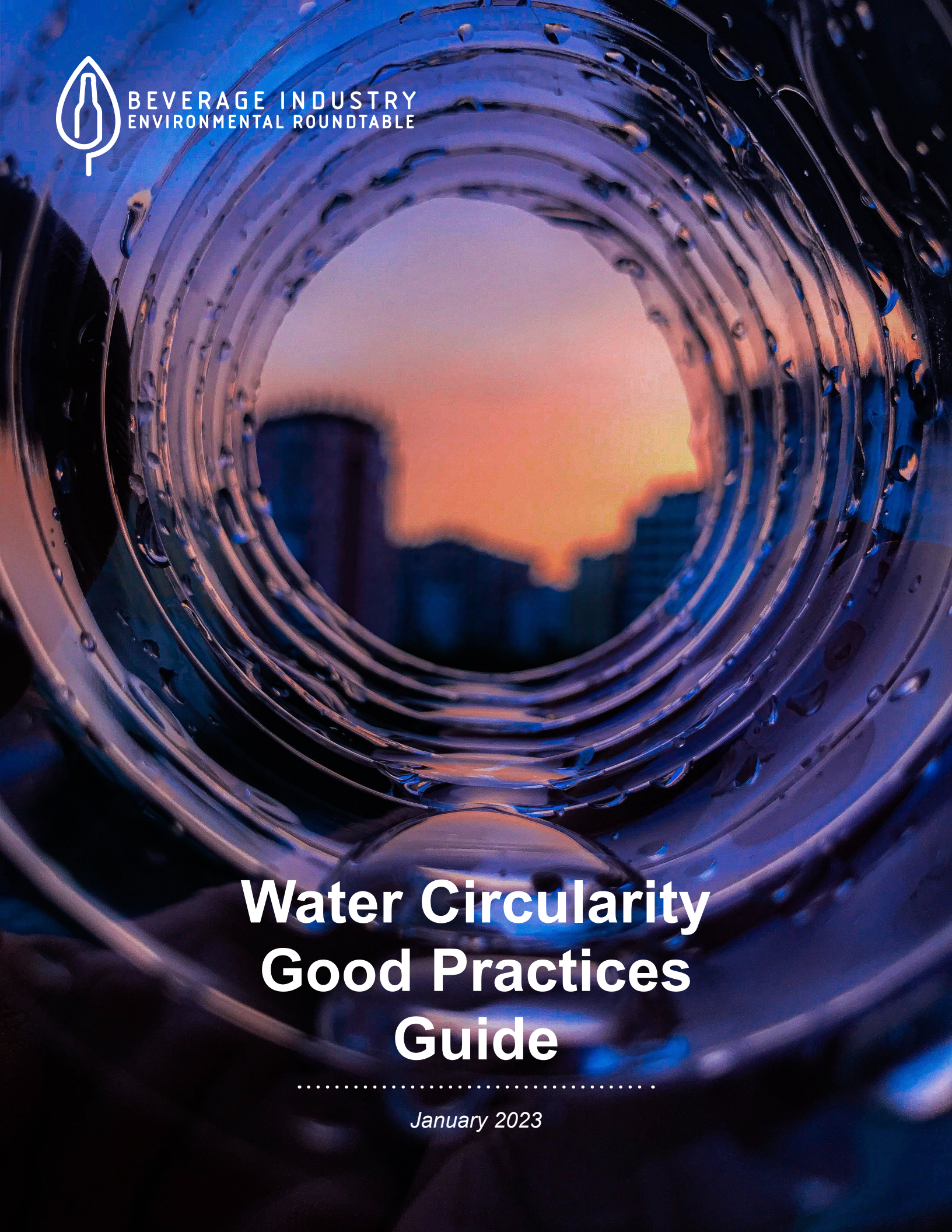

BEVERAGE INDUSTRY
ENVIRONMENTAL ROUNDTABLE

Water Circularity Good Practices Guide

January 2023

Foreword

The Beverage Industry Environmental Roundtable (BIER) is committed to working together as leaders in the industry to advance the sector's environmental sustainability, often through progressive, yet still pragmatic, approaches. The collective experience of our member companies lends itself to sharing success stories but also working together to learn from common challenges. Water is the first ingredient in all of our member's products and therefore good water stewardship is a necessity to ensure business continuity. When considering water circularity in particular, BIER members,along with other companies have all clearly identified the why[1234] behind engaging in these types of projects. Building upon BIER's strong water stewardship foundation, this guide seeks to outline the ***how-to*** of successful pre-project planning, concrete steps for successful implementation, as well as considerations that should be made after the projects have been implemented to ensure long-term success.

The concept of water circularity is not a new approach, although it might have been known by other terms. On-site circularity measures have been employed across different sectors around the globe for years. As those on-site circularity applications become more widespread and "business as usual," it becomes imperative to look outside the four walls of our facilities, beyond operational efficiency, where off-site circularity measures can help positively impact the overall health of the shared watersheds in which we operate. In contrast to long-established approaches for on-site circularity, those for off-site circularity are only now emerging, maturing, and being optimized. This guide will walk the reader through the high-level considerations of an easy-to-follow process, as well as the important considerations for when to pivot focus more intentionally from on-site techniques to off-site circularity endeavors.

This guide seeks to coalesce insights already developed by BIER and other leaders in the fields of water stewardship and circularity with the ever important and necessary consideration of appropriate stakeholders. We at BIER hope this guide can serve as an approachable and usable document to better prepare you and your organization for the task ahead – socializing water circularity opportunities, particularly those off-site, to reduce our reliance on freshwater resources and improve the health of our watersheds.

- Daniel Pierce, Executive Director, BIER

1. Beverage Industry Environmental Roundtable (2020) Context-Based Decision Guide for Water Reuse and Recycling.
2. World Business Council for Sustainable Development. (2017) Business guide to circular water management: spotlight on reduce, reuse and recycle.
3. World Business Council for Sustainable Development. (2020) Wastewater Zero: a call to action for business to raise ambition for SDG 6.3.
4. The CEO Water Mandate (2013) Guide to Water-Related Collective Action.

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Executive Summary

Global demand for reliable, clean freshwater continues to grow. According to the UN, half of the world's population lives in a water-scarce area at least one month of the year, and this is projected to increase to nearly 6 billion individuals facing water risk by 2050. As climate change, political unrest, and increased pollution reduce the availability of our freshwater resources, there is increased need to be more thoughtful and creative by working collaboratively on our water challenges. The Guide to Water-Related Collective Action warns that "done poorly, collective action can undermine a company's reputation, tarnish product brands, and exacerbate existing problems." So why engage in such a risky endeavor, like an off-site circularity project? The Guide to Collective Action also calls for "establishing nonconventional relationships with nontraditional partners," and much of the dialog across sectors calls for innovative coalitions to help solve the global challenges we share. Businesses and communities will need circularity initiatives to thrive. Going forward, circularity must be included as part of a business's water strategy, at the basin scale, for those who want to manage their risk. We need to think earlier to prevent water problems and circularity is a valuable tool for doing this.

In this Water Circularity Good Practices Guide, we have developed the *BRAID Work Stream*, intended to coordinate the complexity of solutions, strategies, and tailored outreach materials employed in order to design and deliver sustainable watershed-level impact, long-term. The *BRAID Work Stream* is intended to keep a pulse on engagement and operations simultaneously, allowing an organization to remain nimble and adaptable to ensure continuous support by building public confidence in circular water reuse strategies.

The BRAID Work Stream

Benchmarking - establish context by understanding water use-discharge dynamics within the watershed.

Relationships - local partnerships, built on trust lead to more successful, long-term solutions.

Accountability - transparent communications around circularity performance is critical. Engage stakeholders early and often.

Intertwined - stakeholder engagement, quality assurance, and innovative solutions will likely overlap, and occur frequently.

Dynamic - to remain successful, continue to evaluate and/or adopt new opportunities, technologies, and messaging.

Considerations for Circularity

Pre-Implementation:
- Baseline data collection

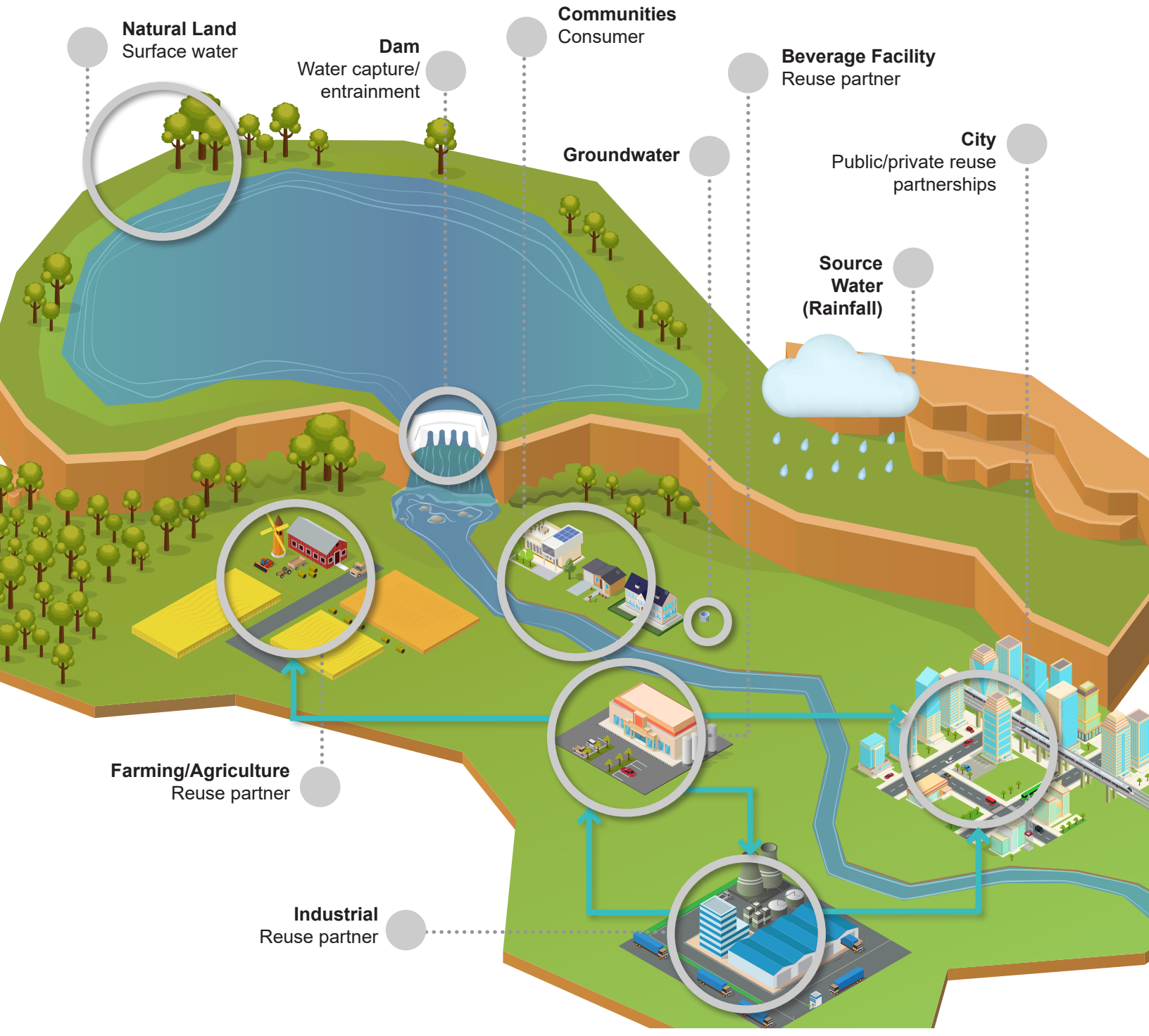
Implementation:
- Stakeholder engagement
- Context-based solution

Post-Implementation & Sustained Effort:
- Quality assurance
- Identify new reuse opportunities & synergies

Successful circularity solutions begin with partnership and trust. The number one question to ask is:
"Where should we go as a community?"
- BIER member

Water risks are shared risks. Similarly, creating watershed or basin-level solutions can lead to shared benefits, including: information sharing, innovative excellence, credibility, and cost savings through joint financing. Much like the MSPs (multi-stakeholder platforms), a water management solution, presented by the 2030 WRG in the 2021 annual report, the *BRAID Work Stream* is a multidimensional approach to creating impactful on and off-site water circularity solutions for the watershed.

Infographic depiction of watershed. Implementing circularity solutions at the basin scale requires consideration of a complex network of source waters, flow optimization, resource sharing, and partnerships. This non-exhaustive list illustrates potential use-reuse pathways to consider when embarking on your water circularity journey.



