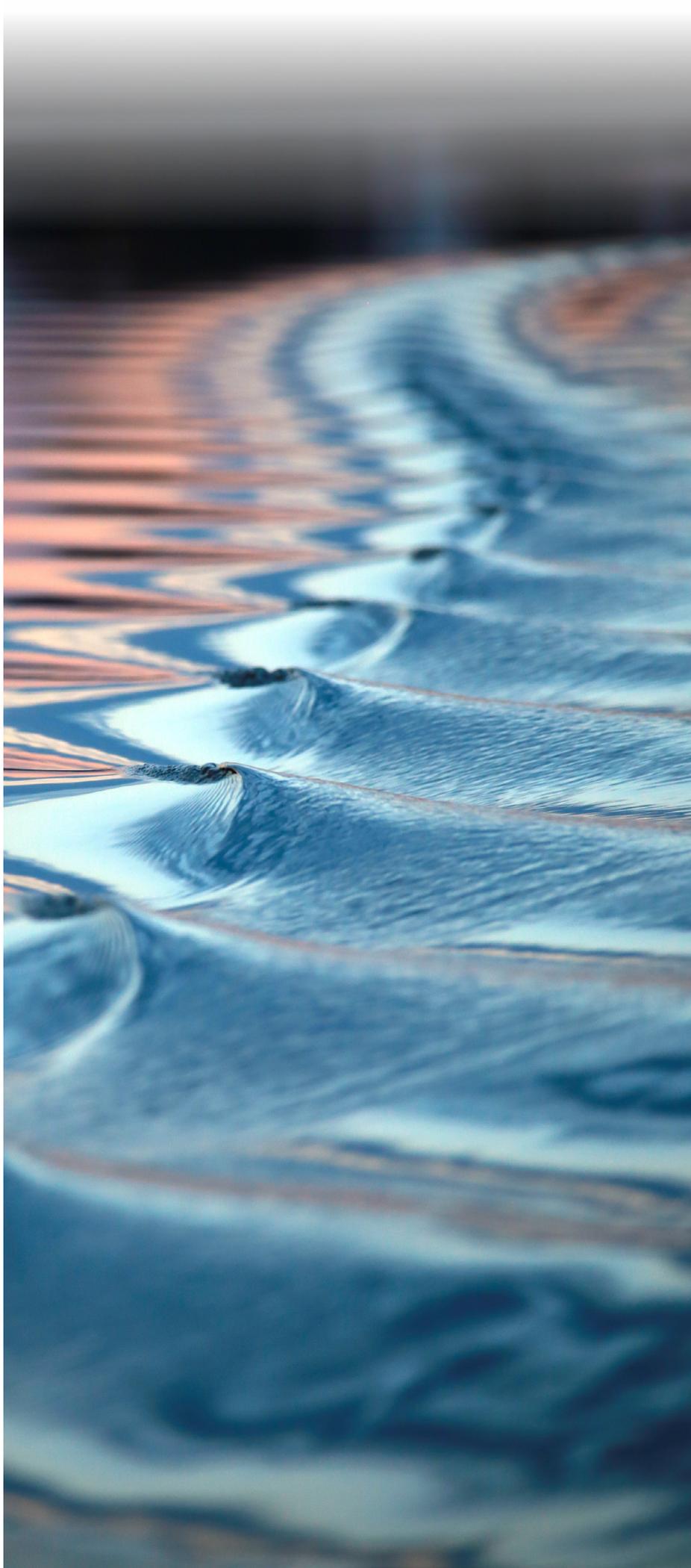


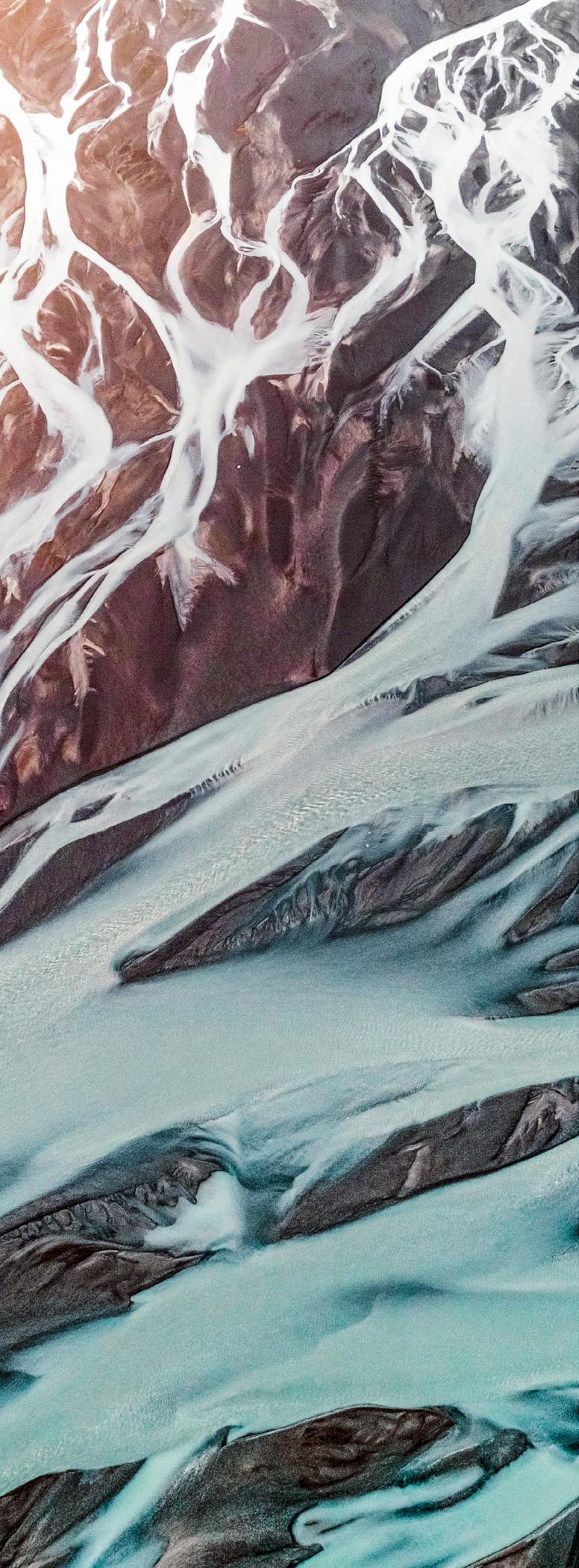
Water in a changing climate:

Reducing risks,
leveraging opportunities
and enhancing resilience

March 2022

*This white paper was produced in partnership between
WSP and the Alliance for Global Water Adaptation*





Understanding climate-related risks and resilience is a journey

Resilience is a journey, not a destination. As the climate has changed, so too have the approaches needed to understand and proactively address associated risks and opportunities. Utilities, governments and corporations across all sectors are realizing that looking to the past is no longer sufficient to plan for our future in a changing climate.

Strategies to adapt and enhance resilience to climate change should be robust, flexible and able to respond to a wide range of futures. They should be crafted in a holistic, transparent and inclusive way. Frameworks and processes to support organizations in making decisions about climate change must also be adaptive, and organizations must realize that climate resilience work will require constant monitoring, evaluation and continued action.

Water and climate change go hand in hand. Since life depends on water, projected changes in precipitation patterns due to climate change are an increasing global concern. Water utilities, by their nature of ensuring customer access to water, are especially realizing the urgency to proactively prevent the worst climate futures. Many are already weaving climate change considerations into their integrated resource planning, supply chain sourcing and capital planning decisions.

However, to truly create a more resilient future, the mainstreaming of climate change considerations into decision-making must occur more ubiquitously, and more quickly, across all organizations.



New frameworks can help organizations enhance their climate and water resilience

There are two iterative approaches to manage climate-related risks that go hand in hand: identifying an organization's climate-related risks and opportunities, and then determining the organization's resilience. **This paper dives into two frameworks that can guide organizations along their climate-resilience journey.** These frameworks can help organizations facilitate discussions around climate impacts and develop a strategy to begin mainstreaming climate change into organizational decision-making with the goal of enhancing their resilience to known and unknown climate-related shocks and stresses.

