Melissa Lubitz	Hydraloop Inc.
Michael Holm Møller	Orbital Systems
Michael Jahne	US EPA
Michael Lesniak	Aquatech International
Michele risko	Not applicable
Miriam Hacker	The Water Research Foundation
Monika Merk	WateReuse Association
Mudit Gangal	Synagro Technologies
Nadja Contzen	Eawag: Swiss Federal Institute of Aquatic Science and Technology
Nancy Rice	MN Dept of Health
Natalie DeRoock	Tucson Water
Natalie Mladenov	San Diego State University
Newsha Ajami	Lawrence Berkeley National Lab
Nicholas Ashbolt	CRC SAAFE
Nonhlanhla Kalebaila	Water Research Commission
Olga Murujew	INTEWA
Oliver Ringelstein	INTEWA GmbH
Oren Kleinberger	Atlanta Pure Water Inc
Pablo Heleno Sezerino	Federal University of Santa Catarina - Brazil
Pam Emerson	Seattle Public Utilities
Patrick Thomson	Arizona State University
Paul Lander	University of Colorado
Paula Kehoe	SFPUC
Pedro Carvalho	Aarhus University
Pete Sabo	AK Industries & Hydro-Actoin
Peter Fiske	NAWI-LBL
Phillip Majeke	Water Research Commission
Prachi Patel	Austin Water
Preston Kirby	Virginia Department of Health
Qilin Li	Rice University
Rajiv Kumar Srivastava	Texas A&M University

Ramona Reddy-Maduray	Water Partnerships Office - South Africa
Richard Peter	Compo Closet
Richard Ross	Epic Cleantec
Rick Warner	Jacobs
Robert Bair	University of South Florida
Robert Drew	Ecovie Water Management
Robert Kershner	Innovative Treatment Products, Inc. aka Innovatreat
Robert Stefani	Austin Water
Rosario Cortés	WateReuse California
Ryo Yamada	WOTA Corp.
Saaransh Verma	Spray Engineering Devices US
Sahba Iravanimanesh	RWTH - Chair of Management Accounting
Sam Arden	Eastern Research Group, Inc.
Sayani Halder	WOTA Corp.
Scott Struck	National Renewable Energy Laboratory
Sebastien Tilmans	
Shannon Spurlock	Pacific Institute
Sharlene Leurig	Adaptive Partners
Sharon Nappier	US EPA
Shawn Crawford	Rainwater Management Solutions Inc.
Shreya Nath	WELL Labs, IFMR
Stefan Bergsma	Desah
Stephen Macone	Osborne Co Representing Wahaso, Hydro Reserve & Grundfos
Steve Deem	Water 1st International & Retired Washington Department of Health
Sudhir Pillay	Water Research Commission
Sybil Sharvelle	Colorado State University
takashi kawakami	wota corp.
Tiffani Kavalec	US EPA
Todd Russell	System Operation Services, Inc. (SOSI), REED International LTD
Tressa Nicholas	Idaho DEQ
Tristian Bounds	Regen AEC
Trudi Bick	Water Environment Federation
upmanu lall	arizona state university

Veronika Zhiteneva	Waterloop Solutions
Victor D'Amato	NC DEQ-Division of Water Infrastructure
Vincent Gruffat	Natural Systems Utilities (NSU)
Willie du Plessis	Fountain Water and Sanitation
Zach Gallagher, PE	Natural Systems Utilities
Zachary Dorsey	WateReuse Association

BILD Action Implementation Plan	
Action Title:	Develop a risk management framework for microbial and chemical contaminants in onsite potable and near-potable water reuse applications
Brief Description of the Action:	There has been increasing momentum to expand existing non-potable uses of onsite-treated waters to potable and near-potable uses such as bathing. Despite the advantage of this approach for building resilient water supplies, this extension necessitates new risk management considerations that may differ from those for larger centralized systems. For this action, we will develop risk-based frameworks for onsite potable and near-potable water reuse applications by adapting existing microbial risk models to these applications and developing new ones to address chemical exposures that were not previously considered for non-potable use. In addition to building risk management frameworks, we will assess broader professional management requirements related to operation, monitoring, and regulatory compliance. We propose convening expert panels and/or workshops to synthesize recommendations on these topics and generate broadly applicable guidance for water sector reference. This will ultimately enable risk-based, defensible ordinances around water quality and use.
Anticipated Timeline:	Need to determine
Possible Action Leader(s) and Key Contact:	Need to identify Proposed expert panel requires sponsorship, e.g., WRF
Partner(s) and Key Contact:	Need to identify

BILD Action Implementation Plan	
Background:	Existing risk-based frameworks for onsite water reuse focus on non-potable uses, such as irrigation and toilet flushing; however, interest is growing in onsite potable and "near potable" applications (e.g., bathing) as well. New frameworks to support these future developments are needed to manage both microbial and chemical risks. While treatment targets for removing enteric pathogens from recycled water could be adapted from those used for non-potable applications, existing onsite approaches do not account for likely chemical exposures in drinking water. Chemical risk frameworks, therefore, are critical for extending public health safeguards to building scale applications of potable reuse. Additionally, building management requirements must address appropriate monitoring and operational practices for these applications, such as testing frequencies and *Legionella* control. New regulatory considerations are also needed as onsite treatment systems become drinking water suppliers. Ultimate guidances must provide robust evidence to regulators and end users that public health will not be compromised during any form of water reuse.
Opportunities to be Gained:	• Define microbial treatment and management targets for onsite potable and near-potable water reuse applications • Develop chemical risk management approaches for onsite potable and near-potable water reuse applications • Identify operation, monitoring, and regulatory considerations for onsite potable and near-potable water reuse applications • Provide water sector guidance on appropriate management frameworks for onsite potable and near-potable applications
Implementation Milestones:	✓ See Table
Photo / Image / Relevant Quote: (optional)	
References:	
Possible Outputs:	See Table

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Identify research partners and/or expert panel to address risk management questions about onsite potable reuse	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
2	Adapt existing microbial management models for onsite systems to potable applications, including both enteric and opportunistic pathogen control	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
3	Develop chemical risk management frameworks for onsite treatment systems	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
4	Assess professional management needs for onsite potable applications (operation, monitoring, and regulation)	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
5	Synthesize results into broadly applicable water sector guidance	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.

[1] The status field should be left blank until the implementation milestone can be marked as “completed,” “canceled,”

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Peer-reviewed research publications describing applied risk assessments for onsite potable and near-potable water reuse applications	2-3	☐
Guidance document describing risk-based management practices for onsite potable and near-potable water reuse applications	4-5	☒

BILD Action Implementation Plan	
Action Title:	Advance single family home water reuse technologies through attainable risk-based frameworks
Brief Description of the Action:	Declining availability of adequate water supply to meet household demands due to factors such as drought or extraction of groundwater beyond its recharge capacity has prompted growing interest from water-conscious families and technology innovators in single-family and appliance scale water reuse systems (e.g., recirculating devices). However, this has presented challenges for local agencies given a lack of robust risk-based policy guidance. The proposed action will address this need by identifying gaps in existing public guidances, conducting research to fill the gaps (e.g., determining pathogen reduction targets) or specifying criteria for future developments (e.g., new treatment and monitoring technologies), creating associated guidance information, and working with partners such as the NBRC to translate resulting best practices into model codes, standards, and policies. Water is considered from all sources which may include but are not limited to: rainwater, stormwater, graywater, domestic wastewater (combined blackwater and graywater), and blackwater separately. These could include source-separated waters. The output will consider constraints of initial costs; ongoing operating, maintenance, and monitoring needs; technology existence; and availability of materials and support, such as regulatory and service provider staffing. The overall objective is to create a pathway for states to allow approval of water reuse at the single-family level by developing guidance on creating single-family home reuse programs. Educational partners will develop programs to train service provider staffing and for elected officials. Definitions: Technologies: An appliance or treatment system that can be indoor/outdoor and used for various end uses. Attainable: Considering constraints of costs, technology existence, availability of materials, equipment, and support
Anticipated Timeline:	Timeline is pending per partner identification and additional milestone specification.
Possible Action Leader(s) and Key Contact:	TBD
Partner(s) and Key Contact:	Blue Ribbon Commission

BILD Action Implementation Plan	
Background:	Implementation of water reuse in single family homes is desired or needed in some areas. Drivers include homes on private water systems (wells with declining supplies), local government interest in water conservation, and promotion from technology manufacturers. This practice needs to emphasize public health considerations, with attention to design, treatment options, operations and maintenance, and cost-benefit. Currently there is limited risk-based guidance available, creating barriers to implementing this type of system. We need to develop a pathway for states to allow approval of water reuse at the single family level by developing guidance on how to go about creating single-family home reuse programs (including ordinances, policies, regulations, etc.).
Opportunities to be Gained:	Some of the opportunities that could be gained by developing single family home water reuse can include: • Conservation of potable water supplies for drinking water purposes • Conservation of water sources for ecological preservation • Development of a new service industry to install and service systems • Development of new technology industries
Implementation Milestones:	See Table
Photo / Image / Relevant Quote: (optional)	
References:	
Possible Outputs:	See Table

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Identify gaps to fill by looking at currently available information. For example, there are gaps in technology (monitoring, treatment, etc.).	Blue Ribbon Commission?	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
2	Fill the gaps with research, technology development, information synthesis, etc. Include outcome-based targets for outstanding needs.	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
3	Create guidance(s) to make the pathway forward more clear (including safety, public health, environmental protection, operation and maintenance, and oversight considerations).	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
4	Work with the Blue Ribbon Commission and other partners to translate guidance into model codes, standards, policies, and programs (e.g., recommended best practices).	Blue Ribbon Commission?	IAPMO NSF States Local Governments	Month, Year	Month, Year	Milestone Status.	Provide brief update.
5	Consider case studies demonstrating risk-based implementation.	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Possible examples: Water Reuse Case Study: The Alaska Water and Sewer Challenge | US EPA.	Provide brief update.