Concept

What is Water Circularity

The United Nations Human Right to Water identifies safe, sufficient, accessible, acceptable, and affordable water services as a prerequisite to healthy, prosperous communities. Increasing pressures on water supply, due to climate change and other factors, political unrest, land use change, pollution, population growth and migration, and changing consumer expectations have raised the visibility of water insecurity and piqued the interest of stakeholders well beyond the beverage industry. Increasingly, companies are shifting away from the traditional linear economy, where water use and management follow the Take-Use-Discharge philosophy, to a more sustainable circular economy, which emphasizes the reuse and recycling of materials to help preserve and restore natural resources. Water Circularity applies the circular economy model to virtually all water streams inside and outside a facility. This level of scrutiny intentionally changes the value of those water streams, from raw to in-process to wastewater, and incentivizes creative approaches to reuse and recycling, both on-site and off-site. Water circularity seeks to drive net reduction in freshwater demand (or usage) by examining cascaded [water] use with water-chain partners. The ultimate goal is to ensure greater availability of freshwater to the environment, and to the regional and local water supply (see Appendices A-E).

Why is Water Circularity Important

Water is a shared resource that impacts companies across the globe, as well as the communities where they operate, market, and sell their products and services. Businesses are looking with greater scrutiny at water use in their direct operations as well as across their often-complex value chains. There is a growing recognition of the gap between water supply and demand, and the lack of water valuation (“true cost of water”) in corporate decision-making. Businesses are bringing focus on the need for watershed-level approaches, combining water valuation with water catchment planning and interventions. Numerous publications have emerged as water circularity continues to drive collective action across industries, communities, and governments. BIER’s publication of the “Context-Based Decision Guide for Water Reuse and Recycling” addresses the importance of transitioning beyond simple water reduction to incorporate broader adaptations for water reuse, reclamation, and recycling (both on and off-site); this guide expands on that foundation. Informed decisions based on localized context (watershed properties, infrastructure demands, and governance) around a facility drive changes in water “investment” strategies through partnership and communication.

There is a growing understanding of the complexity around sustainable water resource management that successful water circularity does not just encompass change at one facility or within one business, but rather collaborating with other water users within the watershed. For example, the 2030 Water Resources Group (WRG) aims to help drive systemic change and advance leadership of institutions across the world are framed on three pillars: transforming value chains, promoting circular economies, and building resilience. The group has delivered several outcomes including a new regulation on the reuse of non-potable urban water in São Paolo, a groundwater dashboard in Mongolia for policy and decision making, guidelines for polluter pays principles for industrial wastewater in Kenya, and a cap and trade policy around wastewater reuse certificates (WRCs).

More recently, the World Business Council for Sustainable Development's (WBCSD) publication in 2021, "Water Circularity Metric: Tool Application and Guidance Note," outlines steps businesses can take to adopt a common metric for water circularity. The intention of creating and adopting this metric is to identify where water circularity efforts can be improved, specifically in terms of "closing the loop" (effectiveness) and "optimizing the loop" (efficiency).

While water circularity is gaining popularity across the world, it is challenging to plan and develop targets when the process and accompanying metrics are still evolving. WBCSD's Circular Transition Indicators (CTI) framework addresses this metric gap and provides resources for companies to better understand water circularity while also providing insights about their business throughout the process. WBCSD recommends that companies begin exploring their circularity performance with a self-assessment. It focuses predominantly on how mass (for example, water) flows through a business which can be used to determine how efficiently the company performs. The insights can then be compared or integrated with existing sustainability frameworks that encompass a business's larger sustainability impact (e.g., greenhouse gas emissions, biodiversity, human capital, etc.).

On-Site vs. Off-Site

As established by BIER's Context-Based Decision Guide for Water Reuse and Recycling, there are two primary operational differences between on-site and off-site water circularity initiatives, as defined by BIER below.

- **Water Recycling (On-site):** Water that requires additional treatment and reconditioning to use more than once within facility processes and/or on-property, instead of or prior to discharging as industrial effluent to a receiving body, the environment, or a third-party wastewater treatment provider. This is the fraction of water that is diverted from the traditional waste stream to become utilized water within another process in the facility based on its current and/or potential future quality.
- **Water Recycling (Off-site):** Water that requires additional treatment and reconditioning for beneficial use off-property by the company or a third-party as an alternative to discharging as industrial effluent to a receiving body, the environment, or a third-party wastewater treatment provider. This is the fraction of water that is diverted from the traditional waste stream to an alternative use case, based on the current and/or potential future quality of the water leaving the facility.

Table 1 - Select Examples of On-site and Off-site Water Circularity Solutions

On-Site Water Recycling & Reuse (Circularity)	Off-Site Water Recycling & Reuse (Circularity)
Landscape Irrigation	Agricultural Irrigation
Cleaning/Sanitation	Green Infrastructure
Cooling Towers	Neighboring Industry
Boiler Feed	Aquifer/Surface/Groundwater Recharge
Firefighting	Recreation
Vehicle/Crate/Pallet Washing	Environmental Remediation

There are many opportunities that a company could adopt to begin practicing water circularity. As mentioned previously, the circular economy perspective is changing the perception and value of wastewater. Most business materiality and risk assessments underestimate wastewater pollution and relegate the responsibility of these risks to external stakeholders (e.g., downstream changes). This often means that innovative collaborations are necessary to drive impactful change, specifically in reducing impacts of wastewater pollution downstream of operations and throughout value chains. Recycling and reusing wastewater presents an affordable and sustainable source of water, energy, and nutrients. Although implementing such systems and operations may be costly at the outset the return on investment can be realized through tangible benefits to the business, communities, as well as benefits to human health, economic development, and environmental protection.

Current State Summary

Introduction

Typically, water-related pressures are considered local-level issues, as there are no two locations in the world that have the exact combination and intensity of water risks.

Although water risks can be addressed at a local level, increasing water scarcity, flooding, pollution, and demand can affect all levels in society at varying intensities, as well as exacerbating a myriad of impacts on people, businesses, and nature. This wider area of impact necessitates wider involvement in solutions, including enabling and implanting circularity projects. For example, the UN indicates that by cities more efficiently using water and safely reusing wastewater, there will be less strain on the surrounding ecosystems. Since water is such a universal need, changing the availability of high-quality water requires coordination between the efforts of government, business, the scientific community, and local buy in and support. Outlined in the following sections are some of the circularity-related initiatives enacted or proposed at the national and global levels by legislative bodies, intergovernmental organizations, and non-government organizations. These initiatives are another indicator of circularities powerful role in helping solve our water challenges.

Public Sector

From the community level to the world stage, water conservation, protection, and quality management are governed across a wide spectrum of regulation. Just as demands on every watershed are unique, so too are the approaches taken to form regulatory frameworks.

- **Europe:** In 2020, the European Union (EU) adopted Regulation EU 2020/741 to take effect in June of 2023. This regulation defines minimum requirements for reclaimed water at the EU level, specifically covering urban wastewater in a reclamation plant for safe agricultural use. The aim is to combat increased agricultural and urban development demand and resultant drawdown on the groundwater supply at the regional level. There are several EU-funded projects currently underway, as part of Horizon 2020, investigating the circular economy and the role that wastewater can play in the sourcing of “new” water, energy, and raw materials. The AquaSPICE project, which received funding through Horizon 2020 and is expected to conclude in 2024, is an innovative program aiming to establish circular water use in European process industries.

- **United States:** The United States (US) Environmental Protection Agency (EPA) outlines the practice of wastewater reuse as "fit for purpose," defined as the necessary minimum amount of treatment required on a parcel of water to raise the quality to ensure public health, environmental protection or specific use needs. Some of the proposed reuse pathways from the EPA's perspective include agricultural irrigation, landscaping, municipal water supply, process water, indoor uses such as toilet flushing, dust control, construction processes, recharging or refreshing artificial lakes and aquifers, and environmental restoration. The US EPA has guidance on a range of reclaimed water sources including, but not limited to stormwater reuse, municipal wastewater, industrial processes, and agricultural runoff.

  Some states have expanded on the EPA's guidance and enacted specific wastewater reuse programs. The Village of Cloudcroft PURe Water Project in New Mexico is one of the EPA-aligned indirect and direct potable reuse programs. The project augments the municipal water supply using advanced treated wastewater. Other potable reuse programs involve the Chattahoochee River and Lake Lanier, the Colorado River municipal water district raw water production facility, the Wichita Falls River Road Wastewater Treatment Plant (WWTP), and the uniform water recycling criteria being developed in California. Los Angeles Municipal Water Authority has been recycling wastewater for decades, and is poised, pending upcoming legislation, to institute a program for direct-use potable water. Additionally, there are non-potable reuse programs. The Washington Department of Health is considering adopting standards for on-site non-potable water reuse of wastewater from domestic fixtures, graywater, rainwater, stormwater, foundation drainage and air conditioning (AC) condensate. Furthermore, New Mexico is drafting regulations to handle some food processing wastewater in addition to wastewater from sewer sheds. Many local municipalities offer education and resources for communities to capture rainwater for reuse as irrigating water.

- **Asia:** Singapore is investing in technology to treat, recycle and supply water to domestic and non-domestic constituents. Water use in Singapore is expected to nearly double in the next 40 years and as a result, the small country needs to become completely water independent. Additionally, the World Resources Institute (WRI) states that Singapore ranks fifth among the top 33 countries likely to face extremely high-water stress by 2040. The country has a Four National Taps program designed to integrate water management regulation, structure, and culture. The program describes the four national taps as water from local catchment, imported water, high-grade reclaimed water known as NEWater, and desalinated water. The NEWater process currently has 5 plants in operation that treat used water into reclaimed water. NEWater is mainly used for industrial and cooling purposes at water plants, industrial facilities, and commercial businesses. However, during periods of drought, NEWater is blended with raw surface water before being treated at the WWTPs. Recycled wastewater can now meet 40% of Singapore's water demand, a figure that is expected to rise to 55% by 2060, according to the country's water agency.

Non-Governmental and Intergovernmental Organizations

Governments implement regulatory changes that can protect the water resources under their purview, but sustained solutions to complex global challenges can only come from multi-stakeholder collaborations. It is essential to recognize the other key players integral to progress, and these include non-governmental organizations (NGOs), intergovernmental organizations, academic institutions, and the private sector. Together these organizations can drive momentous programs that effect positive change at the watershed level.

- **The UN Sustainable Development Goals (SDGs):** The UN is an international organization, is neither a State nor a government, and includes 193 Member States. The UN developed 17 Sustainable Development Goals (SDGs) to help guide society towards the achievement of these goals, which were adopted by world leaders in September 2015 at the UN Summit. The SDGs are a call to action to not only protect the planet but also aim to improve the lives of

everyone, everywhere. While many of the SDGs are interconnected, SDG 6 ensures clean water and sanitation for all. It measures the success of this goal by 8 targets and 11 indicators. In service of these water goals, the United Nations has published the World Water Development Report annually. Most recently the 2022 volume addressed groundwater; however, in a previous volume (2017) wastewater management was showcased. The document outlines the technical aspects of wastewater management including the prevention or reduction of pollution at the source, proper wastewater collection and disposal, the use of wastewater as an alternate source of water, and the recovery of useful by-products. These challenges can be found in agricultural irrigation, potable reuse such as recreation or aquifer recharge, landscaping irrigation, environmental remediation, and industrial uptake or reuse.

- **UN Global Compact CEO Water Mandate:** The CEO Water Mandate, a coalition of stakeholders including business leaders, governments, civil society organizations, and the UN. The mission is to address global water challenges through aligned common principles of corporate water stewardship. Endorsing companies commit to action through six key elements: direct operations, supply chain and watershed management, collective action, public policy, community engagement, and transparency. In 2017, the CEO Water Mandate published "Exploring the Case for Corporate Context-Based Water Targets." The paper is a guidance for companies seeking to employ meaningful water metrics and targets. It establishes how to set water targets based on catchment-level challenges and priorities and how the targets should contribute to public sector priorities while reducing overall water risk.

  The UN Global Compact and CEO Water Mandate created the Water Action HUB (updated in 2022 to include more functionality) to connect stewardship and circularity efforts around the world. The HUB is a global online collaboration and knowledge sharing platform which maps and helps connect water and climate related projects. This interface permits users to filter projects by country, region, type of project, SDG targets addressed, project status, and the types of organizations involved.

- **Beverage Industry Environmental Roundtable (BIER):** BIER published its "Context-Based Decision Guide for Water Reuse and Recycling" document with the aim to help companies develop a water strategy that goes beyond simple reduction. The document was a response to internal business drivers and external pressures related to the challenges associated with water risks: quality, quantity, and utilization. The report outlines the basic strategy for evaluating water challenges, identifying potential reuse pathways, and calculating the true cost of water for operations.

- **Global Reporting Initiative (GRI):** The Global Reporting Initiative (GRI) is an international independent standards organization that helps businesses, governments, and other organizations understand and communicate their impacts on issues such as climate change, human rights, and corruption. The GRI Standard 303 for Water and Effluents provides guidance on what metrics and topics companies should report on regarding wastewater. It also includes information on water interactions as a shared resource and how to manage discharge-related impacts.