These frameworks are unique for two reasons:

- 1. Traditional organizational decision-making tends to focus on the short-term, but climate change decision-making demands decisions and planning for both short- and long-term.** The unique aspects of decision-making to address climate change are the longer-term time horizons, uncertainties, multi-system impacts and high complexities associated with climate-related risks. These elements of decision-making can be challenging to integrate into near-term decision-making processes. For example, when planning for investment strategies, such as the decision of when to invest in upgrading a water treatment plant or to replace water delivery pipelines, organizations need to assess how existing operations are already being affected by climate change and how strategies need to be adjusted or adapted to address these changes in both the short- and long-term. This can be challenging for organizations to grapple with, but these frameworks can help an organization's functional leaders explore the impacts of certain decisions under uncertain futures or conditions.
- 2. Traditional decision-making for climate change requires robust scientific understanding of potential future impacts of climate change and access to best available data and information,** such as climate models, scenarios and meteorological data. However, traditional approaches can be hindered when data is not available and models are inconclusive, contradictory or overly complex, which can lead to uncertainty. For example, a utility may be hesitant to plan for an increase in microbursts, or an increase in wildfire conditions, because there is still a good amount of uncertainty about how future climate conditions may change the intensity or frequency of these events. However, postponing action until the data is perfect will result in a lack of action, possibly to the detriment of the organization, its customers, or the surrounding community. Therefore, it is important to consider flexible decision-making processes that assume there will be uncertainty and contain mechanisms to react and respond in the face of uncertainty.