[1] The status field should be left blank until the implementation milestone can be marked as "completed," "canceled,"

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Report/synthesis of concepts and recommendations as a tool for regulatory use	Implementation Milestone X	☒
Case studies	Implementation Milestone X	☐
Model code for program development use	Implementation Milestone X	☐

BILD Action Implementation Plan	
Action Title:	Establish risk assessment methodologies for fit-for-purpose onsite industrial reuse
Brief Description of the Action:	Onsite industrial water reuse provides resiliency and efficiency opportunities yet unclear risk management requirements have presented implementation challenges. This action will develop a risk-based framework for assessing potential industrial reuse configurations with a focus on worker safety and public health protection that is adaptable across multiple industries (e.g., high microbial sources, high salinity sources, organics-laden sources). The framework will include approaches for classifying water sources and end uses (both domestic and process-associated), identifying associated contaminants of concern, selecting fit-for-purpose water quality parameters and treatment processes (e.g., a decision matrix), verifying and monitoring performance, and addressing management and operation aspects. Outputs will be tailored to address both regulatory needs and facility design, enabling engagement between industry and regulators to accelerate the planning and implementation process. Existing reuse examples and an exemplary case study will be used to demonstrate the applied framework and highlight key decision-making considerations.
Anticipated Timeline:	Need to determine
Possible Action Leader(s) and Key Contact:	Could be led by consulting firm if resources identified
Partner(s) and Key Contact:	Need to identify

BILD Action Implementation Plan	
Background:	Industrial facilities have a renewed interest in water reuse given emerging economic drivers, resiliency needs, and environmental stewardship goals. While much of the current conversation involves the use of municipally treated recycled water, onsite water sources (e.g., graywater, rainwater, and stormwater) and wastewater from industrial processes can also be treated onsite and used to offset freshwater demands. To achieve these offsets, new water treatment configurations are needed that are acceptable to both industry and regulators. These configurations must be protective of worker safety and public health and compatible with the desired end-use. A fit-for-purpose approach is therefore required that takes into consideration the potential chemical and microbial risks (e.g., *Legionella*) associated with different industrial reuse configurations (e.g., data center cooling, general manufacturing, food and beverage production). However, there are currently no risk-based frameworks to assess recycled water quality for general facility uses (e.g., cooling) and specific industrial processes. While water quality requirements for industrial uses will largely be determined by the specific requirements of the industrial process, science-based guidelines are needed to inform industry management decisions and demonstrate required levels of safety to relevant regulators and permit writers.
Opportunities to be Gained:	• Define key considerations for safely implementing onsite industrial reuse • Develop adaptable risk-based framework for onsite industrial reuse, focused on worker safety and public health, that can be tailored to different industries and scenarios of interest • Demonstrate the applied framework through a practical case study from the food and beverage industry • Provide translational guidance for regulators and facility designers to enable informed decisions as they develop industrial reuse projects that are protective of public health and the environment
Implementation Milestones:	See Table
Photo / Image / Relevant Quote: (optional)	
References:	
Possible Outputs:	See Table

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Define key safety attributes to consider when planning onsite industrial water reuse (e.g., source water and end use characteristics)	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
2	Develop risk-based treatment framework that can be adapted to different industries and industrial processes	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
3	Demonstrate the proposed framework through case study(s) from the food and beverage manufacturing industry	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
4	Generate translational documents and educational information for regulatory and facility design use to support long term safe operations	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
5	Host webinars and/or session at WEF/WateReuse Industrial Water Solutions conference	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.

[1] The status field should be left blank until the implementation milestone can be marked as “completed,” “canceled,”

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Report describing the risk-based framework for industrial onsite reuse	2	☒
Case study articles applying the risk-based framework to food and beverage reuse	3	☒
Translational documents (fact sheets, infographics, checklists, templates, etc.) for general audiences, regulators and facility staff/representatives	4	☒

BILD Action Implementation Plan	
Action Title:	Adapt risk-based management structures for decentralized water systems to the European context
Brief Description of the Action:	Identify existing regulations and barriers to decentralized water reuse in European countries. Identify differences between European countries which could influence approaches (explore synergies with developing microbial risk benchmarks action group). Compare European status quo with US risk-based framework to identify challenges & alignments. Provide roadmap(s) for implementing country-specific guidelines for decentralized reuse.
Anticipated Timeline:	✓ Initial factsheets for Switzerland, Germany & UK in fall 2025. ✓ Distribute survey for acquiring more information from other European countries by January 2026 ✓ Define roadmaps for implementing more DWR in European countries by mid 2026
Possible Action Leader(s) and Key Contact:	Veronika Zhiteneva, Waterloop Solutions GmbH, vzhiteneva@gowaterloop.com
Partner(s) and Key Contact:	Eva Reynaert, German Environment Agency, eva.reynaert@uba.de Brian McCarthy, Scottish Water, brian.mccarthy@scottishwater.co.uk Eberhard Morgenroth, eawag, eberhard.morgenroth@eawag.ch Sahba Iravanimanesh, RWTH, iravanimanesh@controlling.rwth-aachen.de Michael Jahne, US EPA, Jahne.Michael@epa.gov Bob Rubin, NC State University, Rubin@ncsu.edu Cissy Ma, US EPA, Ma.Cissy@epa.gov Monika Merk, WateReuse Association

BILD Action Implementation Plan	
Background:	Decentralized water reuse is an increasingly critical tool for enhancing water security and climate resilience. However, implementation of decentralized systems faces significant regulatory and operational barriers, which vary widely between countries. Existing regulations often differ in scope, stringency, and risk assessment approaches, creating fragmented frameworks that can slow adoption and innovation. Understanding these differences is essential for developing harmonized yet country-specific guidelines. This action group aims to identify the regulatory landscape and key barriers to decentralized water reuse across European countries, highlighting areas where national policies diverge or align. By exploring synergies with ongoing efforts, such as the development of microbial risk benchmarks, and comparing the European status quo with the US risk-based framework, we can identify both challenges and opportunities for alignment. Ultimately, this work will support the creation of roadmaps to implement effective, safe, and context-appropriate decentralized reuse guidelines across Europe.
Opportunities to be Gained:	✓ Harmonize approaches for starting decentralized, on site water reuse projects ✓ Provide recommendations for the development of context-appropriate regulations for on-site water reuse in Europe
Implementation Milestones:	See table below
Photo / Image / Relevant Quote: (optional)	
References:	
Possible Outputs:	See table below

Implementation Milestones Table

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Compile factsheets on status of decentralized water reuse management approaches & regulatory frameworks in Switzerland/ Germany/UK - compared to US documents (2017 report & 2025 risk assessment report)	Veronika Zhiteneva	all	Oct 2025	Month, Year	Milestone Status.	Provide brief update.
2	Draft survey for outreach to other countries on status of decentralized water reuse	Org. Name(s)	Org. Name(s)	Q3/Q4 2025	Month, Year	Milestone Status.	-Questionnaire drafted -Discussed collaboration with EU JRC on 5 September 2025
3	Synthesize information & compile roadmaps for implementing decentralized reuse in X countries	Org. Name(s)	Org. Name(s)	Mid 2026	Month, Year	Milestone Status.	Provide brief update.

[1] The status field should be left blank until the implementation milestone can be marked as “completed,” “canceled,”

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Factsheets on status of decentralized water reuse management approaches & regulatory frameworks in Switzerland/Germany//UK	1	☒
Roadmaps for implementing decentralized reuse	3	☒

BILD Action Implementation Plan	
Action Title:	Further the science of microbial risk assessment to support its application in the risk-based management of decentralized water systems
Brief Description of the Action:	This action aims to advance the science of quantitative microbial risk assessment (QMRA) for determining microbial treatment targets in decentralized water systems. Specifically, it will develop flexible approaches for establishing health-based benchmarks that can be applied in different contexts (e.g., socioeconomic conditions or reuse configurations) and integrated modeling techniques that address the variability in treatment performance to inform removal crediting frameworks and associated monitoring needs. The outcomes will be disseminated through journal publication as well as concrete recommendations intended for use by technology developers and regulators.
Anticipated Timeline:	September 2025 – March 2027
Possible Action Leader(s) and Key Contact:	Eva Reynaert, German Environment Agency, eva.reynaert@uba.de
Partner(s) and Key Contact:	Brian McCarthy, Scottish Water, Brian.McCarthy@SCOTTISHWATER.CO.UK Eberhard Morgenroth, Eawag, eberhard.morgenroth@eawag.ch Émile Sylvestre, TU Delft, E.Sylvestre@tudelft.nl Kerry Hamilton, Arizona State University, Kerry.Hamilton@asu.edu Michael Jahne, US Environmental Protection Agency, Jahne.Michael@epa.gov Preston Kirby, Virginia Department of Health, Preston.Kirby@vdh.virginia.gov

BILD Action Implementation Plan	
Background:	Quantitative microbial risk assessment has been used to determine microbial log-reduction targets for water reuse to ensure compliance with target health benchmarks and inform the design of treatment trains. However, assumptions from centralized reuse may not translate directly to decentralized systems. This Action addresses three gaps: 1. The absence of target health benchmarks tailored to decentralized systems, where pathogen transmission through reclaimed water may be minor relative to other routes (e.g., person-to-person). Benchmarks could be adaptable to different socioeconomic contexts and reuse configurations (e.g., potable vs. non-potable, single residence vs. community). 2. The need to incorporate variability and uncertainty in setting treatment targets and assessing compliance, particularly given reliance on limited datasets. 3. The limited integration of treatment targets, technology performance, and monitoring, leading to conservative assumptions in each area rather than a holistic assessment of risk. There is therefore a need to develop integrated risk modeling that realistically reflects risks and accounts for real-life operation and uncertainties in decentralized systems to support the implementation of practical, cost-effective solutions that ensure public health protection.
Opportunities to be Gained:	✓ Advancing frameworks for microbial risk and treatment targets by making them adaptable to different contexts and reflective of real-life operation of decentralized systems ✓ Providing recommendations on target benchmarks used to determine treatment targets for the design of practical, cost-effective systems while maintaining a high level of public health protection ✓ Offering recommendations on applied monitoring approaches that ensure consistent compliance with health benchmarks
Implementation Milestones:	(see Implementation Milestone Table)