- **CDP (formerly Carbon Disclosure Project):** CDP is an international non-profit organization that helps investors, companies, and governments disclose and manage their environmental impacts. Their areas of focus include climate, water, and forests. CDP aims to address water security by motivating companies to disclose and reduce their environmental impacts. In the 2019 CDP Global Water Report, only 10% of companies surveyed reported risks linked to water pollution. A year later CDP reports that only 4.4% of companies are reporting progress on their water goals, i.e., greater than 10% of target. While circularity is not directly referenced in the current questionnaire, CDP scores companies on their water-related initiatives that have substantial financial or strategic impact on their business.

Industry

Many companies have been on a path to being better water stewards for many years. The Charco Bendito project, a 2020 restoration of 21.5 hectares of land in the Jalisco region of Mexico by BIER members showcased how collaboration, stakeholder engagement, and on-the-ground- water stewardship projects can have tangible benefits to the watershed and the community. Circularity expands on water stewardship by creating connected solutions aimed at reducing freshwater withdrawals, improving the quality and quantity of available drinking water, and improving ecosystem health and resiliency. Some practices from the private sector have been used to inform public policy, leveraging their applied experience with methodology for conserving resources, specifically water. Most facilities in the food and beverage industry have adopted water reduction, water efficiency and/or water circularity programs. Some have responsible standards for effluent that go beyond legal requirements for discharge to the environment. External stakeholder engagement and public support often limit effluent recycling to non-product or municipal reuse scenarios (for example, landscape irrigation, sanitation). Current targets for several companies in the food and beverage sector often include some form of "net positive balance," returning a larger quantity of freshwater to the environment for beneficial community use than is consumed by the company operations.

- **ABInBev:** ABInBev, often described as the world's largest brewer, has set a goal to ensure 100% of facilities and breweries are engaged in water efficiency efforts and ensure 100% of facilities in water stressed areas are implementing programs to improve water availability and quality by 2025.

  ABInBev currently has established water conservation efforts at all 12 of their flagship US breweries, which has resulted in a 23% reduction in water usage since 2012. In Houston, Texas alone, 100 million gallons of water are reclaimed annually, resulting in a 10% reduction in reliance on municipal water. The savings are a direct result of the partnership forged with Cambrian, a commercial distributor of wastewater treatment and recovery solutions, as part of the Water Energy Purchase Agreement (WEPA). Cambrian's proprietary solutions and technologies are designed to deliver improved wastewater management at reduced energy costs (i.e., lower emissions). The partnership reinforces the significance of the nexus between the financial and environmental ecosystems.

- **Aquapolo:** Aquapolo Ambiental is the largest water reuse project in Latin America, supplying 100% recycled industrial water to four Braskem petrochemical plants in São Paulo, Brazil. The project's successful collaboration resulted in the avoidance of more than 50 million USD (Us Dollars) of potential loss during the water crisis of 2014-15 in the region. The project generated cost reduction in equipment maintenance, reduced water use, and provided social and environmental co-benefits. Braskem is leading a "call to action" to encourage more companies to develop or join similar projects. The long-term (41 year) commitment by the two companies to purchase and reuse municipal wastewater is a defining factor to the success of the project.

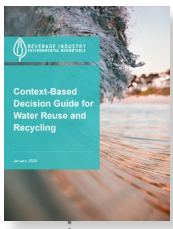
- **BioMakeries:** In an effort to help cities transition from a linear to a regenerative circular model, a decentralized network of BioMakeries (urban metabolic hubs) powered by Biopolus Metabolic Network Reactor (MNR) technology, is being used to harness clean water, nutrients and minerals from wastewater and organic waste. These units are modular, and able to be integrated into any urban environment. At the heart of Biopolus is the MNR, a high-tech living system of integrated biomass and a water transport network housing a diverse array of microbial species designed to process wastewater and supply continuous access to cleaner water.

The first operational BioMakery was deployed in 2018 at the La Trappe brewery in the Netherlands. The brewery's industrial wastewater is treated to a high quality, and reused for irrigation and local aquifer recharge, with plans to develop additional on-site uses such as bottle rinsing.

- **Swinkels:** Interest in Europe exists around moving from linear to circular economy. Around a decade ago, Project Beer Water was initiated. The project's focus has been on soil, groundwater, and healthy ecosystems to maintain vitality long term by using processed water from breweries to distribute to farmers for irrigation in subirrigation systems. Achieving this required the implementation of a combination of circular methodologies: procurement, production, and high-quality reuse. To measure performance, Swinkels established a Key Performance Indicator (KPI; the Swinkels Circularity Index – SCI) specifically around circularity. As part of efforts to ensure quality, Swinkels measured discharge levels of nutrients and salts to ensure ecosystem health. The process to implement an off-site circularity solution began with a shared interest between breweries and farmers – water. Starting small with a few farmers allowed Swinkels to build trust in the community. Farmer support was ensured by the brewery carrying upfront costs instead of distributing them to the farmers. Building relationships with local government was crucial to long-term community commitment and project success. Swinkels partnered with KWR for data collection and created a cross-functional team, to promote collaboration between company, farmers, bank, water board, and the government.

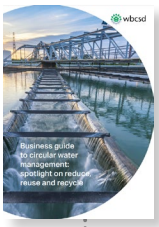
2. IEA, World Energy Balances, 2020. https://www.iea.org/data-and-statistics/charts/world-total-energy-supply-by-source-1971-2018

Process & Framework



Context-Based Decision Guide for Water Reuse and Recycling

Published by Beverage Industry Environmental Roundtable (BIER)



Business Guide to Circular Water Management: Spotlight on Reduce, Reuse and Recycle

Published by World Business Council for Sustainable Development (WBCSD)

Getting in Step: Engaging Stakeholders in Your Watershed

Published by Environmental Protection Agency (EPA)

From Dialogue to Action the Road to 2030: Annual Report 2021

Published by 2030 Water Resources Group (WRG)

Guide to Water Related Collective Action

Published by CEO Water Mandate

Circular Decision Making

Overview: The BRAID Work Stream

Much like a braided river, a network of river channels weaving across the landscape, resulting from fluctuations in the balance of sediment, water, and other physical features, the *BRAID Work Stream* is a dynamic process that evolves over the lifetime of the project, creating a comprehensive, watershed level solution that is multidimensional in approach. The approach outlined below focuses on building strong, inclusive partnerships, continuous and effective communications, and innovative solutions to guide businesses on their circularity journeys. These pillars have proven essential for successful water stewardship and circularity initiatives, but especially so when considering circularity because of its complexity and high dependence on end users. The *BRAID Work Stream* approach focuses on merging independent work streams to promote a thoughtful, and well-organized program, involving the following components:

B **Benchmarking:** monitoring and measuring baseline watershed conditions helps develop the necessary context to make thoughtful stewardship decisions. Understanding water use needs, use-discharge dynamics is important for establishing partnerships, creating performance metrics, and accountability. Further, that context extends to other businesses and entities working in the basin.

R **Relationships:** partnerships are necessary to create successful, long-term circularity solutions. Having partners allows a business to spread risk, reduce its financial burden, increase accountability and expertise, address project adversity, and (potentially) broaden scope. Partnerships should also include community engagement; solutions that are community-centric help to build trust.

A **Accountability:** businesses must be open and honest in communications, reporting on: implementation progress; quality control initiatives and results; and operational successes and challenges. Circularity is about building trust, facilitated by communication with stakeholders early and often, devoting resources and committing to transparency.

I **Intertwined:** the process of connecting with stakeholders, reporting results, deploying solutions, and ensuring quality and safety standards should not be standalone or one-time events, delivered in isolation. Instead, communication and outreach efforts should happen throughout the process and be tailored to different groups' needs, overlapping with the various technical solutions, from the ideation stage to beyond implementation.

D **Dynamic:** circularity solutions must evolve in many ways, as communities mature and prosper, reuse opportunities will present themselves, remaining adaptable ensures long-term, sustainability. Likewise, as populations change, so too does the messaging (and how it is delivered).

Public perception is a significant barrier to widespread adoption of water circularity solutions. Meeting the UN Sustainable Development Goals (SDGs) by implementing off-site circularity solutions and generating trusted, long-lasting community support requires a comprehensive approach, which includes accelerating approaches to Collective Action and Integrated Water Resource Management (IWRM). The robust, comprehensive, and integrated nature of the *BRAID Work Stream* approach can help educate and build public confidence in the benefits of circular water reuse activities.

Pre-Implementation

Contextualizing the Facility Within the Watershed

Taking a Step Outside Your Facility

Water use reduction has been an operational target of many companies across sectors for years. This approach is intuitive, since in-plant water use streams are normally under direct control of the operators, and in many ways represent the most straightforward opportunities for water efficiency improvement. Various technological advances (type and cost of technology) or process improvements have enabled companies to dramatically reduce their dependence on freshwater abstraction. However, when the facility is considered in the context of the greater shared watershed, additional parameters (e.g., related to effluent discharge) and other important environmental, social, and reputational factors must be considered[5]. Moving towards a circular model, whereby discharged "waste" more intentionally reenters the value stream, requires a greater understanding of how the facility interacts with the environment, its neighbors, and the greater community within the watershed. Considerable effort should be placed on understanding the impact the facility has within the watershed. Identifying all the users and activities within a given basin will inform a dialogue on how wastewater might collaboratively be repurposed (by other users within the same or different sectors). Similarly, to how the Water Circularity Metric tool (outlined below) aided companies to identify circularity opportunities within the four walls, framing your facility's water usage in comparison to the needs of the basin will aid in contextualizing solutions.

Identify Fresh and Recycled Water Opportunities & Synergies

Site-Level Water Circularity Considerations

1. Define water quantity and quality required for use (facility demand)

2. Define water quantity and quality of source water (current and alternatives)

3. Define water quantity and quality of water post-use (pre-treatment discharge)

4. Define water quantity and quality required for use and discharge (current and alternatives)

Based on WBCSD's Water Circularity Metric (WCM) tool

5. The Beverage Industry Environmental Roundtable (2017) Performance in Watershed Context.

The Water Circularity Metric (WCM) tool, a collaborative effort between BIER and WBCSD, relied on four key steps when assessing site-level circularity:

1. Define water quantity and quality requirements for the facility
2. Define quantity and quality of source water
3. Define quantity and quality of water post-use
4. Define quantity and quality of water for use or discharge

When mapping site-level considerations, these principles help extend circularity efforts beyond the facility and into the basin by increasing the visibility of circularity opportunities and the opportunities to work with others on circularity initiatives. Adding partner facilities, taking advantage of alternate end-use situations, and increasing the scope for sourcing water will help in identifying intake-effluent synergies and cost-sharing amongst water users within a basin[6].

Implementation

Identify Key Stakeholders

The need to move beyond water use reduction has been identified by BIER (Context-Based Decision Guide for Water Reuse and Recycling), UN Global Compact's CEO Water Mandate (Guide to Water-Related Collective Action), and others as the next step in water security. As water efficiency programs mature and technologies evolve, the benefits from the proverbial "low-hanging fruit" become exhausted, and companies look beyond their four walls toward more basin scale stewardship initiatives. Making water stewardship a priority for the basin requires external partnerships, in both the public and private sectors, and across multiple usage types (industrial, agricultural, public works, etc.).

According to the US EPA, the "most effective plans contain a comprehensive analysis of existing conditions and ecological, social, economic, cultural, and political issues." Coordinating potentially disparate interests requires a lot of energy and information gathering, asking many thoughtful questions, and being an active listener. The focus of any project involving recycled water outside of the facility should revolve around candid and frequent communication, shared goals and objectives, clear roles, and cooperation toward collective impact. An additional summary of the EPA guide for stakeholder engagement within the watershed can be found in **Appendix F**.

Forging Partnerships

Moving the Needle Internally: Connecting Executive Support & Frontline Implementation

A study published by Bain & Company in 2016 discusses the corporate imperative for implementing meaningful change on sustainability topics. Oftentimes, there is a disconnect between the ideals championed at the executive level and their implementation on the ground. Generating facility-level support for sustainability initiatives requires:

- Top-down leadership support or directives
- Investments and resources
- Incentivizing change; and
- Tying sustainability efforts to KPIs

Since circularity is driven by end-users, advancing circularity initiatives can become bottlenecked if management of stakeholder engagement is not prioritized; it is easier to identify opportunities than it is to implement them. Generating internal support is often the first perception hurdle to be cleared. If the project cannot gain facility-level buy-in, the project will never succeed. As with many elements of change, starting small and championing every win is critical to increasing prioritization of sustainability efforts; elevating these efforts from a "nice to have" into essential territory. With sustained efforts from executive level management, organizational buy-in can become culture, embedded in the day-to-day activities.

Top 3 Barriers to a Successful Sustainability Program
Lack of investment or resources
Competing priorities
Cultural change challenges

Top 3 Factors to a Successful Sustainability Program
Senior leadership support
Employee engagement
Clear goals & metrics

From Bain & Company 2016.