The ability to make meaningful decisions under the uncertainty and complexity associated with climate change also requires a shift to a systems approach that allows for more dynamic and adaptive planning through participation of multiple stakeholders and collaboration with experts. The frameworks presented in this paper aim to:

- Enhance connections across various business functions within an organization;
- Improve exchange of multidisciplinary, decision-useful information;
- Increase understanding of existing and potential climate-related risks; and
- Better formulate risk reduction plans and visualize desired outcomes, co-benefits and trade-offs.

The two frameworks presented in this paper take a systems approach to achieve coordination, transparency and alignment of common goals among stakeholders. These two frameworks, if used together, can help take organizations one step further and connect their understanding of shared climate-related risks and opportunities to develop an adaptive resilience strategy that could inform more consistent decision making across all levels of an organization and beyond – including ecosystems, communities and supply chains.

- **Business Function Mapping Framework (BFMF).** Between 2018–2020, seven U.S.-based water utility members of the Water Utility Climate Alliance (WUCA) co-designed a comprehensive, enterprise-level framework to help utility leaders understand the exposure and sensitivities of their business functions in a changing climate.¹ The resulting [Mapping Climate-related Risks and Opportunities to Water Utility Business Functions Framework](#), and its 2021 update [An Enhanced Climate-Related Risks and Opportunities Framework and Guidebook for Water Utilities](#) (referred to in this paper as the Business Function Mapping Framework, or BFMF) are intended to serve as a replicable, iterative and tailorable approach that utilities and other organizations, such as corporations or governments, can adapt and follow. The BFMF provides the steps designed for individual utilities to understand, assess and address climate-related risks and opportunities associated with their critical business functions.

¹Seven utilities include: Austin Water, Denver Water, Fort Collins Utilities, New York City Department of Environmental Protection, San Diego Public Utilities Department, San Francisco Public Utilities Commission (SFPUC), Salt Lake City Department of Public Utilities, Southern Nevada Water Authority (SNWA), and Tampa Bay Water.



- **Water Resilience Assessment Framework (WRAF).** The [Water Resilience Assessment Framework](#) was developed by the Pacific Institute, CEO Water Mandate, Alliance for Global Water Adaptation, World Resources Institute and International Water Management Institute. It was launched in 2021 to facilitate a shared understanding of water system resilience and allow practitioners to develop common measurable goals and outcomes for stakeholder and resilience planning. The WRAF was designed to be used by a wide variety of stakeholders such as utilities, corporations and watershed managers.

To help our clients make climate-informed decisions under uncertain circumstances, WSP has been leveraging lessons learned and the tabletop exercise approach from Federal Emergency Management Agency’s (FEMA) Long-Term Community Resilience Exercise Resource Guide. We have taken a format of a traditional tabletop exercise – originally designed to test how processes, plans and people *do* function in an emergency – and leveraged virtual tabletop exercises to explore how processes, plans and people *could* function under different future climate scenarios. The BFMF was originally designed in 2018 in partnership with seven member utilities of WUCA and then pilot tested with two water utilities in 2020 (Box 1). With the 2021 release of the WRAF, we are exploring adding a resilience assessment and strategy development layer onto our existing climate-related risk and opportunity assessment approach – taking this tabletop exercise approach to the next level.

Although both frameworks can be applied by organizations as a standalone approach to inform decisions in a changing climate, these frameworks can be used in tandem. The BFMF helps organizations explore climate-related risks and opportunities relevant to their business functions, whereas the WRAF encourages organizations to take a broader view – and start moving from reducing climate-related risks and leveraging opportunities to developing a resilience strategy taking a systems approach. Resilience in planning is emerging as a way for organizations to take a systems approach to climate-related decision-making under climate shocks, stresses and change.

Although both frameworks were designed with and for water utilities, the approaches have broader applicability. Ultimately, these frameworks can be used by any organization that wishes to enable inclusive collaboration, resulting in an improved understating of the ways climate change may exacerbate their existing underlying conditions and stressors and potential solutions to address these impacts.

IN PRACTICE: TABLETOP EXERCISE

In 2020, WSP tested, updated, and refined the Mapping Climate-related Risks and Opportunities to Water Utility Business Functions Framework in partnership with two U.S.-based water utilities, Denver Water and San Francisco Public Utilities Commission, through a series of internal, interactive and virtual tabletop exercises. Tabletop exercises provide a structured approach for utilities to develop a common understanding of their existing and potential risks and opportunities related to climate change, as well as identify resource and capacity building requirements, strengths, areas for improvement, solutions and potential best practices.