BILD Action Implementation Plan	
Photo / Image / Relevant Quote: (optional)	
References:	Sharvelle, S., Ashbolt, N., Clerico, E., Holquist, R., Leverenz, H., & Olivieri, A. (2017). Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems. Prepared by the National Water Research Institute for the Water Environment & Reuse Foundation (WE&RF Project No. SIWM10C15). Alexandria, VA. https://www.nwri-usa.org/_files/ugd/632dc3_8831385f1c2f4bb1b2976b06719832ae.pdf?index=true Jahne, M. A., Schoen, M. E., Garland, J. L., Nappier, S. P., & Soller, J. A. (2024). Microbial Treatment Targets for Potable and Nonpotable Water Reuse–A Comprehensive Update and Harmonization. *Environmental Science & Technology Letters*, 11(11), 1175-1181. San Francisco Public Utilities Commission (SFPUC) (2024), Independent Advisory Panel for Single-Family Water Reuse Applications Report. https://www.sfpuc.gov/sites/default/files/documents/independent_advisory_panel_report_december_2024.pdf.
Possible Outputs:	(see List of Outputs)

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	An overview and assessment of approaches for setting health risk benchmarks is completed and the most relevant approaches are identified	Org. Name(s)	Eva Reynaert, German Environment Agency	12, 2025	Month, Year	Milestone Status.	Provide brief update.
2	Microbial log-reduction targets for decentralized water reuse are calculated and compared across selected benchmarks	Org. Name(s)	Eva Reynaert, German Environment Agency	06, 2026	Month, Year	Milestone Status.	Provide brief update.
3	A set of case studies is selected and relevant benchmarks are applied to calculate log-reduction targets	Org. Name(s)	Eberhard Morgenroth, Eawag	09, 2026	Month, Year	Milestone Status.	Provide brief update.
4	Integrated treatment failures into risk assessment models to evaluate impact on required log-reduction targets	Eva Reynaert, German Environment Agency	Michael Jahne, US EPA Émile Sylvestre, TU Delft	09, 2025	Month, Year	Milestone Status.	Provide brief update.
5	Monitoring options are determined for typical on-site reuse systems (e.g., MBR+UV)	Eva Reynaert, German Environment Agency	Org. Name(s)	12, 2025	Month, Year	Milestone Status.	Provide brief update.
6	Overview of sources of uncertainty in microbial risk assessment for on-site water reuse	Kerry Hamilton, Arizona State University Émile Sylvestre, TU Delft	Org. Name(s)	12, 2025			

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
7	Assessment of impact of uncertainty in exposure assessment on the determination of log-removal targets	Kerry Hamilton, Arizona State University Émile Sylvestre, TU Delft	Michael Jahne, US EPA	06, 2026			
8	Vision for integrated quantitative microbial risk assessment incorporating treatment targets, operation and monitoring	Eva Reynaert, German Environment Agency	Eberhard Morgenroth, Eawag Michael Jahne, US EPA	12, 2026			

[1] The status field should be left blank until the implementation milestone can be marked as “completed,” “canceled,”

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Peer-reviewed article comparing approaches for setting risk benchmarks (09, 2026)	1 and 2	☐
Policy-oriented whitepaper with recommendations on most suitable approach(es) to set benchmarks (09, 2026)	2	☒
Research brief(s) on appropriate log-reduction targets for the selected case studies that regulators and utilities can use (09, 2026)	3	☒
Workshop on health benchmarks at Society for Risk Analysis Annual Meeting 2026 (12, 2026)	1, 2, and 3	☐
Peer-reviewed journal publication on integrating monitoring frequency into microbial risk assessment (12, 2025)	4	☐
Case study for typical on-site treatment trains on monitoring frequencies (12, 2025)	5	☐
1-pager on sources of uncertainty and variability in microbial risk assessment for on-site water reuse (03, 2027)	6	☐
Peer reviewed journal publication on effect of uncertainty on log-removal targets (09, 2027)	6 and 7	☒
Perspective article on integrated quantitative microbial risk assessment incorporating treatment targets, operation and monitoring (03, 2027)	8	☒
Case study on integrated quantitative microbial risk assessment (03, 2027)	8	☐

BILD Action Implementation Plan	
Action Title:	Develop a framework for pathogen reduction crediting that is adaptable to innovative technologies
Brief Description of the Action:	Full implementation of the risk-based approach requires consistent approaches for ensuring that systems are performing as designed to meet risk-based treatment targets. Performance crediting involves validating the removal of pathogens by specific unit processes in relation to determined sensor data, thereby greatly reducing if not eliminating the need for costly and slow-response effluent monitoring (i.e., pathogens or indicators of their presence). While developing a clear, consistent process for performance assessment is needed for existing treatment technologies, it is of particular concern to facilitate crediting of new and innovative processes and techniques. This task will develop the integrated validation and monitoring framework and work with stakeholders for incorporation into existing (e.g., NSF certification) and new (e.g., BILD Test Bed Action) applications.
Anticipated Timeline:	Jan. 2026 – Dec. 2028
Possible Action Leader(s) and Key Contact:	Jay Garland, USEPA garland,.jay@epa.gov.
Partner(s) and Key Contact:	Michael Jahne, USEPA Frederick Tack, Consur Bryan Kimball, Hack Additional Potential l Partners Include: Certification Bodies • NSF • IAPMO National and local regulatory Bodies Technology Developers (treatment technology, monitoring and control technology) Technical Experts to Advise Testing Protocols

Background:	One of the key factors limiting implementation of decentralized water reuse has been regulatory uncertainty or unified guidance on how to certify and monitor that systems are operating safely. A recently developed risk-based approach has addressed this roadblock by providing a framework for defining required treatment for safe, fit-for-purpose reuse. Significant advancements have been made in defining the log removal targets (LRTs) for infectious microorganisms (bacteria, viruses, protozoa) when reusing a range of alternative source waters (e.g., building wastewater, graywater roof rainwater) for non-potable and potable purposes. While LRTs provide clear goals for the treatment systems, **s**tandardized approaches for ensuring that systems are meeting these targets are also needed to fully implement the risk-based approach. For example, NSF International, IAPMO, and ARCSA International have developed standards to enable certification of onsite reuse systems using the risk-based framework, but associated methods for determining process log reduction values (LRVs) have not been fully developed nor demonstrated beyond existing guidances adopted from drinking water. Such methods would specify how to define the LRVs for specific unit processes (i.e., pathogen crediting), including monitoring approaches to verify these credits during initial certification and on-going operation. The integrated risk-based framework for defining the efficacy and safety of water recyling systems, originally developed in Australia (i.e., WaterVal), has been widely adopted in the centralized, potable water reuse sector, including recent documents summarizing the rationale, general approach, and methods for pathogen crediting. Building from this work, the present action will develop a similar framework tailored to the decentralized field. Unique considerations include adapting methods to smaller scale and a broader range of potential applications (both in terms of alternative source waters and end uses). Developing a framework which has sufficient standardization to meet risk management goals while providing flexibility to adapt to new treatment approaches (e.g., nature-based solutions) and advanced monitoring technologies are key to expanding adoption of existing technologies while facilitating innovation. A draft list of relevant definitions: *Validation:* robust demonstration of a technology's LRV achievement *Monitoring*: sensors demonstrating that the operational process remains within validated conditions *Crediting*: assigning an LRV to the validated process provided specified monitoring parameters are met *Verification*: in situ demonstration that an installed system operates as credited (if required)

BILD Action Implementation Plan	
Opportunities to be Gained:	✓ Provide a consistent understanding of best approaches and required criteria for crediting the pathogen removal performance of decentralized water reuse systems within the risk-based framework ✓ Build confidence in the crediting methods through demonstrations and partnership with industry standards organizations ✓ Establish specific protocols to be used by testing and certification bodies ✓ Provide guidance to regulators on how to consider validation techniques in the permitting of facilities, and when providing oversight for compliance.
Implementation Milestones:	See Table Below
Photo / Image / Relevant Quote: (optional)	✓
References:	https://rewater.usc.edu/potable-water-reuse-report/ https://www.waterrf.org/research/projects/evaluation-microbial-risk-assessment-techniques-and-applications https://www.waterra.com.au/waterval/
Possible Outputs:	See Table Below

Implementation Milestones Table

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Produce a summary document detailing the best approaches for performance validation and monitoring to ensure that pathogen log reduction targets (LRTs) are being met in decentralized water euse systems.	Jay Garland USEPA ORD	Michael Jahne USEPA	June, 2026	Month, Year	Milestone Status.	Provide brief update.
2	Develop integrated framework describing criteria for pathogen reduction crediting of decentralized water treatment technologies.	Jay Garland USEPA ORD	Michael Jahne, USEPA Frederick Tack, Consor	December, 2027			
3	Conduct pilots of performance assessment approaches involving both established and new treatment technologies.	TBD Funding dependent	TBD	June, 2028 Tentative	Month, Year	Milestone Status.	Provide brief update.

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
4	Defined protocols to be used by relevant testing organizations.	TBD	TBD	December, 2028	Month, Year	Milestone Status.	Provide brief update.