Creating Ground Swell: Communications Customized for Diverse Audiences

Identifying these project support hurdles, i.e., safety, inherent distaste for, etc., is one step in the process of turning opinion in favor of the reuse of wastewater as a value-adding commodity within the watershed. Considerable effort needs to be made to reach every stakeholder, where they have concerns. Efforts include, but are not limited to:

Internal	Internal & External	External
Workplace training	Pamphlet distribution	Community outreach events, including purely social events
Board & senior executives engagement	Billboards & advertisements	Facility tours
		Winning over community leaders

Community (bottom-up) support increases the success of regulatory programs (top-down), enhancing the impact and value of water reuse programs.

Understanding all potential stakeholders in a watershed requires thorough research, candid dialogue, and collaboration with community, municipal, and state leaders. The objective is to understand different stakeholders' attitudes and concerns towards water and water issues within a basin or catchment. In fact, this authentic engagement of community stakeholders, particularly affected parties, is a key component of a company's obligation to respect the UN Human Right to Water. It is imperative to get a sense for how these communities use water. At the heart of this issue is trust. According to the 2022 Edelman Trust Barometer, people want more business leadership, not less – business' societal role is here to stay. To build trust, you should bring communities into conversations early in the process, to demonstrate how deeply you are committed to and rely on the highest quality of water possible. Partnering with local leadership (both formal and informal) will help in understanding where a community gets information from and what format they will find most trustworthy. Messaging should be tailored to speak to community values, which will help to motivate the communities to further adopt circularity measures.

Identify Hurdles

Perception Hurdles

Effectively managing public perception of wastewater reuse programs and initiatives is among the key determinants for a successful initiative and a failed one. In fact, negative perception can lead to the avoidance and even public outcry of a well-developed project, irrespective of how technologically advanced or scientifically sound it might be. The onus is on the implementer to rollout a robust, comprehensive, and long-term outreach program designed to rally support, creating a community of ownership for these recycled water efforts. Just as context is critical to water recycling and reuse efforts, so too is the social context unique to each watershed. Creating community-level support requires a multidimensional communication approach, marketing, and a comprehensive outreach campaign (for more details on stakeholder data gathering refer to **Appendix F**). The inherent distaste for, or the subconscious bias surrounding wastewater reuse, transcends race, age, sex, ethnic origin, socio-economic status, religious belief, and educational background. As very few social echelons exist where the idea of reintroducing wastewater into the community's freshwater network does not trigger a biased response, educational efforts will need to be tailored for diverse audiences to bridge divides.

One of the first efforts should be to rebrand wastewater. Moving away from the narrative of water as a waste product and into value-based terms, like NEWater (Singapore) or as a resource (SUWANU EU). Assuaging concerns over health and safety will be a throughline from project ideation until long after the project has been implemented. Effective messaging should therefore emphasize the ultimate goals of the reuse project rather than the source water. However, full transparency is still required to promote trust and ensure continued support through successive project stages.

Perceived risks and therefore costs (energy, education, and treatment level) increase the closer to the consumer (especially children) recycled water use gets.

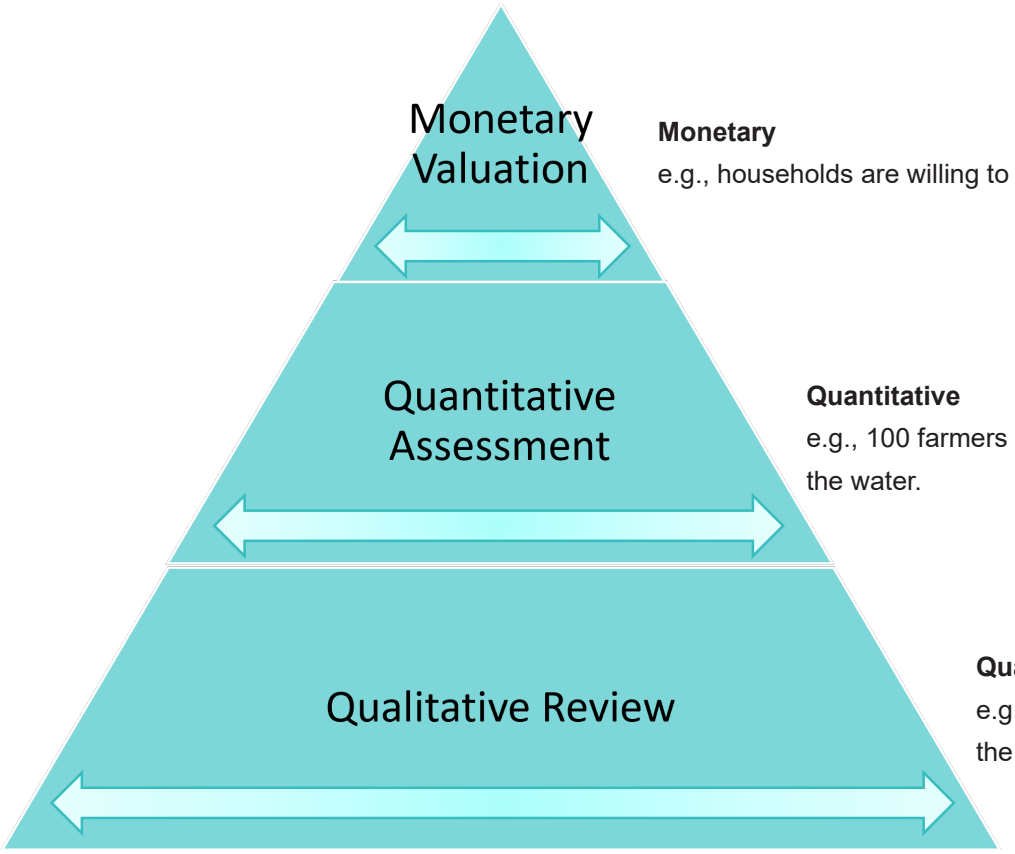
Confidence in the regulatory process, the regulators, and the testing process are often cited as barriers to public acceptance of wastewater recycling programs. Making public water utilities an important ally in water circularity efforts is critical for long-term success of any of these programs. Companies should establish trusted partnerships early on with municipalities and others and help strengthen public confidence in municipal supplies. Combating the fear factor and mistrust requires educational materials aimed at cutting down this bias. Garnering support from the local leaders, whether a trusted farmer or municipal official, will go further than educational materials alone in changing opinions. Every effort should be made to demonstrate full transparency on testing methods, safety studies, and fair reuse policies. Other efforts to generate public support for water recycling efforts include tours of treatment facilities, on-site reuse strategies actively being employed, and exhibits of success stories from other communities around the world.

Quality and safety requirements continue to evolve as testing standards and instrument sensitivity continue to push the edge of detection limits. Combining high resolution experimental studies with advances in our understanding of human health concerns has demonstrated the need to continuously test, and report on the quality of repurposed wastewater. Collectively described as Contaminants of Emerging Concern (CEC), this ever-growing ensemble of malefactors, whether as a sole aggravator, several working in concert, or the cumulative effects of contaminants in the watershed and greater ecosystem, is an area of great concern for stakeholders across a watershed. It is critically important that the health-based establishment of acceptable contaminant limits (by WHO and most national governments) continue to be supported and explained to the general populace, over time.

Identify Risks

As water demand continues to exceed water supply, water costs will undoubtedly increase. The publication from WBCSD, the Business Guide to Water Valuation, provides businesses guidance on water valuation, aiming to educate companies on the main assessment concepts and techniques, and how water value, cost, and price are related, but not synonymous. Water valuation is defined by the Guide as "assessing the worth of water to different stakeholders under a set of specific circumstances". Water values can be environmental, social, or economic in nature. The Guide utilizes 25 business-related valuation cases from 10 different sectors that exemplify how valuing water can help businesses meet their goals.

Figure 1 - Hierarchy of Valuation Approaches (from WBCSD "Business Guide to Water Valuation")



The Guide states that the valuation process should always begin with a qualitative valuation. This could mean a business only describes water value to their operations, or it could utilize a scale of value such as high, medium, and low ratings. After a qualitative review, a quantitative assessment should be performed, which quantifies the physical units or indicators associated with the values. Then, the final step is to execute a monetary valuation, where monetary values are determined.

In 2015, BIER published the True Cost of Water Toolkit 2.0 with the aim to estimate the true cost of water at defined "pinch points" within a typical beverage facility. It also details four cost categories: yield loss, electrical energy input, thermal energy input, and chemical inputs, and includes worksheets with automatic calculations for 11 pinch points based on user data. Once the value of water has been assessed, a business can begin to best determine and evaluate the associated water risks within their operations.

Implementation: Pragmatic Guidance from Practitioners

Off-site circularity solutions require pairing effluent with a recycled water user. Currently there are a variety of treatment solutions designed to bring water to the desired fit-for-use case. However, water-saving initiatives can extend to supporting ecosystem health and restoration or promoting initiatives in neighboring or partner industries.

"There is no 'one size fits all' approach"

Many communities are supported by companies that are improving water quality and access to clean drinking water by planting trees to reduce runoff and/or storing water in natural or built aquifers. Others have implemented water quality projects, which include community water purification plants, rainwater harvesting, wetland restoration, and desilting dams.

Support from the agricultural industry can be garnered through infrastructure partnerships (see **Appendix B - Swinkels**). Considering that reduction (or efficiency) is the first step in the water conservation continuum, the agricultural industry, as the biggest global abstractor of freshwater (~70%), has an opportunity to improve efficiency and thus reduce freshwater abstractions. Investments in agricultural irrigation technologies not only provide valuable gains in efficiency (e.g., ditches, weirs, irrigation piping), but also engenders community leaders. Recent studies on safety and increased yield point towards the growing potential for the marketability of crops irrigated with recycled water (see **Appendix C - SUWANU EU**).

From the interviews conducted with BIER members and an in-depth literature review, the following list of advice has been compiled for overcoming the perception hurdles identified above.

Do	Don't
Identify potential stakeholders and develop relationships before fully initiating projects	Begin the project without watershed partners
Identify potential regulatory and quality restrictions early on	Ignore health and environmental concerns
Establish funding for the project before making any large-scale decisions	Dismiss psychological barriers
Find compatible partners (quality, industry type, etc.)	Forget to consider the technical, managerial, and financial viability of reuse schemes
Obtain community engagement to ensure a successful and favorably viewed project	Ignore knowledge gaps regarding contaminants, future contaminants, mixtures, and emerging science
Establish local context by maximizing local relationships to help realize potential	

Post-Implementation & Sustained Effort

Continuous Support

Post implementation can be just as critical as the initial stakeholder engagement. Continued monitoring of quality will ensure lasting trust. Maintaining clear channels of communication will ensure key stakeholders remain engaged, and the context of how the off-site circularity solution fits into watershed-level stewardship remains understood. It is through sustained partnership that strong communities and trust grows. Throughout the *BRAID Work Stream* process there is need to: ensure that established partnerships and solutions evolve with the changing regulatory landscape; continue to meet quality standards; and address any new perception hurdles.

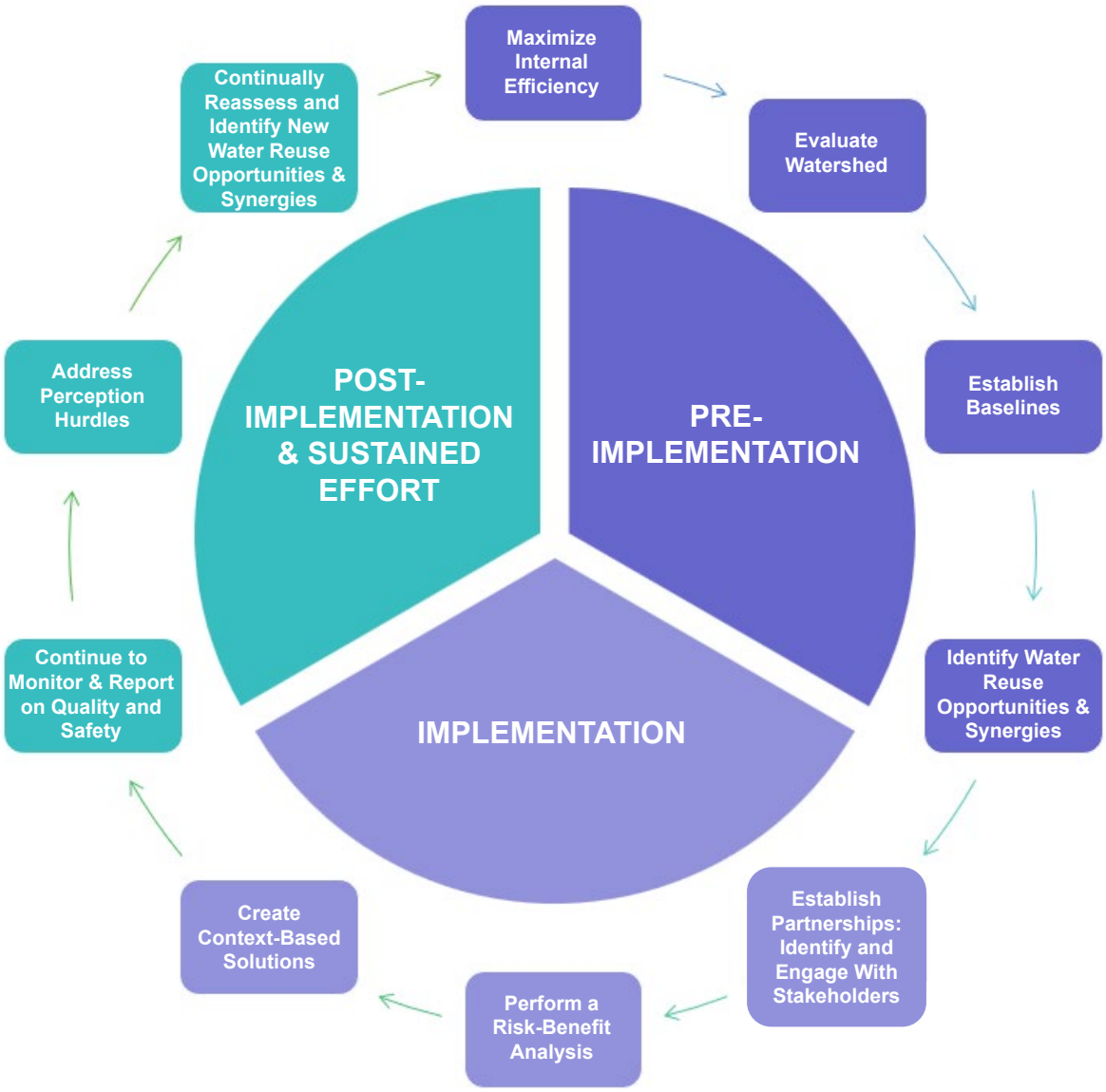
Metrics on project performance and community impacts must be communicated over the lifetime of the circularity initiative partnership. Considering population turnover, it is important to maintain reporting of the following key metrics:

- Active partnerships
- Process efficiency
- Soil health characteristics
- Return on investment
- Process Maintenance and energy costs
- {Water, nutrient, energy...) savings to date
- Crop yields
- Infrastructure improvements
- Educational resources, opportunities, and initiatives
- Stakeholder feedback
- Water stress and pollution status

In general, context will govern what is reported, at what frequency, and to what level of detail to satisfy the needs of the community and stakeholders impacted by the project. Much of these context-based characteristics measured and communicated will be identified very early in the process, but it's imperative to remain sensitive to changing values, regulations, and new partnerships to ensure maximizing the value proposition of the circularity initiative.

Considerations for Circularity Solutions

Taking on a circular solution is a complex endeavor. As this guide has demonstrated, there are a myriad of factors to consider, from making the business case, to handling community relations, to navigating the regulatory landscape. The following framework should be used as high-level guidance. Part flow diagram and part checklist, this framework is a collection of activities to help shape circularity efforts at the basin level.



Pre-Implementation

- Begin with on-site recycling initiatives first, however, consider watershed implications for your discharge at this time.
- Monitor and measure discharge to establish key performance indicators (KPIs).
- Understand the baseline conditions of the watershed and the business's contribution to watershed health.
- Understand total water usage in the watershed.
- Identify wastewater reuse opportunities and synergies.

Implementation

- Establish partnerships with relevant stakeholders, local connections are imperative.
- Conduct risk assessments: environmental, health & safety, reputational
- Deploy unique, context-based circularity solution(s).
- Monitor system for quality assurance purposes.

Post-Implementation & Sustained Effort:

- Continue to monitor and report on quality & safety to maintain transparency and trust.
- Establish independent verification of quality controls to continue to build trust in circular solution.
- Assess progress made on circularity solutions.
- Address perception hurdles through outreach, education, and transparent
- communication.
- Identify new reuse opportunities and synergies.

Further Reading & End Note

For more detail on Water Circularity initiatives please see **Appendix G** for a full list of references. The following compiled list of resources, organizations, and companion literature should serve as a strong foundation for your circularity journey:

- Beverage Industry Environmental Roundtable (BIER) Context-Based Decision Guide for Water Reuse and Recycling. January 2020.
- World Business Council for Sustainable Development (WBCSD) Business guide to circular water management: spotlight on reduce, reuse and recycle. June 2017.
- United Nations Global Compact Water Action Hub.
- NextGen Water and Circular Economy: A White Paper. October 2018.

End Note

In an era where distrust is society's reflexive position, it is incumbent upon businesses to be the leaders of change.[7] Throughout this document, we have stressed the urgency around forging partnerships and communication (early and often) when embarking on circularity solutions, especially opportunities off-site. It's hard to overstate the importance of both in the process of establishing circularity measures. Establishing partnership has emerged as the defining concept of sustainable development[8]. Having vision-aligned partners and engaged stakeholders, each with well-defined roles, leads to trust and the overall success of the project[9]. The cornerstone to every successful partnership is communication. Expanding context-based decisions to include local perspectives and needs, as wells as how these aspects change over the life of a project is instrumental in creating a shared language around, shared ownership of, and a deep commitment to circular solutions.

7. Edelman Trust Barometer (2022). Global Report.
8. Stibbe, D.T., Reid, S., Gilbert J.; The Partnering Initiative and UN DESA (2019). Maximising the Impact of Partnerships for the SDGs.
9. GlobeScan and Unilever (2018). Partnerships for Progress.

Appendix A:

Lessons Learned from Singapore

Singapore's holistic approach to water management strategies includes collecting every drop, reusing water endlessly, and desalinating water. These sustainable strategies have led to an effective, integrated, and cost-efficient way to meet the growing water demand in a city-state that lacks an independent, natural source of freshwater. PUB, Singapore's national water agency, has built a diversified supply of water known as the "Four National Taps" that supplies the city-state with drinking water. This supply includes water from local catchment areas, imported water from the Johor River, desalinated water, and NEWater – Singapore's brand of high-grade reclaimed water.

NEWater was introduced in 2002 and marks a major step in the water sustainability journey for Singapore. NEWater plants treat secondary effluent from sewage treatment plants into high-grade reclaimed water that surpasses World Health Organization (WHO) and Singapore drinking water standards. Nearly 40% of Singapore's water demand is met by five NEWater plants which produce 285 million cubic meters of fresh water annually. Water from these plants is mainly utilized for industrial processes and distribution into drinking water reservoirs. Future plans aim for a 15% increase in NEWater contributions by 2060, which could meet up to 55% of Singapore's total water demand. The implementation of NEWater has helped transform Singapore into a global hydro hub and a model city for pioneering integrated water management.

Process: Singapore's NEWater plants convert effluent from wastewater treatment plants into high-grade reclaimed water through advanced membrane microfiltration technology, two-stage reverse osmosis, ultraviolet disinfection, and other treatment processes. A newly developed pump-free deep tunnel sewerage system conveys wastewater from all around Singapore to water reclamation facilities where it is treated and further purified into NEWater. This system allows almost every drop of water to be collected and reused. Water produced in NEWater plants is either distributed to reservoirs for indirect potable use or supplied to industries for direct non-potable use. Along with five desalination plants, NEWater factories help make a circular water economy a viable possibility in Singapore.

Considerations: Even though NEWater exceeds drinking water standards, overcoming the public's stigma and psychological fear of drinking treated sewage water was a key challenge when promoting the new technology. Singapore worked hard to replace water terminology, such as wastewater and sewage, which had a negative connotation to reflect its value as a resource. Industries were also hesitant to use NEWater as a replacement in plant operations; education and communication with stakeholders were key to the success of the program.

In order for integrated water management of water resources to be successful, the separation between water supply and wastewater treatment agencies needed to be discarded. In 2001, PUB was reconstituted as the singular agency to control and manage all aspects of the water cycle. This allowed for streamlined implementation and expansion of the NEWater system.

Energy consumption accounts for almost two-thirds of the operational costs of NEWater plants; however, this is still much lower than desalination plants. In addition, expensive membrane technology is used in the process, and replacement of these membrane systems, constitutes a large portion of maintenance and overhaul costs. The relatively short design life of microfiltration and reverse osmosis membranes used in the process can significantly add to operational costs.

Production values of NEWater plants can be reduced because of fluctuations in water intake and demand.

Awards

- **Award of Excellence**, National Water Research Institute, USA, May 2002
- Environmental Contribution of the Year, Global Water Awards 2008
- Water Agency of the Year, Global Water Awards 2006
- "Water for Life" **UN-Water Best Practices Award** 2014 (for outreach and public education surrounding NEWater)
- Resilient Water Agency of the Year, Global Water Awards 2021

Cost: The Changi NEWater Project Phase 2 plant is the most recent NEWater factory in Singapore and began operations in 2016. The total estimated cost of the new plant, which boasts a total recovery rate of over 70% and a production capacity of 50 MGD, was approximately $125 million USD. The NEWater plant has a high degree of advanced automatic control and low operational energy consumption. Only 15 total personnel are needed to maintain and operate the system, which greatly reduces labor costs. Over 30 water design indicators and 189 consistently monitored production test indicators are included in the project design.

Education, Outreach & Marketing: Singapore's government and PUB have been extremely active in promoting the use of NEWater and water sustainability. There has been extensive community and public engagement to increase NEWater acceptability and get the message across that it is safe to drink and reliable. PUB has increasingly drawn public acceptance for NEWater by engaging the media as partners, gaining public endorsement by leaders, and publishing expert opinions to help lend credibility. The NEWater Visitor Centre provides an opportunity for the public to understand Singapore's water strategy through learning the concepts and technology behind NEWater.

PUB has published guidebooks called The Best Practice Guide for Water Efficiency for multiple water use sectors in an effort to provide large water users with the tools necessary to adopt more water-efficient practices. The Singapore International Water Week is a biennial event that brings together industry leaders, policymakers, experts, and practitioners to share policy developments, showcase technologies, form partnerships in research and development, and address challenges. Singapore's Watermark Awards were developed to celebrate achievements in water efficiency and conservation of water resources.

Key Successes:

- NEWater provides a great model for other countries/cities facing scarce water resources.
- PUB has saved manufacturing plants, particularly those in the wafer fabrication industry which use ultra-pure water for production, up to 20% in chemical costs for water treatment
- The Singapore government has made the price of NEWater more competitive than tap water by lowering taxes and fees. NEWater has a considerable cost advantage over desalination due to its significantly lower energy consumption.
- Singapore's per capita household water consumption was reduced from 165 liters per person per day in 2000 to 141 liters per person per day in 2018. This is largely due to significant public engagement and education in water sustainability and use. Singapore's goal is to decrease consumption to 130 liters per person per day by 2030.

Public-Private Partnership: Singapore Refining Company Private Limited (SRC)

PUB (Singapore's water agency) provided technical support and co-funded a joint venture between Singapore Petroleum Company Limited and Chevron Singapore Pte with the goal to reduce water use in refining operations by implementing an on-site Effluent Treatment Recovery Plant (ETRP) in 2016 (first of its kind in Singapore – fully automated plant). The ETRP supplements SRC's Effluent Treatment Plant which can treat 6,000 m^3/day of effluent to discharge limit standards and has a design capacity of 2,500 m^3/day, treating water to NEWater grade (high-grade reclaimed water) for process reuse. This allows SRC to meet approximately 20% of SRC's NEWater demand (potentially can reduce NEWater consumption by 30%). Water from the primary treatment plant is further treated using the ETRP to remove suspended solids, dissolved solids oil, grease, and other contaminant. The process includes flat sheet ceramic membrane microfiltration and a two-step reverse osmosis process.

Considerations:

- Higher recovery means higher pressure requirement, which has a greater energy demand.
- The higher pressure also creates higher system choking tendencies (this is why they decided that 50% recovery rate was optimum after an economic analysis), leaks or cracks in plastic piping may reduce recovery rates as well, "minor hurdles during commissioning".
- Conducted "extensive pilot-testing" before building to identify optimal capacity.

Key Successes:

- Allows reuse of effluent that was previously discharged into the sea (within NEA's guidelines).
- Increases capability to recycle water by up to 50%.
- Boosted water recycling rate from 18% to 42%.

Key Stakeholders:

- PUB (Singapore's water agency) provided technical support and co-funded the project.

Appendix B:
A Conversation With Swinkels Family Brewers

Inspired by the Ellen MacArthur Foundation, Royal Swinkels Family Brewers (Swinkels) has been transitioning from a linear economy to a circular economy model. With more than a dozen projects underway, Swinkels has been making water security a priority for more than six years. We sat down with Marthijn Junggeburth, Sustainability Manager at Swinkels, and Donya Fakhravar, Process Manager – (waste)Water Treatment, to discuss their biggest project to date – Boer Bier Water (Farmer Beer Water).

AG: Please provide a brief overview of the off-site water circularity/wastewater recycling project.

The interest in sustainability started more than 10 years ago, with a focus on protecting water resources for future generations. We are all family businesses, so it was natural to come together for this cause. When you are a part of a community, you "know" everyone. This helps to build trust. Trust was really important for us, it is what has helped us to ensure we could deliver quality water back to our community.