During the virtual tabletop exercises, participants were able to break down silos and come together as a diverse group to share multi-disciplinary knowledge, collaboratively address questions and concerns and co-develop solutions. While climate change may impact these utilities and their respective business functions in different ways, the underlying conditions and climate stressors they face were similar and staff were able to relate to those similarities and find ways to collaborate to increase their preparedness to climate change.

Business Function Mapping Framework



HOW TO READ THIS GRAPHIC:
Steps in gray are the "BASIC" steps utilities can take to begin identifying climate risks and opportunities.
Steps in blue are the "ADVANCED" steps for those utilities who may already be on their journey to assess climate change impacts to critical business functions and are working to more holistically mainstream climate risks, adaptation and resilience into all relevant plans, policies and procedures.



Figure 1. The Business Function Mapping Framework.

Business Function Mapping Framework

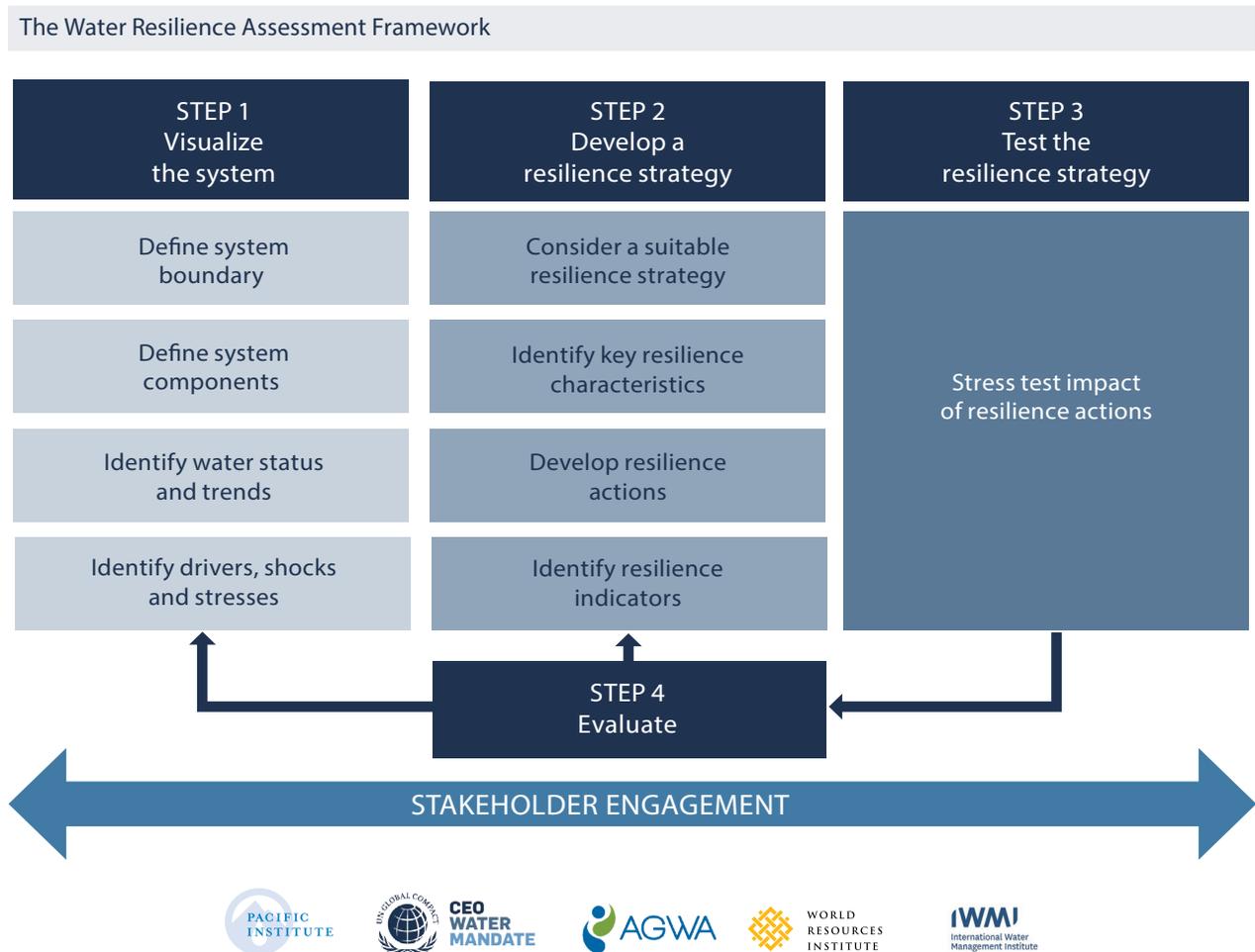
Between 2019-2021, WSP supported Denver Water and the San Francisco Public Utilities Commission (SFPUC) through the conduct of interactive tabletop exercises to map climate-related risks and opportunities to the utilities' mission-critical business functions. Originally deployed by the military to simulate various emergency or rapid response situations and practice strategic planning, tabletop exercises that are designed to prepare for and adapt to various systemic threats (like climate change or social cohesion erosion) can test the potential impacts of climate change on organizational preparedness, response, recovery or resilience. The approach to tabletop exercises that we are exploring in this article is based on a pilot testing of the Mapping Climate-related Risks and Opportunities to Water Utility Business Functions Framework that was initially developed in partnership with seven member utilities of WUCA from 2018-2019. The pilot testing between 2019-2021 resulted in the development of an updated version of the framework that we discuss in this article – the BFMF.