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Summary of best practices and criteria for pathogen reduction crediting of decentralized water treatment technologies (January 2027)	Implementation Milestone 1-2	☒
Report on demonstration studies of the pathogen reduction crediting framework. (TBD)	Implementation Milestone 3	☒
Protocols for pathogen reduction crediting. (TBD)	Implementation Milestone 4	☒

Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

BILD Action Implementation Plan	
Action Title:	Develop test beds for advancing and validating new and innovative treatment and monitoring technology for onsite water systems
Brief Description of the Action:	There is not currently a pragmatic pathway for new and innovative technologies for onsite water treatment to be validated and enter the market. Test beds are needed to enable advancement and validation of treatment and monitoring technology, particularly new and innovative technology, including nature-based solutions. This action seeks to motivate the need for test bed facilities, identify funding mechanisms to support validation at test bed facilities, and finally provide resources that link technology developers to test bed facilities, technical advisors, and funding mechanisms.
Anticipated Timeline:	Jan. 2026 – June 2028
Possible Action Leader(s) and Key Contact:	

BILD Action Implementation Plan	
Partner(s) and Key Contact:	Technology Developers (treatment technology, monitoring and control technology) Certification Bodies • NSF • IAPMO Regulatory Bodies Authors of WRF 5040 Owners/Operators of Test Best Labs Technical Experts to Advise Testing Protocols

BILD Action Implementation Plan	
Background:	There is not currently a pragmatic pathway for new and innovative technologies for onsite water treatment to be validated and enter the market. Funds, technical expertise, and facilities are needed that support validation on new treatment and monitoring technologies. Treatment technology should be inclusive of nature-based solutions. Test bed facilities would provide space, access to water sources (real or simulated), testing protocols, and technical expertise to support validation of technologies for entry into the market. These test beds should include capacity for testing management strategies in addition to technical performance, with the ability to mimic unusual and challenging operating conditions. Testing of management strategies could include piloting approaches for detecting and handling of out of spec water and routine operation and maintenance strategies. These testbeds can serve as a platform to test frameworks for validation and monitoring protocols developed via other BILD actions. Multiple scales should be addressed, from the pilot lab to building and even community scales and across geographic regions. These test beds should include extensive monitoring, ideally integrated with data sharing capabilities to advance the field.
Opportunities to be Gained:	✓ Provide resources that enable new and innovative technologies, including nature-based solutions, to validate systems for entry to the market. ✓ Link technology developers to test bed facilities, technical advisors, and funding mechanisms to support validation testing. ✓ Expand test beds beyond lab scale to community scale

BILD Action Implementation Plan	
Implementation Milestones:	
Photo / Image / Relevant Quote: (optional)	
References:	*FAST Water Network | The Water Research Foundation* *https://reuse.water.columbia.edu/database/dashboard* *https://www.waterrf.org/resource/implementing-onsite-and-distributed-water-reuse-systems-united-states-literature-review*
Possible Outputs:	*See Table Below*

Implementation Milestones Table

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1a	Summarize the State of Practice and Need for Test Beds: Survey owners/operators of DWS to determine if/how project could have benefited from test bed and certification bodies for need	Sybil Sharvelle	Authors of WRF project 5040, IAPMO, NSF	December, 2026	Month, Year	Milestone Status.	Provide brief update.
1b	Summarize the State of Practice and Need for Test Beds: Develop web portal of existing DWS test bed facilities, capabilities, and expert technical advisors	TBD	TBD	December, 2026	Month, Year	Milestone Status.	Provide brief update.
1c	Summarize the State of Practice and Need for Test Beds: Review of successes and lessons learned from test beds in other fields	TBD	TBD	December, 2026	Month, Year	Milestone Status.	Provide brief update.
2	Identify existing and expand new funding mechanisms to support pilot testing of technologies and management practices	TBD	TBD	December, 2027	Month, Year	Milestone Status.	Provide brief update.
3	Develop resources that links technology developers and test bed facilities to funding mechanisms	TBD	TBD	June, 2028	Month, Year	Milestone Status.	Provide brief update.
4	Identify opportunities for community scale test beds			TBD			

[1] The status field should be left blank until the implementation milestone can be marked as “completed,” “canceled,”

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Summary of Needs for Test Beds	Milestone 1a	☐
Guidance for Test Bed Facilities	Milestones 1a, 1c	☐
Develop web portal of existing DWS test bed facilities, capabilities, and technical consulting expertise (update and expand the FAST Water Network)	Milestone 1b	☐
Expand web portal to link technology developers and test bed facilities to funding mechanisms	Milestones 2 and 3	

BILD Action Implementation Plan	
Action Title:	Improve monitoring protocols to enable autonomous control for DWS
Brief Description of the Action:	Sensor-based, critical control point monitoring of treatment performance is a key element of the risk-based approach for managing water reuse systems. The distributed nature of decentralized water systems amplifies the need for robust, autonomous monitoring and control approaches. This action aims to promote further research and development of both sensors and data analytic approaches (including application of artificial intelligence) which advance independent operation of decentralized water systems. A primary need is an assessment of the state of the science including monitoring technology, use of new pathogen surrogates, and data analytics and machine learning approaches for advancement of autonomous control. The key outputs envisioned are a concise description of the state of the science, including associated gaps for development, and a strategy for communicating these research needs to potential funders to create a pathway to enable advancements in the field.
Anticipated Timeline:	Jan. 2026 – Dec. 2028
Possible Action Leader(s) and Key Contact:	Jay Garland, USEPA garland. @epa.gov.
Partner(s) and Key Contact:	TBD
Background:	This area was identified as a priority research and development area during initial discussion in BILD technology innovation working group. Discussion emphasized the distributed nature of DWS and commonly expressed concerns about ensuring reliable performance. Expertise and time constraints limited further development of the idea, so there is a clear need for partners to more fully define both the overall state of the science and identify priority gaps.
Opportunities to be Gained:	✓ Improved understanding of key research and development needed for effective autonomous monitoring/control of DWS ✓ Increased confidence in the reliability of DWS
Implementation Milestones:	See Table Below

BILD Action Implementation Plan	
Photo / Image / Relevant Quote: (optional)	✓
References:	https://rewater.usc.edu/potable-water-reuse-report/ https://www.waterra.com.au/waterval/
Possible Outputs:	See Table Below

Implementation Milestones Table

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Produce a detailed state of the science review on monitoring reuse systems with a DWS focus, including key research and development needs	Jay Garland USEPA	TBD	December 2026	Month, Year	Milestone Status.	Provide brief update.

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
State of the science document, suitable for peer-reviewed publication and/or sharing with funding organizations.	Implementation Milestone 1	☒

Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

1.

BILD Action Implementation Plan	
Action Title:	Develop asset management checklist for building owners of onsite water systems
Brief Description of the Action:	Communities are turning to DWS as another tool in the toolbox to help address issues of water scarcity, sewer capacity issues, and resiliency in the face of climate change. The key to unlocking these benefits is to develop tools that help building owners the DWS as a long term asset. Having a tool such as a checklist for building owners can help DWS stay operational and produce safe water for reuse in perpetuity. This action will be developing an asset management checklist for building owners that will encourage proactive planning and management of the DWS. It is intended to focus on building owners and set clear roles and responsibilities, and build capacity in the technical, financial, managerial, and human resource aspects of DWS. Having this checklist would help building owners mitigate their risks by supporting reduced downtime of the DWS, setting clear expectations of the ongoing financial needs, and supporting the DWS team and building staff in their roles. The checklist is intended to also assist in institutional knowledge transfer so when a future building owner inherits a building with a DWS they can understand what is needed to manage the asset long-term.
Anticipated Timeline:	Completed by Jan 2027
Possible Action Leader(s) and Key Contact:	Tressa Nicholas, Idaho DEQ, Tressa.Nicholas@deq.idaho.gov Bob Salvatelli, H2O Innovation, bob.salvatelli@h2oinnovation.com Sahba Iravanimanesh, RWTH Aachen University, iravanimanesh@controlling.rwth-aachen.de Taylor Nokhoudian, SFPUC, tnokhoudian@sfwater.org
Partner(s) and Key Contact:	TBD

BILD Action Implementation Plan	
Background:	The focus of this work will be to build capacity in the technical, financial, managerial, and human resource aspects of DWS. Technical capacity is defined as the ability to maintain the physical infrastructure to operate the DWS safely and meet permit requirements. This includes meeting routine and emergency operations. Financial capacity is defined as the financial resources, budget for current operations, future needs, and emergency situations. Managerial capacity is defined as personnel management, customer response, and management of system. Human resource capacity is defined as communications among the DWS team and stakeholder awareness.
Opportunities to be Gained:	• Enable building owners to mitigate their risks through proactive planning and management of the DWS. • Assist in institutional knowledge transfer so when a future building owner inherits a building with a DWS they can understand what is needed to manage the asset long-term. • User assurance for system reliability
Implementation Milestones:	See table
Photo / Image / Relevant Quote: (optional)	
References:	
Possible Outputs:	See table

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	**Complete draft asset management checklist**	Tressa Nicholas, Idaho DEQ, Tressa.Nicholas@deq.idaho.gov Bob Salvatelli, H2O Innovation, bob.salvatelli@h2oinnovation.com Sahba Iravanimanesh, RWTH Aachen University, iravanimanesh@controlling.rwth-aachen.de Taylor Nokhoudian, SFPUC, tnokhoudian@sfwater.org		**January 2026**	**Month, Year**	**Milestone Status.**	**Provide brief update.**
2	**Obtain feedback from BILD capacity building working group and BILD on draft checklist**	Tressa Nicholas, Idaho DEQ, Tressa.Nicholas@deq.idaho.gov Bob Salvatelli, H2O Innovation, bob.salvatelli@h2oinnovation.com Sahba Iravanimanesh, RWTH Aachen University, iravanimanesh@controlling.rwth-aachen.de Taylor Nokhoudian, SFPUC, tnokhoudian@sfwater.org		**April 2026**	**Month, Year**	**Milestone Status.**	**Provide brief update.**
3	**Incorporate feedback into checklist, identify gaps and stakeholder perspectives not yet incorporated**	Tressa Nicholas, Idaho DEQ, Tressa.Nicholas@deq.idaho.gov Bob Salvatelli, H2O Innovation, bob.salvatelli@h2oinnovation.com Sahba Iravanimanesh, RWTH Aachen University, iravanimanesh@controlling.rwth-aachen.de Taylor Nokhoudian, SFPUC, tnokhoudian@sfwater.org		**June 2026**	**Month, Year**	**Milestone Status.**	**Provide brief update.**

4	**Conduct interviews/meetings with additional stakeholders**	Tressa Nicholas, Idaho DEQ, Tressa.Nicholas@deq.idaho.gov Bob Salvatelli, H2O Innovation, bob.salvatelli@h2oinnovation.com Sahba Iravanimanesh, RWTH Aachen University, iravanimanesh@controlling.rwth-aachen.de Taylor Nokhoudian, SFPUC, tnokhoudian@sfwater.org		**September 2026**	**Month, Year**	**Milestone Status.**	**Provide brief update.**
5	**Finalize asset management checklist**	Tressa Nicholas, Idaho DEQ, Tressa.Nicholas@deq.idaho.gov Bob Salvatelli, H2O Innovation, bob.salvatelli@h2oinnovation.com Sahba Iravanimanesh, RWTH Aachen University, iravanimanesh@controlling.rwth-aachen.de Taylor Nokhoudian, SFPUC, tnokhoudian@sfwater.org		**January 2027**	**Month, Year**	**Milestone Status.**	**Provide brief update.**
6					**Month, Year**	**Milestone Status.**	**Provide brief update.**