We don't do it the easy way. We start at the source – let's save energy first, and then look at needs. We asked ourselves "What do we <u>really</u> need"? From there we start our sustainability journey. Sustainability concerns the entire chain – suppliers to customers. Our approach is a combination of circular procurement, circular production, and high-quality reuse. We strive for excellence in circularity through several efforts, but it starts with water – having sufficient water of good quality for all users.

We have our own treatment facility at Bavaria. We take our residual water, treat it to make sure it is high-quality, and then pump it into the canal system. This helps to recharge the groundwater, to ensure there is enough for local farmers. We use sub-irrigation systems, channels, and ponds to deliver water to community farmers around the brewery. We are focused on keeping our soil and our water vital for the long term.

AG: Can you discuss some of the impacts you are having on the community?

Drought has been a big problem. We currently deliver more than 800,000 m^3 of treated wastewater back to the water shed annually. Despite the drought, the farmers who are connected to our water reuse irrigation systems still had a good harvest. They produced 50% more than others during a dry summer.

AG: How did the conversations with stakeholders start?

Water is a common interest. Where there are people, there is beer. Beer and Farming. They both require water. From there we had data from KWR; they had been doing research in the area for years and gathering data. It [the data] was something we used as motivation. We started our conversations with the community at a small scale. We talked to one farmer about our plan to reuse treated wastewater. One farmer has grown to 21 farmers who benefit from our project.

AG: What role did government play? What were the regulatory hurdles that you and your team had to address to be able to conduct the project?

The government was asking breweries to decrease their nutrient load from their wastewater. We decided to implement the Boer Bier Water project instead of negotiating new permits. The project required further treatment of the water. Knowing the relevant government officials was important in getting the project off the ground and its continued success. Success for us was all about building relationships. We already had a presence in the community, being a 7th generation family business, and then we have the [KWR] data. Next steps were to collaborate on implementation. We partnered with the government, farmers, the banks, and the water board. This cross-functional group ensured progress was made.

AG: What do you see as the biggest challenges/roadblocks for successful implementation? What advice do you have for other companies that are thinking of implementing circularity projects?

Don't start too big; start small and work together [with stakeholders]. As I mentioned, we started with one farmer. We paid for everything – pumping, irrigation, etc. However, to expand we needed to obtain funding; this was difficult. Eventually the Netherlands government and the European Union joined us in financing the project, which is how we are able to support 21 farmers with our Boer Bier Water project. Relationships are very important. We have organized classes for interested stakeholders. We have annual meetings with our stakeholders. They get to see our progress, how the water we save has a [positive] impact on the community. We also spend effort on informing the community through distributing pamphlets and with signs.

Appendix C:

Public Sector Case Studies

Taken from a literature review, the following case studies highlight successful offsite circularity projects.

MeProWaRe - Off-Site

Project Overview: MeProWaRe is an EU project in Italy, Spain, and Portugal that couples wastewater treatment with Mediterranean agricultural processes through customized reuse of treated effluents for optimal growth and production (crop yield and quality). Crops are irrigated with varying levels of treated wastewater (growth stage dependent) and effects on the soil and crops are monitored to build datasets that provide consistent information. Treated wastewater in Italy is provided by a local wastewater treatment plant with a full-scale tertiary treatment, based on surface filtration and UV disinfection.

Process:

1. Engage stakeholders to understand key issues and develop Fuzzy Cognitive Map (FCM)
2. Irrigate crops with treated wastewater and conventional water sources for comparison purposes
3. Monitored wastewater quality, crop yield, and soil health
4. Modeled water use and needs
5. Communicate results

Considerations:

- Perceived Complexity: cross sector issues concerning quality
- Public Perception: negative feelings could lead to the rejection of projects
- Environmental Risks: soil salinization, crop contamination, pollution

Takeaway Advice: Irrigation with treated wastewater is effective and the overall water quality is good. Soil salinity and plant health should be monitored over time when irrigating with treated wastewater. Results found that treated wastewater was just as effective for irrigating Mediterranean crops (grapes and olives) as conventional water. The results showed that treated wastewater chloride was the only parameter above the recommended value (but less than legal limit) for reuse in agriculture. However, the treated wastewater was higher in nutrient and organic substance content, providing a significant fertilizing contribution for the crops when compared to crops irrigated from conventional water sources.

RichWater - Off-Site

Project Overview: The RichWater project in Algarrobo, Spain has developed a compact, integrated technology for water reuse in agriculture to deliver fertilizer and water to crop. The solution combines an energy efficient membrane bioreactor (MBR) and UV disinfection for water treatment with an advanced module optimizing the level of nutrients and water for fertigation of crops. RichWater integrated technology offers a monitoring/control module that includes soil sensors to determine exactly when and how much fertigation is needed. The solution guarantees demand-driven and pathogen-free fertigation through drip irrigation to permanent crops.

Process:

1. Sewage and wastewater are pumped to an aeration tank and then treated using a membrane bioreactor
2. An ultraviolet light disinfection module disinfects treated wastewater
3. Soil and Plant sensors determine the required mixture of recycled-fresh water and adjust nutrient ratios
4. Precise quantities of fertigation water are discharged to minimize water usage
5. Communication of results through video, flyers, books, articles

Considerations:

- Coordinating existing technologies into new methodologies
- Ensuring adequate water quality
- Ensuring water meets public health standards

Takeaway Advice: New technology from the RichWater project easily treats wastewater, mixes nutrients to the specified needs of crops and soil and delivers fertigation to crops when it is needed to minimize that water use. Treated wastewater also has a high nutrient and organic substance content, which reduces the need for applying synthetic fertilizers.

SUWANU EUROPE (Israel) - Off-Site

Project Overview: SUWANU EUROPE is a Horizon 2020 project to promote the effective exchange of awareness, knowledge, experience, and skills in the use of reclaimed water in agriculture among practitioners and others, particularly in regions where water is becoming increasingly scarce. Israel is located on the edge of the desert and has a climate ranging from Mediterranean to arid. The south of Israel is almost completely desert and water resources are limited. Israel has been reusing wastewater in agriculture to meet domestic water demand and reduce water consumption for decades.

Process:

1. Centralized policy making for water-related decisions, and regulations for the use of reclaimed effluents.
2. Offered consultation events to switch to irrigating with reclaimed water as well as incentives (a 20% increase in their water quota for replacing potable water with reclaimed effluent).
3. Wastewater is treated using activated sludge, and secondary effluents produced by the Shafdan wastewater treatment plant undergo Soil Aquifer Treatment and disinfection before being supplied for agricultural use.
4. Implement strict regulations to determine the minimum quality criteria for treated wastewater and categorizes reclaimed water by restricted and unrestricted use for irrigation.
5. Adopted a new standard in 1998 to lower the amount of boron and sodium in laundry detergents which resulted in lower concentrations of the chemicals in effluent.
6. Approximately 85% of wastewater in Israel is treated and reclaimed for agricultural use, and potable water makes up less than 50% of agricultural water use.

7. Israel has been promoting water conservation and reuse since the 1940s through street signs, TV, and radio, which has created a local state of mind that readily accepts water conservation and recycling.

Considerations:

- Effluent quality control and managing water chemistry, particularly with respect to sodium and boron
- Ensuring there are no public health risks associated with handling (or using) reclaimed effluent

Takeaway Advice: Clear policies and centralized water management are important for creating a sustainable water sector – all aspects of water use, and reuse are considered. Proper effluent treatment methods are crucial to maximizing wastewater recycling by minimizing risks from poor water quality or public health and will vary based on the quality of the effluent being treated. If removal of specific contaminants is too difficult or costly using conventional methods, it may be more cost effective to reduce the quantity of the contaminant at the point of introduction rather than treating the effluent excessively.

SUWANU EUROPE (Cyprus) - Off-Site

Project Overview: Cyprus is a semi-arid island country in the eastern Mediterranean Sea that has been experiencing water scarcity due to overexploitation of groundwater resources and high-water demand. Increasing water demand for irrigation drove the development of large water reclamation infrastructure projects, including urban wastewater treatment plants and water reclamation plants that were constructed in all major cities to treat and reuse the majority of Cyprus' urban wastewater. To satisfy a water demand that exceeds available water resources, Cyprus has been implementing policies to reuse reclaimed water in agriculture.

Process:

1. Pre-communication intelligence: project justification; costs; environmental impact; risk assessment; exposure risks
2. Cyprus Government Council of Ministries engaged stakeholder groups: Government departments; Local Water & Sewer authorities; End-User associations; Environmental Organizations
3. Information and education campaign initiated early in the project timeline to gather support and acceptance.
4. Replaced freshwater used in agriculture with tertiary-treated urban wastewater, which include: Activated sludge; (ultra)filtration; membrane bioreactor; UV disinfection
5. 15% of irrigation needs today are satisfied using reclaimed water and reclaimed water is expected to account for 25% of irrigation needs by 2025
6. Cyprus produces over 30 million cubic meters of reclaimed water annually and plans to produce up to 74 million cubic meters per year by 2027
7. Communication of standards, results and
8. Reclaimed urban wastewater is used for the following purposes in Cyprus
    a. Irrigation of crops, grass, and green areas
    b. Artificial recharge of aquifers when irrigation demand is lower

Considerations:

- Developing the Cyprus Code of Good Agricultural Practice to establish guidelines on safe irrigation with reclaimed water
- Public Acceptance – psychological barriers (inherent distaste for); trust in authorities; reliability of treatment
- Water pricing – making recycled water cheaper than freshwater

Takeaway Advice: Sustained dialogue with stakeholders drives trust issues. Adopting policy measures that support the reuse of reclaimed water and creating the infrastructure to effectively capture and treat urban wastewater as well as easily access reclaimed water have been key measures in meeting agricultural water demand in Cyprus through reusing water. Increasing water treatment capabilities and capacity increases reclaimed water capacity for reuse.

Appendix D:

Beverage Industry Case Studies

Owing to some of the challenges identified in the framework above, BIER member implementation of off-site water circularity efforts is limited. Public perception of wastewater reuse in the food and beverage sector is a constant challenge. While examples are limited, the following examples from BIER member company interviews, represent some of the efforts realized to date.

ABInBev - Off-Site

Project Overview: ABInBev has been working in the water recycling space for some time with a universal long-term goal that each local solution must have a **Net Positive** Impact. ABInBev's approach to water reuse begins internally, with the identification of systems where treated, reused water can be integrated in the processes where the water is consumed (except water going to the product or in direct contact with the product), reducing drawdown of freshwater. Once water leaves the facility, different, **locally-specific end-use** destinations are identified in order that this treated water had a second benefic use. Example off-site solutions:

- Effluent is used externally by local firefighters
- Irrigation support for municipal government (public lands, parks, etc.)
- Road maintenance

In all these cases of external reuse the facility involved create a partnership with the new final users with clear controls of volumes, quality under the umbrella of local authorities.

Process:

1. Identify and engage local stakeholders: What are their needs? What freshwater use could be avoided by replacing it with recycled water? What is good for the community?
2. Garner local support through discussions on water quality and invite stakeholders to view whole process
3. Obtain necessary permits for intended use scenarios involving local authorities in the whole process.
4. Rely on global, standardized best practices to ensure local facilities deploy tested methodologies (ensures quality, reproducibility of results and ease of support)
5. Corporate funding accounts for more than 99% of project overhead; local funding comes from groups interested in reducing effluent
6. Conduct impact assessments to ensure net positive impact
7. Ensure quality through testing and monitoring of effluent as part of management system in place

Considerations:

- Quality control of effluent – respecting commitments between parties all the time.
- Verification of process and material – ensuring reliability and sustainability
- Permitting – always involving local authorities as a partner
- Impact assessment – ensure a benefit in one area doesn't have negative consequences for others

Takeaway Advice: Start locally, then replicate regionally and ultimately up to global scale. Ensure the quality of water (and ecosystem) the local community relies on is not impacted – Net Positive Impact. Understand all the actors and interested parties within your watershed – stakeholder mapping is imperative. Do your due diligence on environmental impacts (downstream and cascading); **success comes from taking a holistic approach** to wastewater reuse to drive a net positive outcome for the watershed.

Constellation Brands (CBI) - On-Site

Project Overview: CBI has been operating in Mexico for 10 years. As a water-stressed region, water resources must be thoughtfully managed. CBI is making strides to improve water use efficiency, initiating actions to promote better water management within the watershed, and reducing total water withdrawals. Aspirations include:

- Developing a wastewater reuse partnership with other regional stakeholders
- Utilizing on-site treatment of wastewater to integrate treated water into production process that do not have direct contact with the product
- Partnerships with agricultural industry
- Sharing water-risks
- Investing in agricultural infrastructure (modernizing dams; pumping stations) to help reduce water loss and increase water conduction

Process:

1. Map stakeholder ecosystem to identify all relevant water users in the region
2. Identify water rights issues, relevant water needs for each community
3. Work collectively to identify priorities, shared interests, and common goals
4. Work with regulators and government officials to obtain necessary permitting, and to improve policies for the long-term
5. Work to ensure local buy-in through investment, establishing methods to track Return on Investment (ROI)

Considerations:

- Regulations – ambiguity in how laws will be implemented
- Political environment – trying to change policy through stakeholder engagement
- Water rights – conducting water rights assessments to establish community needs

Takeaway Advice: First, you need to have local context, and maximize local relationships to help realize benefits. Integrating the local community early in the process is critical to success. Identify what does and does not work (current state infrastructure) - there is no "one size fits all" approach. Circularity requires a diversified portfolio to address main water risks – physical, political, regulatory, and reputational. Collaborate locally; you need community engagement to be successful.