A tabletop exercise is typically held in a setting intended to generate discussion of various issues regarding a hypothetical, simulated emergency, or threat. In the context of climate change, tabletop exercises can facilitate conceptual understanding of the topic, identify areas for enhancement and encourage participants to problem-solve and co-create solutions together. An effective tabletop exercise comes from active participation and focused facilitation.

The BFMF was groundbreaking in that it was the first time a tabletop exercise approach was used to understand and identify measures to address the current and future impacts of climate change on mission-critical business functions across water utilities. To design the BFMF, we leveraged insights from FEMA's Long-Term Community Resilience Exercise Resource Guide and the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

While this framework leads to identifying risks and opportunities for use in strategic planning and prioritization activities, it does not assess the climate adaptation or climate mitigation measures needed to create a more sustainable and resilient future. That is where the BFMF can be supplemented by the Water Resilience Assessment Framework.

The Water Resilience Assessment Framework



Source: Water Resilience Assessment Framework, CEO Water Mandate, UN Global Compact | Pacific Institute

Figure 2. The Water Resilience Assessment Framework.

Water Resilience Assessment Framework

The Water Resilience Assessment Framework, developed by the Pacific Institute, CEO Water Mandate, Alliance for Global Water Adaptation, World Resources Institute, and International Water Management Institute and launched in 2021 emerged from the need to help organizations, such as utilities, build resilience. The aim is to prevent shocks and stresses from becoming crises and allow organizations to survive and thrive despite shifting climate conditions. The WRAF is composed of four steps: (1) visualize the system, (2) develop a resilience strategy, (3) test the resilience strategy, and (4) evaluate (Figure 2). Regarding the resilience strategy, the WRAF identifies three strategy types – persistence, adaptation and transformation – which are selected based on the types of disturbances affecting, or anticipated to affect, the system.

The WRAF was designed to supplement existing frameworks and water management approaches, not replace them. In combination with an existing framework an existing framework, the WRAF can add a resilience layer to existing water management and risk assessment approaches. The flagship WRAF document is not overly prescriptive, allowing the framework to be applied in a variety of contexts and sectors and adapted based on institutional capacity and constraints. While the WRAF approach has not been tested yet, the authoring organizations are actively seeking partnerships with organizations interested in testing the concepts.

These frameworks have unique characteristics and synergies that can be leveraged together to help an organization achieve its goals

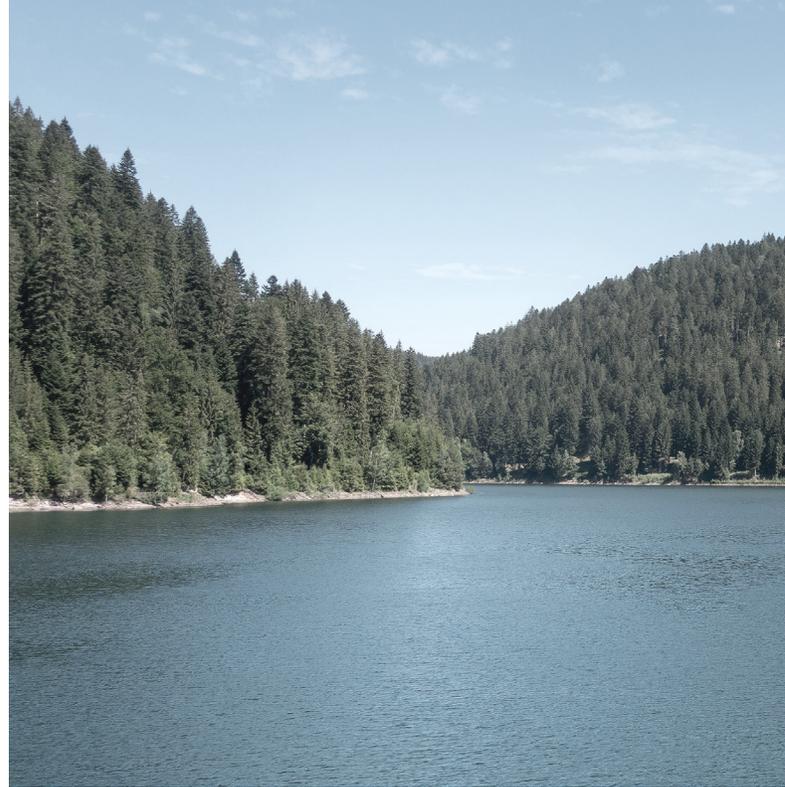
The BFMF focuses on understanding and identifying climate-related risks and opportunities for business function leads across an organization. It is not intended to go so far as assessing the resilience of a strategy or the organization itself. However, due to the cascading and far-reaching impacts associated with climate change risks, the need to enhance resilience to those risks should be a critical consideration. Since the WRAF was designed to be an add-on to existing frameworks add-on to existing frameworks, providing a resilience layer onto what organizations are already doing, we decided to layer the WRAF atop the BFMF to explore their synergies and unique characteristics (Figure 3).