List of Outputs Table

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Draft asset management checklist	**Implementation Milestone 1**	**x**
Final asset management checklist	**Implementation Milestone 2**	**x**

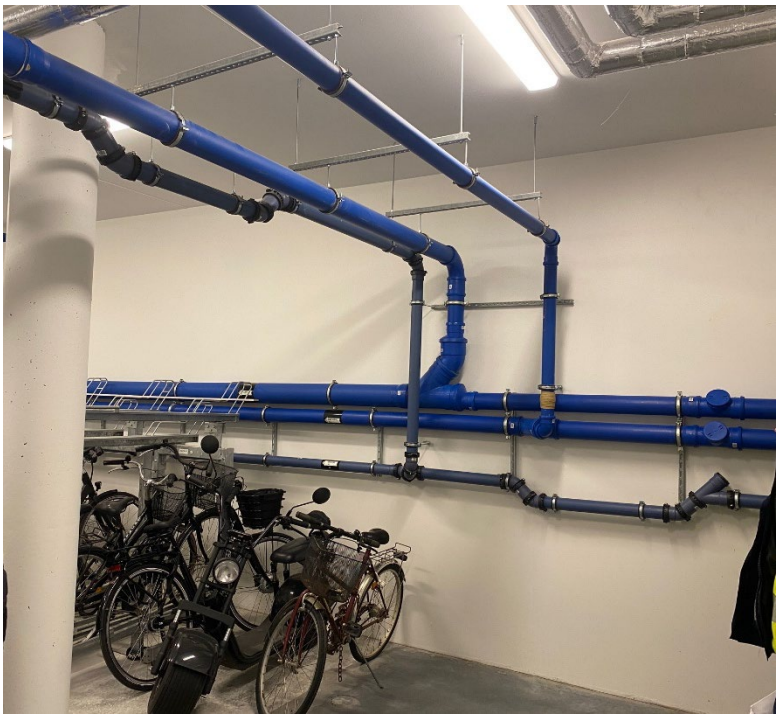
Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

1.

BILD Action Implementation Plan	
Action Title:	*Knowledge transfer of capacity building practices between the National Blue Ribbon Commission for Onsite Water Systems (NRBC) and European blackwater vacuum network.*
Brief Description of the Action:	European water utilities with source separation demonstration sites have jointly identified poor plumbing planning, installation and property maintenance in buildings as a bottle neck for source separation blackwater vacuum systems. As municipal actors, we lack experience on how to work with private plumbing companies within private buildings. The NBRC has 10 years of experience with how to set up training programs for DWR systems in the USA. Although practices differ, the methods applied to increase capacity development are surely universal and would greatly aid the European utilities in setting up a similar programme in the EU region. Thus, a knowledge transfer focused on methods for capacity development between selected actors within the NBRC and a handful European counterparts is needed. The knowledge transfer will be performed via 4 annual workshops (8 in total) and summarized in a short report of recommendations for the formation of a European capacity building program on blackwater vacuum systems in buildings.
Anticipated Timeline:	*Start Q3 2026.* *Finish Q3 2028 (2 years time in total).* *4 online workshops a year = 8 workshops in total.*
Possible Action Leader(s) and Key Contact:	TAUW consultancy agency (NL) – Paul Telkamp Ecoloop consultancy agency (SE) – Elisabeth Kvarnström NSVA water utility (SE) – Hamse Kjerstadius San Francisco Public Utilities Commission – Paula Kehoe or Taylor Nokhoudian
Partner(s) and Key Contact:	NSVA water utility (SE) – Hamse Kjerstadius Jets Vacuum AS (NO) – Evangelos Tyflopoulos Roediger vacuum – Georg Maurer San Francisco Public Utilities Commission – Paula Kehoe or Taylor Nokhoudian National Blue Ribbon Commission for Onsite Water Systems

BILD Action Implementation Plan	
Background:	✓ The European network is already connected through the Interreg ANCHOR project. ✓ Talks of starting a European blackwater vacuum office based around the firm TAUW is under way. ✓ Installation standards for blackwater vacuum systems exists. The problem is rather understanding them and executing a correct solution when faced with real life challenges in a building.
Opportunities to be Gained:	✓ The key people who started the NBRC are still active in the field. Their condensed knowledge and experience can be tapped now. But perhaps not in 5 years . ✓ Relevant suppliers from Europe (Roediger Vacuum and Jets vacuum) are involved together with municipal actors with a unified goal.
Implementation Milestones:	✓ Milestone 1: formation of a workgroup with representation from 1-2 NBRC active members and 3+ European members. Q3 2026. ✓ Milestone 2: completion of 2 orientation workshops on the background, goal, and scope of the NBRC. Q1 2027 ✓ Milestone 3: completion of 2 summarizing workshops on best experiences and practices from NRBC Q3 2027. ✓ Milestone 4: Completion of 2 workshops in establishing differences/overlaps in certification systems, education possibilities. And possibilities for online video training programmes. Q1 2028. ✓ Milestone 5: completion of a short summary report of the key findings from the workshops with recommendations for the implementation of European capacity development programmes. Q2 2028 ✓ Milestone 6: A final workshop to review the summary report, suggest possible changes and to say thanks for the great work. Q3 2028.

BILD Action Implementation Plan	
Photo / Image / Relevant Quote: (optional)	 Photo: Vacuum blackwater piping (grey pipes) in a multiresidential building in Helsingborg, Sweden. Photo: NSVA
References:	
Possible Outputs:	

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Formation of a workgroup with representation from 1-2 NBRC active members and 3+ European members.	Org. Name(s)	Org. Name(s)	Q3 2026	Month, Year	Milestone Status.	Provide brief update.
2	completion of 2 orientation workshops on the background, goal, and scope of the NBRC.	Org. Name(s)	Org. Name(s)	Q1 2027	Month, Year	Milestone Status.	Provide brief update.
3	Completion of 2 summarizing workshops on best experiences and practices from NRBC.	Org. Name(s)	Org. Name(s)	Q3 2027	Month, Year	Milestone Status.	Provide brief update.
4	Completion of 2 workshops in establishing differences/overlaps in certification systems, education possibilities. And possibilities for online video training programmes.	Org. Name(s)	Org. Name(s)	Q1 2028	Month, Year	Milestone Status.	Provide brief update.
5	Completion of a short summary report of the key findings from the workshops with recommendations for the implementation of European capacity development programmes.	Org. Name(s)	Org. Name(s)	Q2 2028	Month, Year	Milestone Status.	Provide brief update.
6	A final workshop to review the summary report, suggest possible changes and to say thanks for the great work.	Org. Name(s)	Org. Name(s)	Q3 2028	Month, Year	Milestone Status.	Provide brief update.

Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

BILD Action Implementation Plan	
Action Title:	Building the Workforce for Decentralized Water Systems: Mapping and Strengthening Personnel Training/Certification Pipelines
Brief Description of the Action:	This action will design and implement a structured framework to identify, align, and strengthen existing workforce pipelines for the installation, operation, and maintenance of decentralized water systems (DWS). It will map current training and certification pathways for plumbers, water operators, and related trades; identify skill gaps; and propose targeted interventions such as cross-training, curriculum enhancements, and certification updates. The goal is to ensure a sustainable, skilled workforce to support the safe expansion of DWS nationwide.
Anticipated Timeline:	Start: August 2025 End: March 2026
Possible Action Leader(s) and Key Contact:	1. IAPMO, Christopher Lindsay, christopher.lindsay@iapmo.org 2. LIXIL Americas, Troy Benavidez, troy.benavidez@lixil.com 3. LIXIL Americas, Andrea Stowell, andrea.stowell@lixil.com
Partner(s) and Key Contact:	1. San Francisco Public Utilities Commission (SFPUC), Taylor Nokhoudian, taylor.nokhoudian@sfwater.org 2. ARCSA International, Heather Kincade, heather.kincade@arcsa.org 3. PHCC (Plumbing-Heating-Cooling Contractors—National Association), Mark Valentini, mark.valentini@phcc.org 4. Building Performance Institute (BPI), Amanda Hatherly, ahatherly@bpi.org 5. Texas Commission on Environmental Quality (TCEQ), Bruce Lesikar, bruce.lesikar@tceq.texas.gov 6. WateReuse, Monica Merk, mmerk@watereuse.org

BILD Action Implementation Plan	
Background:	The adoption of decentralized water systems is growing due to water scarcity, climate resilience needs, and technological innovation. However, the workforce needed to design, install, and maintain these systems is not scaling at the same pace. Existing pathways—such as plumbing apprenticeships, water operator certification programs, and manufacturer training—are fragmented, vary by jurisdiction, and often lack content specific to DWS technologies and risk management. BILD's Capacity Development Working Group identified workforce development as a critical priority and proposed developing a systematic approach to identify the right existing pipelines for training and certifying individuals to install and operate DWS. This action builds on recent mapping and gap analysis work that documented current workforce pathways, barriers, and potential leverage points at both national and state levels.
Opportunities to be Gained:	• Increase availability of skilled professionals to support safe, widespread DWS deployment. • Enhance and standardize DWS-related competencies across multiple trades. • Foster collaboration between utilities, industry, and educational institutions. • Integrate public health and safety considerations into workforce training. • Improve awareness and attractiveness of DWS careers to new entrants.
Implementation Milestones:	SEE BELOW
Photo / Image / Relevant Quote: (optional)	
References:	
Possible Outputs:	SEE BELOW

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Finalize scope and framework for workforce pipeline analysis.	IAPMO & LIXIL	SFPUC, ARCSA, PHCC, BPI, TCEQ, WateReuse	September 2025	Month, Year	Milestone Status.	Provide brief update.
2	Map existing workforce pathways (national + select state profiles).	IAPMO & LIXIL	SFPUC, ARCSA, PHCC, BPI, TCEQ, WateReuse	November 2025	Month, Year	Milestone Status.	Provide brief update.
3	Identify skill gaps, certification barriers, and DWS-specific training needs.	IAPMO & LIXIL	SFPUC, ARCSA, PHCC, BPI, TCEQ, WateReuse	December 2025	Month, Year	Milestone Status.	Provide brief update.
4	Develop strategies for upskilling, cross-skilling, and curriculum integration.	IAPMO & LIXIL	SFPUC, ARCSA, PHCC, BPI, TCEQ, WateReuse	January 2026	Month, Year	Milestone Status.	Provide brief update.
5	Draft implementation toolkit for utilities, training providers, and industry partners.	IAPMO & LIXIL	SFPUC, ARCSA, PHCC, BPI, TCEQ, WateReuse	February 2026	Month, Year	Milestone Status.	Provide brief update.
6	Pilot toolkit elements with select partners; incorporate feedback.	IAPMO & LIXIL	SFPUC, ARCSA, PHCC, BPI, TCEQ, WateReuse	March 2026	Month, Year	Milestone Status.	Provide brief update.
X	Describe activity/output.	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
X	Describe activity/output.	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
X	Describe activity/output.	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.
X	Describe activity/output.	Org. Name(s)	Org. Name(s)	Month, Year	Month, Year	Milestone Status.	Provide brief update.