Heineken - On-Site

Project Overview: Heineken established a new brewery in Meoqui in 2018. It is our largest, greenfield brewery that is located in Chihuahua Mexico, that was built with environmental sustainability as a central design of this brewery. From its inception, the facility was designed to incorporate on-site circularity practices to reduce reliance on freshwater withdrawals. The facility has its own Water Reclamation Plant (WRP). Water systems are separated to create distinct water management lines – process and product. Since 2020, the plant's WRP, utilizes Ultrafiltration and Reverse Osmosis (RO), producing reclaimed water that is used for secondary purposes such as, such as bottle washer, pasteurizer, boiler feed water and general cleaning.

Process:

1. Preliminary peer-research covered: water footprint - site targets and infrastructure needed.
2. **Partner with (current and future) neighbors to identify synergies.**
3. Establish Key Performance Indicators (KPIs).
4. Conduct Source-Vulnerability Analysis, which is a compilation, review and validation of scientific data, watershed information, inventory and analysis of water-related risks, stakeholder mapping and proposed viable options.
5. Outreach events (ongoing): **communicate and share information to stakeholder groups**.
6. Created separate water lines to differentiate recycled and freshwater.
7. Goal is to recirculate throughout the facility indefinitely to reduce reliance of freshwater for secondary purposes.
8. Balancing project to make Meoqui Brewery water neutral currently in place to begin in 2023.

Born Sustainable

- 90% process water circularity
- 30-40% total water circularity
- Below 2 hl/hl

Considerations:

- How to overcome cultural misconceptions about circularity and reclaimed water reuse.
- Operational learning curve: this was Heineken's first plant to open with circular objectives therefore Heineken had to take into **consideration both the water and energy nexus to ensure holistic environmental benefits**.

Takeaway Advice: Understand local regulations on use of reclaimed water. Increase awareness internally and opportunity for usages where freshwater reliance can be reduced. Build strong business case internally to justify investment against environmental impact.

PepsiCo - Off-Site

Project Overview: At a Mexico foods manufacturing facility, PepsiCo set an ambitious target – reach a freshwater usage efficiency of 0.4 L/kg by 2030. To reach this goal, a water reuse strategy needed to be developed and implemented.

- Tracked water pathways, to identify where changes could be made
- Identified and worked with third party water supplier who sourced process water from local food companies that could be further treated and incorporated midstream to reduce total freshwater drawdown.
- The new process enabled the facility to go 90 days w/o the introduction of freshwater water into the process
- Achieved an efficiency of 0.16 L/kg
- The goal is to require zero freshwater consumption altogether for an entire year. If the facility can accomplish that, Vallejo would save approximately 550 million liters of water

Process:

1. Driven by necessity, Mexico is a water stressed area.
2. Project was locally inspired, and locally driven.
3. Fostered partnerships and collaboration with local safety and government officials to ensure the complete support and success of the project
4. Multiple water quality tests to ensure regulatory and food safety adherence. As well as legal and contractual agreements with partners and public water utilities.
5. Secured corporate funding (via proceeds from a Green Bond).

Considerations:

- Ensuring Food safety and quality safety standards are not compromised.
- National and corporate potable water standards had to be met.
- Alignment with administrative and regulatory requirements including environmental permit requirements.
- Tradeoffs, e.g., climate related transport and increased water treatment energy for membrane treatment.

Takeaway Advice: This does not replace the need to ensure your facilities are operating at best practice from a water use efficiency point of view. Have a clear understanding of all the legal, regulatory and Food Safety and Quality requirements that you need to meet and whether your existing water treatment process is able to accomplish this. Understand where this can be used in your production facilities. You need to identify partners who are able to supply process water that meets your requirements from a quality and duration point of view. You need to understand the governing regulations around water supply, ownership, and reuse. Ensure all parties are in alignment. Tackle the logistics of water transport.

Appendix E:

Non-Beverage Industry Case Studies

Apple Inc. - Off-Site

Project Overview: In a detailed water inventory, Apple found that their supply chain accounts for 99% of their total water footprint. Apple partnered with their suppliers as part of their Clean Water Program to reduce water consumption through water reuse. There are currently over 195 participating supplier sites in the Clean Water Program, and they have increased their average water reuse rate to 41% which saved Apple's suppliers a total of 12.3 billion gallons (46.6 million cubic meters) of freshwater in Apple's FY2021 ($280 MM saved in FY2021). 50.3 billion gallons (190 million cubic meters) of water have been saved since the Clean Water Program was initiated in 2013. Water recycling initiatives for suppliers include steam collection from boilers and acid recovery and filtration to clean and reuse process water. Apple is piloting the use of acid recovery and filtration technologies to clean process water so it can be reused multiple times for a critical manufacturing process. This technology extracts and cleans all chemicals out of water used in the final step in the aluminum casting process. The extracted materials are either reused or disposed of, while the water remains within the production cycle. Most of the recycled water at Apple's corporate facilities comes from municipal treatment plants, with less than 5% from onsite treatment. A campus that opened in late 2016 in the South Bay area of California relies almost entirely on reclaimed water. The water comes from a public-private partnership between the California Water Service Company, the City of Sunnyvale, Santa Clara Valley Water District, and Apple. Recycled water produced in Sunnyvale is diverted to Cupertino where water is then distributed to Apple's campus. Apple was the driving force behind establishing the public-private partnership, contributing $4.8 million to the project, and initiating the partnership.

Process:

1. Conduct a detailed water inventory within Apple’s operations and the supply chain
2. Establish the Clean Water Program to engage with suppliers and increase water reuse
3. Reach out to local municipalities and water authorities to establish a reclaimed water use partnership

Considerations:

- Accounting for water consumption in supply chain
- Establishing local municipal partnerships

Takeaway Advice: This does not replace the need to ensure your facilities are operating at best practice from a water use efficiency point of view. Have a clear understanding of all the legal, regulatory and Food Safety and Quality requirements that you need to meet and whether your existing water treatment process is able to accomplish this. Understand where this can be used in your production facilities. You need to identify partners who are able to supply

process water that meets your requirements from a quality and duration point of view. You need to understand the governing regulations around water supply, ownership, and reuse. Ensure all parties are in alignment. Tackle the logistics of water transport.

Chevron - Off-Site

Project Overview: In 2021, Chevron agreed to the Wastewater Zero commitment in partnership with the World Business Council for Sustainable Development (WBCSD), to try to apply wastewater reuse concepts in their refinery operations at one location in Singapore and two in the US. A treated effluent recovery plant was constructed at a Singapore refinery to remove suspended solids, oil, grease, and other contaminants from wastewater to enable water recovery and reuse. The treated effluent recovery plant was the first of its kind in Singapore and increased the refinery's capability to recycle water by up to 50%. According to Chevron, government incentives and technological advances helped drive the Singapore refinery's recycling initiatives. The second project involved a refinery in Richmond, California that increased reclaimed water use to more than 6 million gallons per day through a partnership with the East Bay Municipal Water District in the San Francisco Bay Area. Another refinery in El Segundo, California is making greater use of recycled water using Plant Information Vision, a digital monitoring dashboard that tracks daily water use in cooling tower systems and alerts operators of optimization opportunities, which allows for increased recycled water use in operations.

Chevron is also exploring water circularity in fracking operations and estimates that for every barrel of oil produced by fracking, up to eight barrels of wastewater are produced. In the past, wastewater generated from fracking was disposed of in deep injection wells, but Chevron has recently begun reusing the wastewater generated from fracking in initiating fracking operations in New Mexico and West Texas. Chevron developed this practice after participating in the New Mexico Produced Water Research Consortium to explore long-term alternatives to using freshwater by instead beneficially reusing in-process water.

Process:

1. Government incentives and new technological advances have driven wastewater recycling initiatives in oil refinery operations
2. Established a partnership with a local municipal water district to supply a refinery with reclaimed water
3. Utilized a digital water monitoring dashboard called Plant Information Vision to maximize water circularity opportunities within refinery operations, increasing reclaimed water use by 8% over three years
4. Participated in a pilot program with the New Mexico Produced Water Research Consortium to develop new uses for fracking wastewater. Recycled or brackish sources offset approximately 99% of Chevron's water demand in New Mexico and West Texas in 2021

Considerations:

- Developing new wastewater treatment methods/uses
- Effectively utilizing new technology
- Establishing partnerships with municipal water authorities

Takeaway Advice: Government incentives and technological advances have increased the feasibility of recycling initiatives within the energy industry. Opportunities for wastewater reuse in fracking operations have expanded after overcoming prior limitations through pilot programs that develop new uses for wastewater.

Danone - On-Site

Project Overview: The Flemish Region of Belgium is facing a water shortage for the fourth consecutive year as of 2022. To reduce water consumption, Danone's production plant in Rotselaar has been implementing on-site water circularity principles in its production. Wastewater from yogurt production is sent to the Danone site treatment plant, where it is treated using new membrane technology to meet drinking water standards again. Approximately 75% of wastewater is sent back into production, saving over 500 million liters of water per year and reducing the impact of the plant on groundwater, nearby rivers, and streams. Danone has plans to make surplus treated wastewater available to farmers in the region for crop irrigation during drought. The water circularity innovation at the Rotselaar required an investment of around 2 million euros and was the first Danone plant to launch the program.

Process:

1. Driven by water shortages.
2. Invested 2 million euros into implementing water circularity and water infrastructure.
3. Implemented new membrane technology to treat wastewater to drinking water quality.
4. Treated wastewater is sent back into production.

Considerations:

- Water availability
- Infrastructure

Takeaway Advice: Reuse of wastewater can drastically reduce the impact of a production plant on local water resources. Production plants or other large water consumers or wastewater producers can become a source of water for agricultural irrigation in the surrounding region.

H&M Group - Off-Site

Project Overview: H&M Group's primary water consumption occurs in the supply chain, thus informing the focus of their water conservation and recycling efforts. The textile markets in Bangladesh, India, and Indonesia comprise almost 50% of H&M Group's total textile production, with these countries having local initiatives to reduce water consumption. A unique initiative was born when H&M connected with a local supplier in Bangladesh to recycle wastewater in the denim washing process, which allowed recycling 25% of its total production water in one year. Following the success of this initiative, 19 other denim washing units in Bangladesh replicated the approach and are recycling their wastewater. An initiative was also started with a supplier in India to upgrade their effluent treatment system to allow recycling of nearly all their production wastewater. This initiative has allowed the supplier to no longer discharge wastewater. Water conservation and recycling methods in their Asian textile markets have helped H&M recycle over 4.8 billion gallons (18 million cubic meters) of wastewater.

Process:

1. Analyze supply chain water consumption to determine where water consumption was highest across the value chain.
2. H&M reached out to local suppliers in southeast Asia.
3. Water circularity initiatives were established at individual suppliers through pilot programs.
4. With the success of each pilot program, the water circularity projects can be adopted by other suppliers in the region.

Considerations:

- Accounting for water consumption in supply chain
- Establishing local pilot programs for water circularity projects with suppliers

Takeaway Advice: Focus on the supply chain to maximize water circularity within their operations. By connecting with local suppliers and establishing water recycling initiatives, companies can increase circularity within their supply chain. When local initiatives succeed at individual suppliers, then water circularity programs can be scaled up.

UPL (formerly United Phosphorous, Limited) - On-Site

Project Overview: UPL's goal is to achieve zero liquid discharge across all manufacturing sites through effluent reuse and recycling. UPL characterizes their wastewater by chemical parameter and a color-coding system to denote treatment level. In 2020 and 2021, new wastewater treatment technology was piloted at UPL manufacturing sites to treat the wastewater that has higher Total Dissolved Solids (TDS) and Chemical Oxygen Demand (COD), enhancing their ability to reuse and recycle water in their operations. UPL is piloting multiple other water treatment and management methods that they plan to implement at a larger scale in the future, including vacuum distillation technology, ozonation and electrooxidation, advanced oxidation treatment, and neutralization of evaporation condensate.

Process:

1. Process wastewater is characterized under three different categories based on water quality.
2. Wastewater treatment methods are developed for each category of wastewater that best suits the level of treatment needed.
3. New wastewater treatment methods are regularly piloted so that they can be implemented on a larger scale.