Before the tabletop exercise

STEP 1: Initiate planning

Builds upon BFMF Step 1 (Define assessment objectives and initiate planning) and WRAF Step 1.1 (Define system boundary).

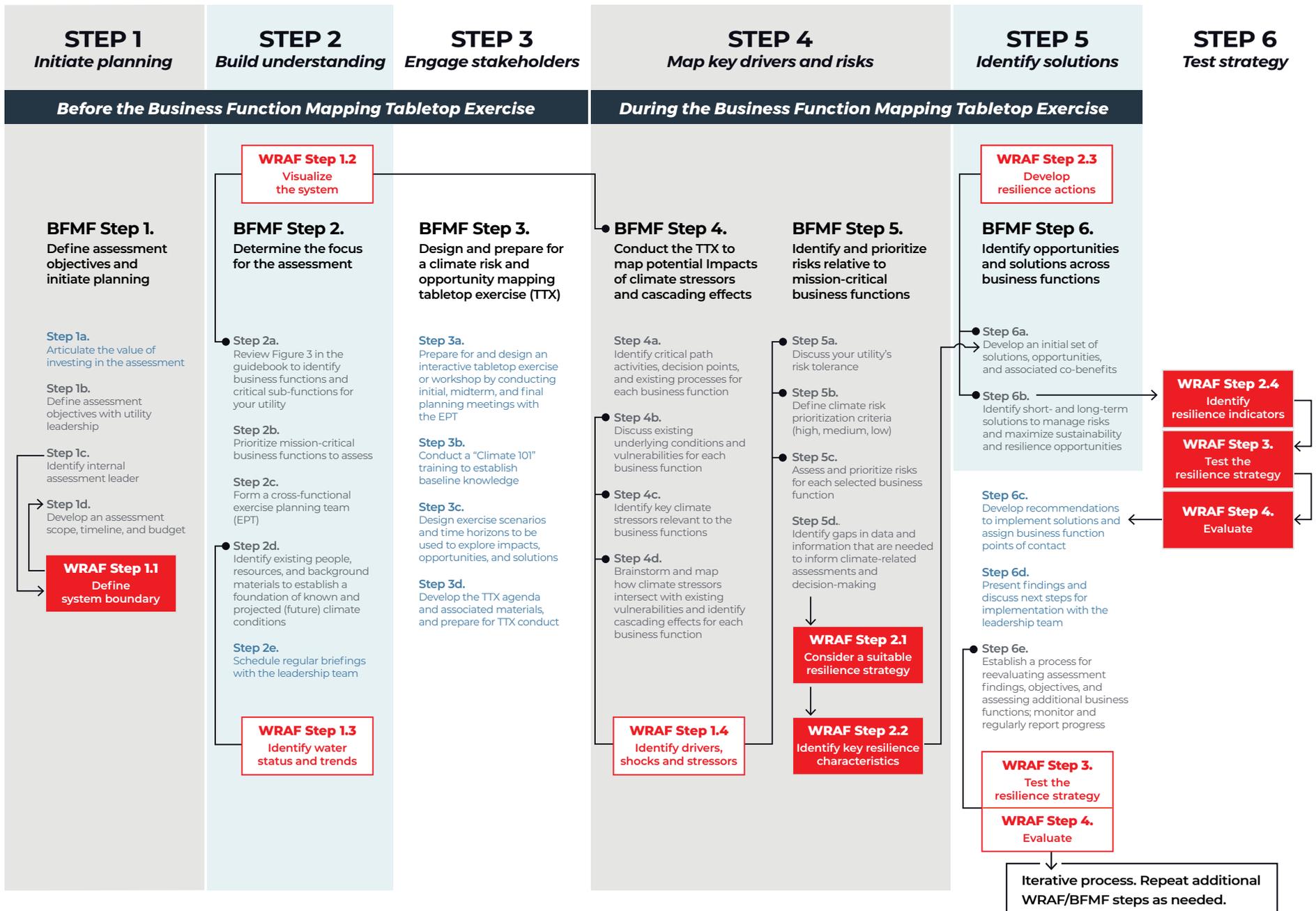
The critical first step that the BFMF articulates is the importance of securing leadership buy-in and managerial support necessary to begin mainstreaming climate adaptation and resilience across the organization. Critical steps that the BFMF includes are to articulate the value of the assessment (BFMF Step 1a) and to define the assessment objectives with leadership (BFMF Step 1b). After identifying an internal assessment leader (BFMF Step 1c), we recommend looking toward the WRAF framework to define the system boundary (WRAF Step 1.1) before developing an assessment scope, timeline and budget (BFMF Step 1d).