[1] The status field should be left blank until the implementation milestone can be marked as “completed,” “canceled,”

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Workforce pipeline mapping with national and state profiles (Nov 2025)	Implementation Milestone 2	☐
Gap analysis report identifying priority skills/training needs (Dec 2025)	Implementation Milestone 3	☐
Draft Implementation toolkit for workforce partners (Feb 2026)	Implementation Milestone 5	☒
Industry review and feedback (March 2026)	Implementation Milestone 6	☐
Finalize toolkit (April 2026)	Implementation Milestone 6	☒

Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

BILD Action Implementation Plan	
Action Title:	Improve communication with the development community to support broader understanding, acceptance, and implementation of onsite reuse with decentralized water systems.
Brief Description of the Action:	Developers and other professionals in the development community, such as local government/utility program staff and leaders, are key stakeholders that need to communicate and coordinate effectively to enable the implementation of onsite reuse systems. However, historically, developers have not been engaged as partners on broader efforts in the U.S. to expand onsite reuse implementation. In this BILD action, leaders and partners will engage with the development community to better understand their perspectives and needs related to decentralized water management approaches and onsite reuse implementation. This action will help create opportunities for knowledge sharing with developers that have experience implementing DWS and those interested but who have questions about processes, benefits, challenges, and lessons learned. The action team will also share existing resources and develop new resources that explore important topics (e.g., permitting processes, incentives, timeline), which states and local government staff can use to better understand developers' perspectives and needs to help enable adoption of decentralized water systems at the local level.
Anticipated Timeline:	*Confirm leaders and partners:* September 2025 to December 2025 *Confirm action approach:* January 2026 to February 2026 *Action implementation:* April 2026 to May 2027
Possible Action Leader(s) and Key Contact:	• WateReuse Association • SFPUC (Taylor Nokhoudian) • Austin Water (Robert Stefani)
Partner(s) and Key Contact:	*TBD* Note: BILD members and National Blue Ribbon Commission members can likely identify developers who are earlier in their journey but have expressed interest in DWS and would benefit from learning from developers with more experience in this space. Ideally the participating organizations would represent a variety of areas in the U.S.

BILD Action Implementation Plan	
Background:	Predominantly in the U.S., buildings in urban areas are connected to centralized wastewater collection systems for treatment and disposal at an offsite location and they are connected to a centralized water distribution system to deliver necessary potable water supplies. Decentralized water systems (DWS) are intended to reuse treated wastewater for a beneficial purpose on or near the premises of a building or part of a community. These systems can be more complicated, expensive, and very different from the systems that developers have traditionally designed and installed for over 100; however, when designed and implemented successfully, DWS can add value to the community through more efficient use of water resources and infrastructure, can be a more resilient solution in some disaster situations, and can be marketed in ways that garner support from building occupants. Further, incentives established at the local level may be able to create returns on investment (ROIs) comparable with traditional building water/wastewater connections. As DWS become more prevalent in communities, either voluntarily or required through ordinance, some developers are learning how to design, build and operate DWS and the associated utilities and municipalities are learning how to permit and inspect systems. For developers new to the process, DWS might seem foreign, overwhelming, or they may not understand the benefits and challenges that may accompany pursuing implementation of DWS. There is an opportunity for those who have been through the process with one or more facilities to share their experiences and knowledge with those just beginning their journey, and for BILD to develop resources that help local governments respond to development community concerns. This is particularly true for cities where DWS is still a new approach and has not yet been implemented. This action will help highlight existing resources, developed by a variety of municipalities, that may be very helpful to developers in other cities even if the programs vary slightly, and seek to leverage the experiences of developers versed in DWS implementation to help others through personal knowledge sharing and the development of additional resources.
Opportunities to be Gained:	• Increased understanding of developers' perspectives on implementation of DWS by BILD leaders and others in the water sector. • Better understanding of DWS opportunities and challenges by developers. • Increased implementation of DWS in areas where they are still voluntary. • More effective relationships between water organizations and the development community. • Development of communications tools and other resources that may be helpful to developers pursuing or considering implementation of DWS.

BILD Action Implementation Plan	
Implementation Milestones and Possible Outputs:	See table below.

BILD Action Implementation Plan	
Photo / Image / Relevant Quote: (optional)	No photos identified at this time, though could include one of the 2024 EPA workshop in DC. Potential action leaders/partners may have some images that may be suitable.
References:	San Francisco Public Utility Commission's Onsite Water Reuse Program Guidebook https://www.sfpuc.gov/sites/default/files/documents/OnsiteWaterReuseGuide_April2025.pdf Austin Water's Onsite Water Reuse Program Guidebook https://www.austintexas.gov/sites/default/files/files/Water/Onsite%20Water%20Reuse%20System/AW_OnsiteWaterReuse_Guidebook.pdf Pacific Institute Guide for Developing Onsite Water Systems https://pacinst.org/publication/onsiteguide/ Onsite Water Reuse System Designers, Builders and O&M Vendors https://www.austintexas.gov/sites/default/files/files/Water/Reclaimed/designers-builders-and-o-m-vendor-list-v4.pdf San Franciso Public Utility Commission's Guidebook for Commissioning an Onsite Water Reuse System https://www.sfpuc.gov/sites/default/files/documents/CommissioningOnsiteWaterReuse_2025.pdf San Francisco Onsite Water Reuse Case Studies https://www.sfpuc.gov/sites/default/files/documents/SF_Non_potable_Case_Studies%20_Sep2024_v2.pdf Austin Water Onsite Water Reuse Case Studies https://www.austintexas.gov/department/onsite-water-reuse-systems#OnsiteWaterReuseCaseStudies Global Case Studies of Onsite Water Reuse Systems https://www.sfpuc.gov/sites/default/files/construction-and-contracts/design-guidelines/3.%20Case%20Studies%20Around%20the%20World_2021.pdf Resources Available from the WateReuse Association https://watereuse.org/educate/national-blue-ribbon-commission-for-onsite-non-potable-water-systems/resources-for-onsite-non-potable-water-programs/ Resources Available from the EPA https://www.epa.gov/waterreuse/onsite-non-potable-water-reuse-resources

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	POTENTIAL LEAD(S) Contact(s)	POTENTIAL PARTNER(S)	TARGET COMPLETION DATE
1	Collect currently available resources on DWS for developers and assess content for sharing further	Brian Good (Denver Water)	SFPUC, Austin Water, EPA, WRA, BILD Comms Workgroup Members, NBRC members	Within 1 month of action start
2	Identify developers with experience designing, building and operating DWS and others that are not as experienced but are interested in DWS	Brian Good (Denver Water)	SFPUC, Austin Water, BILD Comms Workgroup Members, NBRC members, EPA Water Conservation Team	Within 6 weeks of action start
3	Contact developers to gauge interest in sharing their perspectives through interviews, case studies, and/or a knowledge-sharing forum	Taylor Nokhoudian (SFPUC), Robert Stefani (Austin Water)	BILD Comms Workgroup Members, NBRC members, EPA Water Conservation Team	Within 2 months of action start
4	Conduct informational interviews with developers to capture their views on DWS implementation, including challenges, perspectives on incentives, permitting, best practices, communications approaches and needs, and to identify venues where DWS information could be shared with developers			Within 3 months of action start
5	Develop and publish fact sheet(s), case studies, or other write-ups on developer perspectives on DWS implementation based on the interviews conducted			TBD
6	If there is appetite for a knowledge-sharing forum among developers, initiate and complete planning for the event	Ashley Harper (EPA), Brian Good (Denver Water)	BILD Comms Workgroup Members, NBRC members	TBD
7	Host knowledge-sharing forum with developers			TBD
8	Follow up with forum participants to share relevant resources and communicate any next steps			Within one week of forum
9	Develop post-event summary capturing key themes, lessons learned, best practices, etc.			Within one month of forum

	IMPLEMENTATION MILESTONE	POTENTIAL LEAD(S) Contact(s)	POTENTIAL PARTNER(S)	TARGET COMPLETION DATE
10	Based on informational interviews, knowledge-sharing forum, and other research, create and share materials to convey developers' perspectives, needs, and examples of best practices for DWS implementation that can be informative to local government staff and leaders			TBD
11	(Ongoing) Share information on DWS with development community in additional existing forums (conferences, association events, etc.)			TBD
12	Convene BILD planning team to determine any additional milestones related to this action			TBD

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Compilation of resources	1	☐
List of developers	2	☐
Fact sheet(s), case studies, or other write-ups on developer perspective	5	☒
Resource packet for forum attendees (existing resources, attendee list, best practices, follow-up)	6 – 8	☐
Forum report or white paper (summarizing the event, contains any PPT slides, key findings/takeaways/next steps)	9	☒
Materials to convey developers' perspectives, needs, and examples of best practices for DWS	10	☒
Decide next steps (additional forum or knowledge transfer, listening sessions with developers, additional case studies or new ones with different content relevant to developers, co-present at conferences, write articles for trade journals important to developers, etc.)	11 – 12	☐

Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

BILD Action Implementation Plan	
Action Title:	Identify opportunities and establish protocols to foster trust and understanding of decentralized water systems among local governments, utilities, and elected officials
Brief Description of the Action:	To properly advance decentralized water systems (DWS), it is important to build understanding of and trust in the ability of DWS to help effectively meet the water planning needs of utilities and local governments. By sharing success stories and demonstrating onsite reuse as a cost-effective and reliable tool to offset peak potable demand, action leaders hope to overcome skepticism and increase implementation of these projects in communities globally.
Anticipated Timeline:	TBD
Possible Action Leader(s) and Key Contact:	TBD
Partner(s) and Key Contact:	TBD