Considerations:

- Wastewater quality
- Developing new technology

Takeaway Advice: Advances in wastewater treatment technology and innovative water circularity pilot programs are key to increasing wastewater reuse in chemical manufacturing operations. Prior to wastewater treatment pilot programs at UPL, wastewater could not be effectively treated or reused. By segregating production wastewater streams by quality, manufacturers are able to treat higher quality water with less rigorous and expensive techniques, while lower quality water is treated with more rigorous and expensive treatment technology. When wastewater is not mixed, it is not required to all be treated using the same rigorous method.

Appendix F:

Documented Action Plans/Initiatives

From the White Paper on Water and the Circular Economy, three prevalent Circular Economy (CE) principles emerged: **design out waste externalities, keep resources in use,** and **regenerate natural capital**. In essence, a circular system should be designed to keep a (by)product in continuous use in perpetuity. In the context of this discussion, the paper describes how CE principles relate to water systems and sustainable water management. Four perspectives are identified on how to view water usage and its value within a company.

Figure 2: Perspectives: Basis for The CE Framework (Based on Data from a White Paper by Arup, Antea Group, and The Ellen Macarthur Foundation)

'Dimensions of Use' Perspective	'A Systems' Perspective	'A Basin' Perspective	' An Urban Water System' Perspective
• Water is used and valued in various ways and therefore clustered into the three general themes: Service, Energy and Carrier.	• Water is split into two categories: nature managed and human managed. • This perspective better aligns the natural water cycle with the human water cycle.	• Water may be valued differently dependent on the basin it is in. • The type of basin presents varying natures of opportunities and values of solutions.	• Increasing population growth results in greater water demand and valuation within a system, especially in the context of an urban environment. • Systems are much more complex with greater levels of links between energy, water use, food, and industry.

Overall, the application of CE principles can help meet future water demands, while also accounting for resource challenges and changing water quality, pollution risks, and increased environmental regulations. It is necessary when exploring CE frameworks to account for how water is used in various contexts, systems, and conditions, which will better equip companies to identify opportunities and outcomes with greater magnitudes of impact.

Using Data-Gathering Techniques to Collect Stakeholder Information

Goal: To determine the level of awareness of potential stakeholders and their willingness to participate in watershed protection activities, as well as to identify key community attributes

Methods: Focus groups, surveys by mail, community meetings

Sample focus group questions

- What community organizations do you belong to?
- Whom do you go to for advice about rangeland management?
- What are three things you value about your community?
- How do you spend your leisure time?
- For your community, what quality-of-life issues matter to you most?
- For your community, what environmental issues matter to you most?
- Where do you get your information on environmental issues?
- What are some key activities that occur in your community that help create a sense of place?
- Do you think the water quality in your community is improving or declining? Why?
- How is the land managed in your community (ownership, leased lands, and land-use planning)?

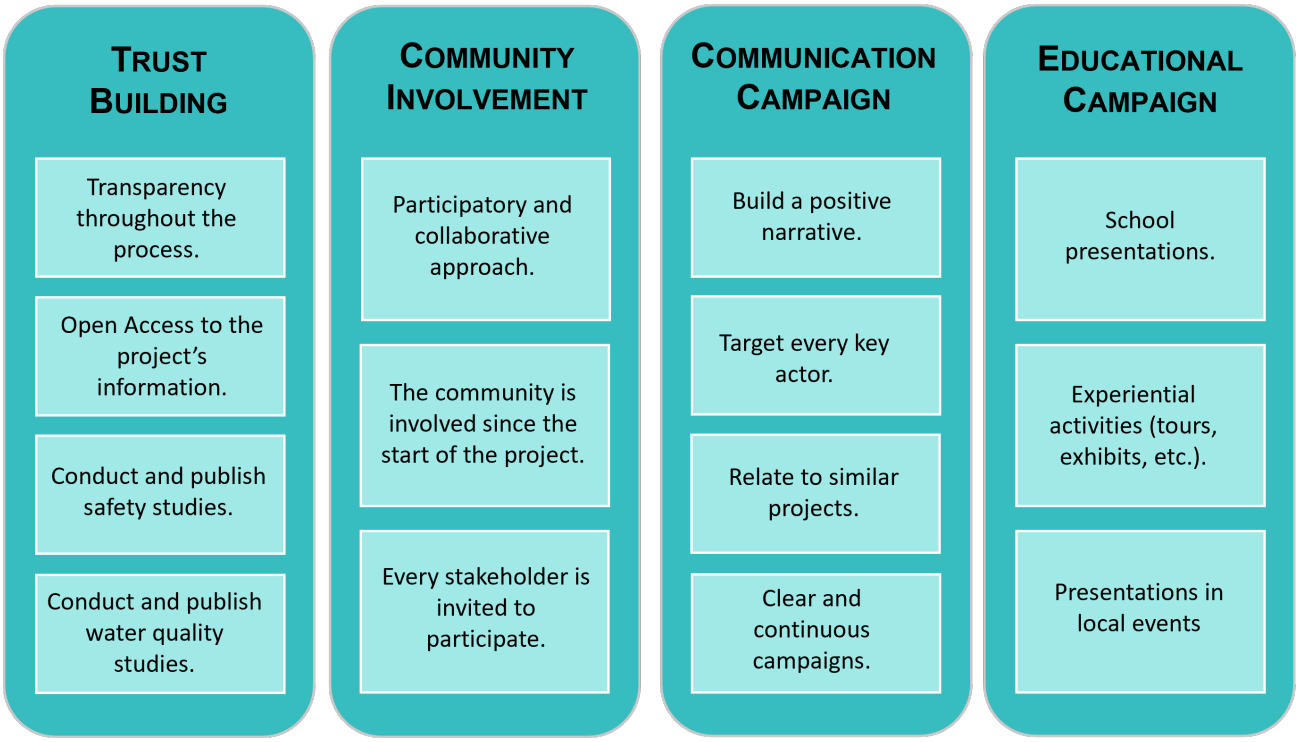
Sample open house questions

- Have you heard about our organization? If yes, from whom?
- Can you find where you live on this map?
- Can you name any nearby streams, rivers or lakes?
- Which environmental resource(s) do you think best describes your community (e.g., parks, marinas, birdwatching, fishing)?

Sample survey questions

- What do you think are the biggest problems facing your community?
  (a) education
  (b) crime
  (c) water quality
  (d) taxes
  (e) other
- In your opinion, what is the best use of the Rio Platte?
  (a) irrigation
  (b) habitat for birds and wildlife
  (c) recreation (hunting, fishing, canoeing)
  (d) other
- Please indicate whether you have a positive or negative view about the following groups, or indicate if you don't recognize the group.
  (a) U.S. Environmental Protection Agency
  (b) Friends of the Rio Platte
  (d) Texas Fish and Game Commission
  (e) Trout Unlimited
  (f) Soil and Water Conservation District
  (g) Northeast Water Supply Association

From EPA - Engaging Stakeholders in Your Watershed, 2nd ed.



From SUWANU Europe Fact Sheet 5.3

What you need to know about potential stakeholders	
What is their knowledge of watershed issues and what are their concerns?	Where do they get their information?
What are their attitudes and opinions about their community?	Whom do they trust?
How do they use the resource?	What do they value in their community?
What language and messages motivate them?	What are the key local activities in the community?

From EPA - Engaging Stakeholders in Your Watershed, 2nd ed.

Appendix G:
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Appendix H:

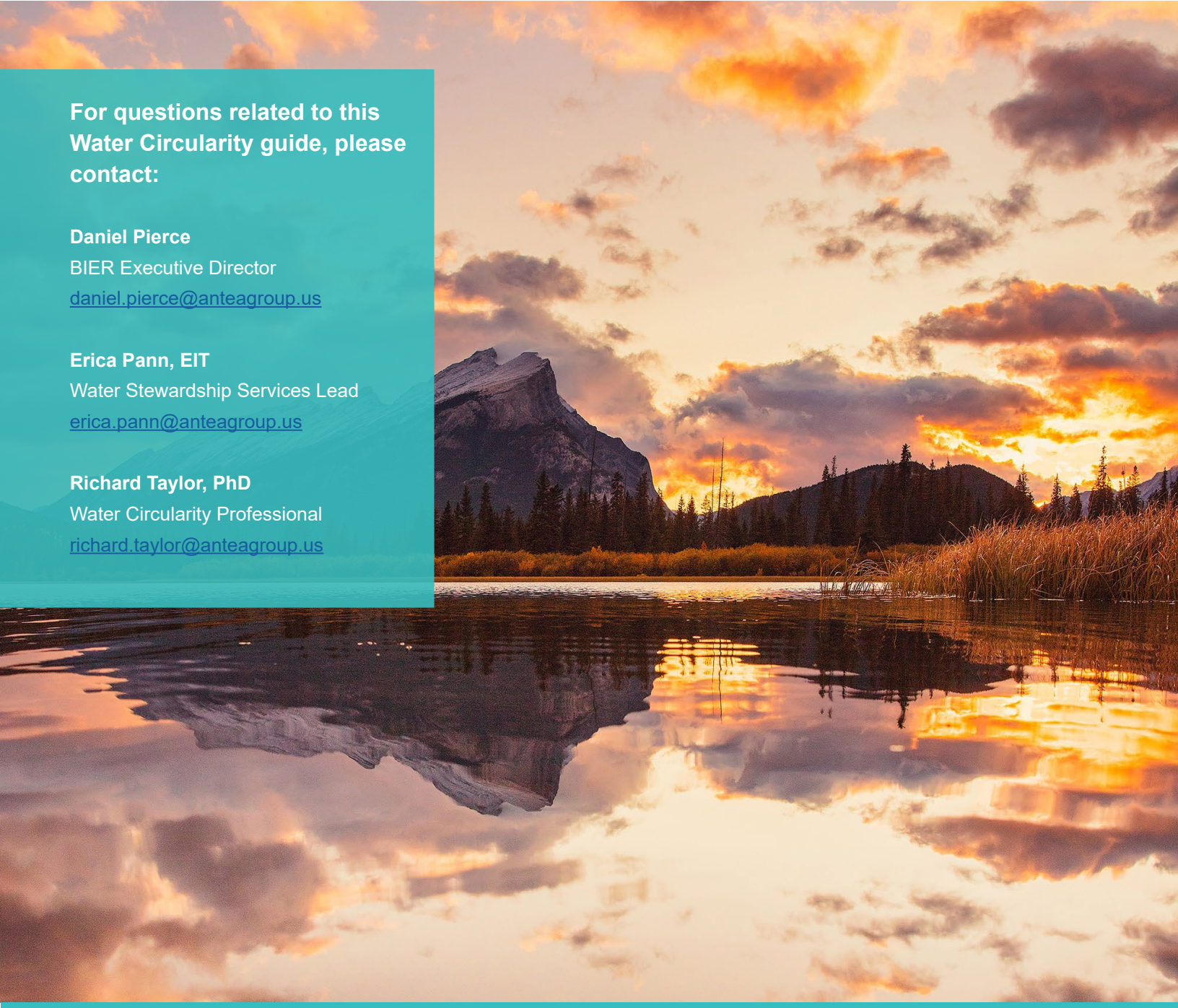
About this Report

This Water Circularity Good Practices Guide aims to help others (companies, thought leaders, NGOs, governments, etc.) on their circularity journeys by highlighting the ***how***. This guide hopes to reach a wide audience, regardless of their water stewardship maturity, and provide considerations and actionable steps towards creating circular solutions in service of increased watershed stewardship.

With persistent, and ever-increasing water-related challenges, we are best served by moving away from a linear economic model [to a circular model] to ensure quality water standards are universally available. As pressures increase inside and outside of a facility, businesses must forge new partnerships to achieve long term sustainability goals. Navigating this new frontier can be challenging. This guide is designed to help negotiate those challenges by identifying common themes between successful practitioners and creating a roadmap for success. Lastly, this guide is an effort to create a unifying document, combining the wisdom of documents that have pushed boundaries in their respective fields. Often these recommended solutions or approaches have been used independent of one another; conversely, this guide advocates for the integration of multiple solutions and approaches to form a more comprehensive strategy.

Acknowledgements

This **Water Circularity Good Practices Guide** was developed through collaboration with the Beverage Industry Environmental Roundtable (BIER). As industry leaders, these global beverage companies developed this guide to advance the sector's sustainability and stewardship objectives. This guide is intended to complement its forebearer **The Context Based Decision Water Guide for Reuse and Recycling**, which urged the transition to go "beyond reduction", and further to promote integrated, comprehensive, and community-based watershed management decisions. By increasing awareness around water circularity means, pathways and solutions, this guide aims to demystify circularity and make solutions approachable to everyone regardless of where they are on their stewardship continuum.



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About the Beverage Industry Environmental Roundtable (BIER)

The Beverage Industry Environmental Roundtable (BIER) is a technical coalition of leading global beverage companies working together to advance environmental sustainability within the beverage sector. BIER aims to affect sector change through work focused on water stewardship, energy efficiency and climate change, beverage container recycling, sustainable agriculture, and eco-system services. For more information, visit www.bieroundtable.com.

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