STEP 2: Build common understanding

Builds upon BFMF Step 2 (Determine the focus for the assessment) and WRAF Step 1.2 (Define system components), with an add-on of WRAF Step 1.3 (Identify water status and trends).

The purpose of the next step is to get the organization thinking about critical functions that the business relies upon (BFMF Step 2b) and to form a cross-functional working group. The working group should consist of champions willing and able to lead and navigate climate risks, opportunities and resilience assessment process. The working group should think of the organization as a system and consider all the components that make up that system, including geography, project conditions, and/or stakeholders involved (WRAF Step 1.2). Once the system boundary is defined and key system components are identified, organizations can begin establishing foundational knowledge and common understanding of current state and recent trends (e.g., creating historic water accounting in WRAF Step 1.3, or projected climate conditions in BFMF Step 2d).



WRAP # WRAP add-ons to BFMF

WRAP # WRAP steps in BFMF

BFMF steps in gray are the "BASIC" steps utilities can take to begin identifying climate risks and opportunities.

BFMF steps in blue are the "ADVANCED" steps for those utilities who may already be on their journey to assess climate change impacts to critical business functions and are working to more holistically mainstream climate risks, adaptation, and resilience into all relevant plans, policies, and procedures.

Figure 3. Assessing water resilience as an add-on to a climate risk and opportunities assessment. The WRAF (white and red) is layered onto the existing BFMF (shown in the columns, in black and blue text). The white WRAF steps are those that are, to some degree, already included in the BFMF, while the red WRAF steps are additions to the BFMF. To use the combined framework, follow the steps of the BFMF and add the WRAF steps at the signaled juncture.

STEP 3: Engage stakeholders across mission-critical business functions

Builds upon BFMF Step 3 (Design and prepare for a climate risk and opportunity mapping tabletop exercise).

This step is entirely unique to the BFMF which was designed specifically to walk an organization through the detailed process they could take to leverage a tabletop exercise approach to identify climate-related risks and opportunities across the organization. A key sub-step of this approach is to conduct a “Climate Change 101” training or orientation with the tabletop exercise participants in advance of the workshop or tabletop exercise (BFMF Step 2e) to achieve level setting and allow for a safe space for participants to ask questions. Cultivating baseline climate competencies across business functions is critical before moving forward in the process, as without a common language and understanding of what climate change could mean for different functions and their roles within the organization, it would be challenging to promote active engagement in the exercise and achieve desired outcomes.

During the tabletop exercise

STEP 4: Identify and prioritize key drivers and stressors and map them to mission-critical business functions

Builds upon BFMF Step 4 (Conduct the tabletop exercise to map potential impacts of climate stressors and cascading impacts), BFMF step 5 (Identify and prioritize risks relative to mission-critical business functions) and WRAF Step 1.4 (Identify drivers, shocks, and stresses) with an add-on of WRAF Step 2.1 (Consider a suitable resilience strategy) and WRAF Step 2.2 (Identify key resilience characteristics).

In this step, through facilitated discussions (e.g., a tabletop exercise in BFMF Step 4), engaged stakeholders can start to identify existing underlying conditions and vulnerabilities for each business function, understand which climate drivers and stressors are relevant, identify the cascading effects that may take place, and brainstorm how the climate stressors intersect with existing vulnerabilities (BFMF Step 5 and WRAF 1.4). For example, organizations can discuss their risk tolerance (BFMF Step 5a), define climate risk prioritization criteria (BFMF Step 5b), assess, and prioritize risks (BFMF Step 5c), and identify data gaps that are needed to be addressed to make climate-informed decisions. To take a systematic approach to understanding and addressing identified drivers, shocks and stresses, it is important to consider an appropriate resilient strategy (WRAF Step 2.1) by adopting a “what if?” future mindset. The WRAF identifies three types of resilience strategies: (1) persistence, (2) adaptation and (3) transformation. Different strategies might be appropriate for different components of a system and

may be adjusted over time. Once a strategy is selected, supporting characteristics (WRAF Step 2.2) can be identified during the tabletop exercise to unveil ways to operationalize the strategy.