BILD Action Implementation Plan	
Background:	Building understanding and trust in decentralized water management approaches among utilities and local governments is vital for the successful implementation of DWS. These systems offer innovative solutions to water management challenges by treating and reusing water at or near the point of use, reducing the demand on centralized infrastructure. However, adopting such systems requires a paradigm shift in how water resources are managed, which can be met with skepticism and resistance. Helping local leaders and utilities understand the benefits, reliability, cost-effectiveness, and other aspects of onsite systems can help increase their trust in these approaches, paving the way for their acceptance and integration into existing water management frameworks. The success of the National Blue Ribbon Commission for Onsite Non-potable Water Systems illustrates the importance of trust and collaboration. This commission, comprising leaders from utilities, public health agencies, and environmental organizations, has demonstrated the viability and benefits of onsite water reuse through pilot projects and policy development. Their efforts have shown that distributed systems can enhance water resilience, reduce environmental impact, and provide economic advantages. By building trust and fostering collaboration, the Commission has been able to advance onsite reuse initiatives across the nation, setting a precedent for other groups to follow. BILD is poised to further these efforts by compiling case studies, a toolbox of resources, and contacts from cities that have successfully implemented decentralized water systems. By sharing lessons learned and best practices, BILD aims to equip utilities and local governments with the knowledge and tools necessary to navigate the complexities of onsite water reuse. This approach not only builds trust but also empowers stakeholders to make informed decisions, accelerating the adoption of sustainable water management solutions. Through collaboration and shared experiences, BILD can help transform the landscape of water reuse, fostering innovation and resilience in communities worldwide.
Opportunities to be Gained:	• Increased awareness and understanding by local governments about DWS implementation
Implementation Milestones and	

BILD Action Implementation Plan	
Possible Outputs:	
Photo / Image / Relevant Quote: (optional)	
References:	

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	POTENTIAL LEAD(S) Contact(s)	POTENTIAL PARTNER(S)	TARGET COMPLETION DATE
1	Create an inventory of relevant existing resources and identify needs and gaps	TBD	TBD	Within 1 month of action start
2	Engage with cities that have implemented DWS to capture lessons learned	TBD	TBD	Within 2 months of action start
3	Create case studies showing the process of enabling onsite reuse for a variety of communities	WEF	TBD	TBD
4	Create a resources guide that demonstrates relative costs and benefits of a variety of decentralized approaches	TBD	TBD	TBD
5	From lessons learned in milestone 2, create an implementing framework which may include a best practice approach involving civic works projects to help determine necessary collaborations, permitting approaches, and other key aspects of project development and implementation	TBD	TBD	TBD
6	Provide adaptable communications materials that local governments may use to support their engagement with other key stakeholders, such as developers	TBD	TBD	TBD
7	Convene BILD planning team to determine any additional milestones related to this action	TBD	TBD	TBD

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Compilation of resources.	1	☐
Case studies	3	☐
Resources guide	4	☒
Implementing framework	5	☒
Adaptable communications materials	6	☒

Building Infrastructure Locally for Decentralized Water Systems (BILD)

Action Implementation Plan

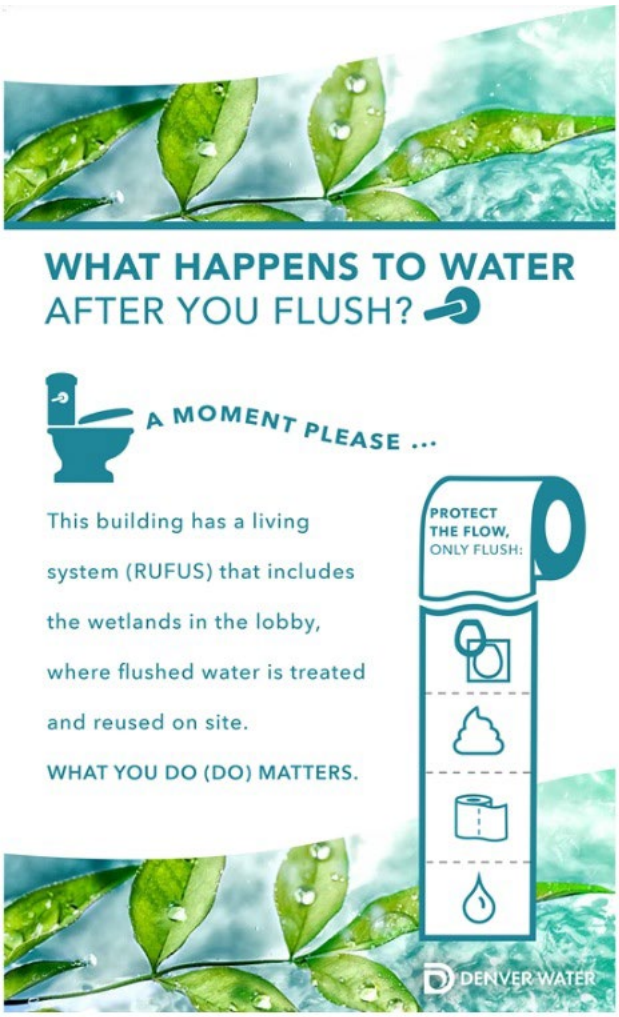
BILD Action Implementation Plan	
Action Title:	Foster engagement and acceptance of DWS for building and facility managers, maintenance staff, and occupants.
Brief Description of the Action:	Installing DWS requires a shift in how building and facility managers, maintenance staff, tenants and occupants interact with the water systems at their facilities and in their building. For managers, this could mean additional reporting requirements, increased coordination with the local water agency, increased coordination for DWS operation and maintenance, and increased engagement with occupants. Maintenance staff may be asked to depart from their standard work to consider what products they use and may be in out in charge of operating and maintaining DWS with little training or background. Tenants and occupants in buildings with DWS can be required to limit the products that they use and, if the building is owner occupied, be limited in the renovations they can undertake. This action will aggregate lessons learned from the successful deployments of DWS to create a toolbox of targeted support for building managers, maintenance staff, and occupants.
Anticipated Timeline:	*Confirm leaders and partners:* September 2025 to December 2025 *Confirm action approach:* January 2026 to February 2026 *Action implementation:* April 2026 to May 2027
Possible Action Leader(s) and Key Contact:	TBD
Partner(s) and Key Contact:	TBD

BILD Action Implementation Plan	
Background:	• DWS implementation requires a different level of public engagement than centralized systems to ensure understanding of how the systems work and how individual behaviors may influence the performance of the more localized system. • While public acceptance is still important, DWS often requires additional commitments and investments by facility and building managers/maintenance staff/building occupants to ensure the system operates properly. • Behavior changes may be necessary to achieve successful operations but those changes can be hard to create and require continuous communications and awareness efforts. • Effective communications need to be targeted and context specific. • BILD can make progress in this space by collecting best practices and creating temples/frameworks for people to adopt and make their own by making them specific to their system and locality.
Opportunities to be Gained:	• Increased understanding of challenges related to continuous operation of DWS, including source control issues. • Better understanding of what messaging has worked for different stakeholder groups (building managers, maintenance staff, occupants) and the recommended cadence for that messaging. • Increased public acceptance of DWS which could drive the market for more systems. • Increased communication between water organizations and customers managing, maintaining, and/or living in buildings with DWS. • Development of communications tools and other resources to help create a useful DWS toolkit.
Implementation Milestones and Potential Outputs:	See table below.

BILD Action Implementation Plan

Photo / Image / Relevant Quote:

(optional)



Messaging posted in the toilet stalls at Denver Water's administration building to raise awareness about their onsite blackwater system, named "ReUse For Us" (RUFUS)

BILD Action Implementation Plan	
References:	San Francisco Public Utility Commission's Onsite Water Reuse Program Guidebook https://www.sfpuc.gov/sites/default/files/documents/OnsiteWaterReuseGuide_April2025.pdf Austin Water's Onsite Water Reuse Program Guidebook https://www.austintexas.gov/sites/default/files/files/Water/Onsite%20Water%20Reuse%20System/AW_OnsiteWaterReuse_Guidebook.pdf Pacific Institute Guide for Developing Onsite Water Systems https://pacinst.org/publication/onsiteguide/ Onsite Water Reuse System Designers, Builders and O&M Vendors https://www.austintexas.gov/sites/default/files/files/Water/Reclaimed/designers-builders-and-o-m-vendor-list-v4.pdf San Franciso Public Utility Commission's Guidebook for Commissioning an Onsite Water Reuse System https://www.sfpuc.gov/sites/default/files/documents/CommissioningOnsiteWaterReuse_2025.pdf San Francisco Onsite Water Reuse Case Studies https://www.sfpuc.gov/sites/default/files/documents/SF_Non_potable_Case_Studies%20_Sep2024_v2.pdf Austin Water Onsite Water Reuse Case Studies https://www.austintexas.gov/department/onsite-water-reuse-systems#OnsiteWaterReuseCaseStudies Global Case Studies of Onsite Water Reuse Systems https://www.sfpuc.gov/sites/default/files/construction-and-contracts/design-guidelines/3.%20Case%20Studies%20Around%20the%20World_2021.pdf Resources Available from the WateReuse Association https://watereuse.org/educate/national-blue-ribbon-commission-for-onsite-non-potable-water-systems/resources-for-onsite-non-potable-water-programs/ Resources Available from the EPA https://www.epa.gov/waterreuse/onsite-non-potable-water-reuse-resources