Organizations with complex structures can consider a hybrid resilience strategy, under which one system component may fall under adaptation, while other components could be under either persistent or transformative strategies.

STEP 5: Identify resilience solutions and innovative actions

Builds upon BFMF Step 6 (Identify opportunities and solutions across business functions) and WRAF Step 2.3 (Develop resilience actions) with an add-on of WRAF Step 2.4 (Identify resilience indicators).

The next steps are about identifying and co-designing solutions and innovative actions. Once organizations identify an initial set of ideas and solutions through the tabletop exercise discussion (BFMF Steps 4 and 5), these solutions could form the basis to operationalize the resilience strategy (WRAF Step 2.3). These actions should complement and build on any sustainability, security, risk reduction, hazard mitigation, resource management, or stewardship activities already taking place. Co-designing innovative actions that haven’t been considered in the past are necessary to address the complexity that climate change poses to our critical systems and services. Actions can be prioritized based on level of impact, timelines, cost to implement, co-benefits and availability of resources. Once actions are selected, corresponding indicators should be identified (WRAF Step 2.4) to support testing the resilience strategy.

After the tabletop exercise

STEP 6: Test the resilience strategy and evaluate outcomes

Builds upon the WRAF Step 3 (Test the resilience strategy) and WRAF Step 4 (Evaluate).

We propose the third step in the WRAF — test the resilience strategy — come after fully employing the BFMF. This step is focused on using stress testing to clarify how well the resilience actions respond to climate-related shocks and stresses, as well as how effectively they support the goals of the selected resilience strategy. Leveraging a tabletop exercise approach can not only use the BFMF to develop the organization’s resilience strategy, but also test the resilience of the strategy under various future scenarios.

Both the WRAF and BFMF have been designed as iterative processes intended to revisit and refine previous steps. Many users may need more than one cycle of developing and testing resilience actions and adjusting the selected strategy based on an improved understanding of the system (WRAF step 4) and the impacts of real-time climate or extreme weather events that impact the system.



What's next?

The BFMF and WRAF provide a structured approach for an organization to understand, assess and enhance their overall resilience to systemic changes – climate change being one of many. However, both frameworks are intended to be used as planning exercises in preparation for implementation. After understanding resource and capacity building needs, identifying gaps and areas of improvement, and prioritizing resilience actions, organization leaders can collaborate internally and externally to co-develop implementation strategies which will help them allocate resources effectively and leverage available and relevant capabilities. These efforts should form part of a continuous and iterative improvement process that can take place before, during, or after the approaches described in this article. Moving into implementation, climate-related risks and opportunities can be mainstreamed into day-to-day operations and actions can be monitored and evaluated to determine their effectiveness lessons learned can be regularly reviewed, evaluated and shared. Over time, successful and time-tested actions can be effectively integrated into organizational plans, policies and procedures, enhancing organizational resilience and preparedness to future climate change impacts. While actions will be taken by organizations, it also is important to consider wider policy and regulatory trends outside the organization to minimize any unintended consequences of actions that could be negated by factors outside of the organizations control, such as regional or national regulations or resource (financial or staff capacity) restraints. It is intended that through the work of enhancing resilience, an organization also can improve business security, employee safety and well-being, and promote greater collaboration and transparency today and into the future.

This white paper was authored by:

- Kimberly Grubert (WSP)
- Alua Suleimenova (WSP)
- Kari Davis (AGWA)

The authors thank the following experts for providing their experience, insights and feedback on this paper:

- Allie Reilly (WSP)
- Eliza Roberts (WSP)
- Emily Wasley (WSP)
- John Matthews (AGWA)
- Gregg Brill (Pacific Institute/CEO Water Mandate)



WSP is one of the world's leading professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, architects, planners, surveyors and environmental specialists, as well as other design, program and construction management professionals. We design lasting solutions in Transportation, Property and Buildings, Earth and Environment, Energy, Water, Climate, Resilience and Sustainability, as well as offering strategic advisory services. With more than 12,000 in the U.S. and 50,000 talented people globally, we engineer projects that will help societies grow for lifetimes to come.

For more information contact:

Kimberly Grubert
kimberly.grubert@wsp.com

Emily Wasley
emily.wasley@wsp.com

wsp.com