Implementation Milestones Table

	IMPLEMENTATION MILESTONE	POTENTIAL LEAD(S) Contact(s)	POTENTIAL PARTNER(S)	TARGET COMPLETION DATE
1	Collect currently available resources on DWS for building and facility managers, building occupants and building maintenance personnel and assess content for sharing further	TBD	TBD	Within 1 month of action start
2	Conduct informational interviews with building and facility managers operating successful systems to understand what messaging has been effective and what common challenges they have had to overcome	TBD	TBD	Within 2 months of action start
3	Conduct informational interviews with maintenance staff working in buildings and facilities with DWS to better understand communication gaps and operational challenges that can be overcome by addressing those gaps	TBD	TBD	TBD
4	Conduct informational interviews with occupants in buildings with DWS to better understand their perception of living in a building with DWS and what communication gaps may exist	TBD	TBD	TBD
5	Convene BILD members to review existing resources and results of interviews; create committee to develop new materials	TBD	TBD	TBD
6	Use information gained from the interviews to define gaps and inform a best practices guide or toolkit as a resource for building managers, maintenance staff, and occupants.	TBD	TBD	TBD
7	Host a nationally accessible webinar to showcase the lessons learned and materials that have been developed.	TBD	TBD	TBD

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Compilation of resources	1	☐
Interview summaries	2 - 4	☐
Toolbox of Best Management Practices: Compendium of BMPs for Building managers, maintenance staff, and occupants	6	☐
Toolbox of Best Management Practices: Templates/Frameworks informed by BMPS to create targeted communications materials for building managers, maintenance staff, and occupants	6	☐
Webinar	7	☐

BILD Action Implementation Plan	
Action Title:	Developing a Modeling Toolbox for Quantifying the Multiple Benefits of Decentralized Water Systems
Brief Description of the Action:	Quantifying the costs and benefits of decentralized water systems (DWS) is important for developing return on investment estimates to inform decision makers. Supporting models have been developed to aid this decision making for a range of geographical applications. These models vary in the scope of their cost estimates, particularly across the range of possible co-benefits. The goal of this task is to bring together the existing modelers within the BILD community to 1) assess the set of existing tools, 2) define reasonable extensions of the models which can be accomplished in the short and mid-term, and 3) evaluate strategies for managing a toolbox of these models that provides support for different target audiences like policy makers, real estate developers, end users, etc. Incorporating quantitative or semi-qualitative estimates of key co-benefits will be emphasized, with selection of the co-benefits coordinated with the "The Communicating the Multiple Benefits of Decentralized Water Systems" Action Group.
Anticipated Timeline:	Jan. 2026 – Dec. 2028
Possible Action Leader(s) and Key Contact:	Jay Garland, USEPA, garland.jay@epa.gov.
Partner(s) and Key Contact:	• Jay Garland, Cissy Ma, EPA • Sam Arden, ERG • Christian Binz, Eawag • Esber Andiroglu, Kyrah L. Williams, University of Miami • Rajiv Paladh, Bosch Capital • Mishqah Hussain, Bosch Projects • Sudhir Pillay, South African Water Research Commission • Jay Bhagwan, South African Water Research Commission • Preyan Arumugam-Nanoolal, University gf Kwazulu-Natal • Monika Merk, WateReuse Association

Background:	Because DWS represents a significant shift from traditional approaches to providing water services, decision makers must consider the costs and benefits of novel alternative scenarios prior to investment. Evaluation is complicated by the myriad of DWS approaches to consider, including different alternative source waters and end uses, various scales of treatment systems (household to large district), and the range of treatment technologies available (including many novel designs). Several groups across the world have developed modeling tools to help define costs and benefits. The following is a brief summary of each of these tools and an update of near-term advancements each group expects within the next year. *U.S. EPA's NEWR Calculator* The EPA's Non-potable Environmental and Economic Water Reuse (NEWR) calculator uses Life Cycle Costing (LCC) and Life Cycle Assessment (LCA) to quantify the costs and benefits of DWS as functions of building characteristics and geographical location. Analysis to date indicates that wastewater provides a consistent source of water at reasonable cost, especially within larger buildings and when heat energy is recovered (Arden et al. 2021). Roof collected rainwater and air conditioning condensate, on the other hand, have lower treatment costs but can provide significant supply only at limited regions within the U.S. (Arden et al. 2021). While these results indicate that NEWR has proven useful for researchers, a recent assessment identified the need to improve the user interface and modeling metrics to increase use by developers, builders, utilities, and policy makers. Specific recommendations included updating cost models to account for recent technology advances (MBRs) and evolution of disinfection approaches (ozone instead of chlorine), as well as capture of the suite of site-specific costs/fees/incentives that are affected by onsite DWS systems. Finally, expanded quantification and messaging of co-benefits of DWS was also indicated as a need. A revised NEWR incorporating these changes is expected to be to be publicly available by January 2027. *WELL Labs and Eawag Strategy Support Tool* WELL Labs and Eawag are currently piloting a strategy support tool for real estate developers and resident welfare associations in Bengaluru, India, which supports them in planning retrofits or new installations of DWS for reuse. The tool takes these actors (that typically lack deep knowledge about decentralized water reuse system's costs and benefits) through a six-step process in which the concrete investment decision is formed. At the end of the process, a 'return on investment calculator' helps them to compare the costs and economic, environmental, and social benefits of the different investment options. By going through this process and getting the final calculations, users of the tool can think deeply about the long-term cost-benefit structures of different water reuse systems and are nudged to invest into more high-quality systems, which often have higher CAPEX in the short run but lower OPEX and higher social and environmental co-benefits in the long run. The ROI calculator is still rather rudimentary and could be improved by incorporating insights from more sophisticated tools like NEWR. In the short run, this model will be improved in close collaboration with other BILD partners, potentially in a MA

BILD Action Implementation Plan

student project. In the mid-term we aim to explore whether the tool could be expanded to other use contexts in Asian, European, or US cities.

SuReal Lab, University of Miami
A modeling approach developed by members of the SuReal Lab at the University of Miami encourages the implementation of water conservation practices in conjunction with tiered treatment to minimize the usage of potable water across various climatic and geographical locations. This method addresses water reuse in the domestic sector, specifically residential demand, through the operationalization of alternate water supply streams that lessen the potable water dependency of traditional municipal sources. Anticipated contributions consider meeting non-residential demand from emerging sectors. The assessment is intended to propel enhanced long-term water planning and consider future impacts unique to the specified urban landscape as well as the cost-benefit analysis of such implementation.

Early results show that building typologies alongside occupant density are important factors that should be considered when estimating the volume of water that can be conserved within a given city. For example, specific conservation measures, such as rainwater harvesting, can have large impacts based on a city's climate whereas measures such water-efficient fixtures are impactful based on end-user perception and community buy-in. Next steps include the evaluation of tiered treatment to meet the domestic sector's potable and non-potable demands followed by the demand of emerging sectors within a city. A model or tool is expected to be developed by December of 2026.

South African Water Research Commission, Bosch
In 2023, the South African project team developed the initial iteration of a Life-Cycle Cost Comparison tool designed to assess and compare the costs of conventional and decentralized sanitation systems. However, additional engagement with South African stakeholders is necessary to determine the extent and nature of future refinements to the model. This effort will involve working with key stakeholders to evaluate gaps, underlying assumptions, and emerging sector insights, with the aim of enhancing the robustness and decision-making value of the existing model. The improved model will enable stakeholders to more effectively compare sanitation solutions and assess the long-term economic benefits of Non-Sewered Sanitation Systems (NSSS). Identification of possible model refinements will be based on feedback obtained from current users. Ultimately, these enhancements could support the informed adoption and scaling of NSSS nationwide. This engagement will occur in 2026, forming the basis for further efforts to strengthen the model. The BILD platform has created an opportunity to identify areas where the model can be benchmarked, strengthened, and further optimized.

Summary
Integration of the different models described above is likely as these four modeling groups continue to interact. One overarching goal of this work group

BILD Action Implementation Plan	
	is to develop a library of available models. A single online site housing both the models and associated background information can improve potential users' access to, and understanding of, these decision support tools. Ideally, this library would be hosted by an organization with high visibility in the field such as BILD, NBRC, WaterReuse Association, etc. Additional milestones and outputs associated with model integration and curation will be defined by this work group as part of a revised action plan at the end of 2026.
Opportunities to be Gained:	• A community of experts in modeling the costs and benefits of DWS to facilitate information exchange, improve coordination, and identify potential collaborations. • Increased access to modeling tools by potential decision makers for estimating DWS costs and benefits, including improved ability to make holistic cost comparisons of various technologies with enhanced transparency of life cycle costs • More informed decision-making related to the development of DWS for different types of applications and target audiences. • Increased adoption of DWS and their associated benefits
Implementation Milestones:	See Table Below
Photo / Image / Relevant Quote: (optional)	
References:	Arden, S., Morelli, B., Cashman, S., Ma, X. C., Jahne, M., & Garland, J. (2021). Onsite non-potable reuse for large buildings: environmental and economic suitability as a function of building characteristics and location. Water research, 191, 116635.
Possible Outputs:	See Table Below

Implementation Milestones Table

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
1	Public release of a revised NEWR tool with improved interface for decision makers, updated modeling estimates of costs metrics, and additional quantification of co-benefits.	Sam Arden (ERG)	Jay Garland (USEPA) Cissy Ma (USEPA)	January, 2027	Month, Year	Milestone Status.	Provide brief update.
2	Update Eawag's and WELL Lab's 'RWA strategy tool' with modules from more sophisticated ROI and LCA models available elsewhere (e.g. NEWR, others)	Christian Binz (Eawag)		January 2027			
3	Development of modeling approach into a tool for the quantification of alternate supply streams and cost/benefit analysis within the domestic sector	Kyrah L. Williams (UM)	Esber Andiroglu (UM)	December 2026			
4	Stakeholder engagement workshop Rajiv Paladh/ Mishqah Hussain	Rajiv Paladh (Bosch)/ Mishqah Hussain (Bosch)	Water Research Commission and University of KwaZulu-Natal	May 2026			

IMPLEMENTATION MILESTONE		LEAD(S) Contact(s)	PARTNER(S)	TARGET COMPLETION DATE	ACTUAL COMPLETION DATE	STATUS[1]	UPDATE
5	Updated implementation plan with additional milestones and outputs associated with potential integration and curation of models.	Jay Garland (USEPA)	All working group members	January 2027			

List of Outputs

OUTPUT DESCRIPTION (MONTH, YEAR)	NO. OF CORRESPONDING IMPLEMENTATION MILESTONE	KEY OUTPUT?
Publicly available revised NEWR tool. (January, 2027)	Implementation Milestone 1	☒
RWA strategy tool successfully piloted and launched in Bengaluru (TBD)	Implementation Milestone 2	