Tools for Utility Risk and Resilience Planning:
A Guided Inventory

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Service delivery interruptions due to unforeseen events can be inconvenient or costly at best, and dangerous at worst. Luckily, there are many free tools and resources available to help you get started with basic steps towards a more resilient and prepared utility or system. Strengthening your basic business functions is the foundation for resilience—it is not just about an emergency plan. The Environmental Finance Center Network (EFCN) provides courses, training, and technical assistance in a variety of technical, managerial, and functional areas; especially in asset management, financial planning, and workforce development and selected operations-oriented technical topics. The last section of this inventory provides links to those additional training and assistance resources. This guide first reviews some basic concepts like those covered in our training and presents a guided tour of the many free tools for utility risk and resilience management available from the United States Environmental Protection Agency (EPA). Each resource has a direct hyperlink to its source on the web.

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1. Basic Frameworks for Resilience Work

A good place to start from among the free tools developed by EPA is to adopt a framework of ongoing steps you will take as a lifeline enterprise. EPA's Route to Resilience consists of a five-step framework that defines basic and more advanced objectives for a utility program, and identifies links to other tools. It is well-suited to small systems. It is oriented towards physical and security (malevolent acts) risks. It is a good place to start to take steps to meet the risk and resilience and emergency planning requirements under America's Water Infrastructure Act (AWIA). EPA provides an Emergency Response Plan Template for Drinking Water Utilities to meet AWIA requirements for the emergency plan. The template includes

links to many useful Incident-Specific Response Procedures (ISRPs) and "rip and run" checklists. Also useful to effective preparedness is the Flood Resilience Checklist developed in EPA's Smart Growth program.

For a look at broader frameworks in more depth, the Water Utility Climate Alliance (WUCA) and Water Research Foundation jointly have developed a detailed guide and test of approaches in a free report, "An Enhanced Climate-Related Risks and Opportunities Framework and Guidebook for Water Utilities Preparing for a Changing Climate." While it has been conducted with large utilities such as Denver Water, specifically aimed at climate impacts, the guidebook illustrates how resilience must be built around a total approach to business functions for any vulnerability. Figure 1, which the University of Southern Maine uses in our training on resilience, highlights that crisis and emergency resilience is built on strong ongoing business functions. An excellent webinar featuring several projects and practice leaders from the WUCA utility alliance is (as of 2022) still available from the American Society of Adaptation Professionals (ASAP) at their YouTube Channel: Co-Creation Webinar 8: Designing Utilities of the Future.

Figure 1: Resilience is Built on Your Total Business Capacities

2. Identify Vulnerabilities and Threats to Resilient Service, and the Specific Assets Affected

Resilience, as well as emergency response planning work, depends on the first step of identification of vulnerabilities and of the specific assets that may be affected. Assets include not only physical resources, whether a circuit breaker panel or an entire water treatment works, but also business functions and supporting resources, including how workforce availability may be affected. That is why we emphasize in our trainings that resilience management means taking stock of your entire business and its ongoing

capabilities and readiness (see Figure 1). There are several available drinking water utility-focused tools for vulnerability assessment covered here.

EPA's Vulnerability Self-Assessment Tool (VSAT) is a web-based, guided program that takes you through a step-by-step process that begins with identifying threats and then pairing each threat with assets that could be impacted. This "qualitative risk assessment" is the basic step needed to satisfy the AWIA act. The pairing of threats and assets is qualitative risk assessment—also traditionally called vulnerability assessment. The VSAT tool can be used to go the next step to a quantified risk assessment that puts possible future losses and loss reduction actions (countermeasures) into dollars and cents. Information on types of threats and types of water utility assets including estimates of general costs for damage and general likelihood of impacts are pre-loaded in VSAT. The utility user must make judgments about threat consequences, possible risk-reducing countermeasures and other inputs with the help of pre-loaded information. These judgments can include percentages of damage, service days lost, injury and fatalities, among others.

When fully loaded with all information, the VSAT tool then produces a baseline scenario which quantifies in financial and economic terms, as much as possible, the possible consequences of the identified threats for the potentially impacted assets. In this and related tools, the baseline scenario is the measure against which expected losses to an asset can be measured and then compared to proposed future loss reduction (avoided losses) that may result from "countermeasures" (i.e., risk mitigation). Basic to the risk management approach is the use of cost-benefit analysis. This means trying to monetize possible losses, possible avoided losses from mitigation actions, and the cost of the actions, in order to see if the possible benefit in avoided future losses is more than the cost of mitigation action investments. Of course, there is more to these decisions than just that analysis, such as needs for and co-benefits from system upgrades, and protecting life safety. The challenge of risk prioritization is discussed in Section 3 below.

There is also a manual Small System Risk and Resilience Assessment Checklist available from EPA without working through the online VSAT tool. It is oriented towards smaller drinking water systems serving populations between 3,301 and 50,000. This checklist is no less comprehensive in the threats listed than the web-based VSAT (Section 1 above). This checklist can be a good starting point for understanding and organizing the information needed for risk assessment of vulnerabilities and assets for any size of utility. It was developed with input from stakeholders like the state-based Rural Water Associations that serve many of the smaller utilities. Conducting a qualitative risk assessment using either VSAT or this Small Systems Checklist will satisfy AWIA's self-certified assessment requirement.

There is also a related tool, the Resilient Strategies Guide (RSG). The RSG is a programmed tool that water, wastewater, and stormwater utilities complete on the web. The RSG tool takes the user step-by-step through setting priorities for threats and vulnerabilities and the affected assets to consider, and risk reduction countermeasures to consider for planning. An additional step takes the user through consideration of funding options for proposed risk reduction. Costs and benefits are not measured within the tool, but the result is an assessment of what the utility should measure to develop a priority risk management strategy.

The RSG is part of suite of several inter-related tools from EPA's [Creating Resilient Water Utilities Initiative](#) (CRWU) which includes tools for the full process of quantified risk assessment and management. The focus of the suite is on climate-driven hazards, but the tools can help with risk management in general as a planning tool. The additional resource tools include a [case study library and exchange](#)—a source of ideas and lessons for strategies from other utilities—as well as tools providing information on possible [future climate conditions](#) and impacts and access to the [CREAT](#) tool. The [Climate Resilience Evaluation and Awareness Tool](#) (CREAT) is in certain ways the most advanced of the multiple resources discussed so far. The VSAT and RSG tools (or Small System Risk and Resilience Checklist) all provide needed input information on priority risks and assets for using the CREAT tool.

The CREAT tool is specifically designed to help utilities plan for emerging and as-yet-unrealized risks from climate change in the future and to help make the challenging judgments of whether it makes economic sense to invest now to reduce impacts to service continuity in the uncertain future. To accomplish this, CREAT includes a tool to access and develop future conditions scenarios from current climate science information, and tools to conduct analyses of the dollars and cents of possible risk reduction investments. The final aim is to see whether or not such risk reduction investments may deliver loss avoidance at least equal to if not greater than the costs of action. Thus, CREAT is an integrated suite of tools for which initial risk and resilience assessment is a starting point, whether from the RSG or VSAT tool.

Typically, about six hours of guided training with the CREAT application on EPA's computer cloud is needed to cover all parts of the tool. This training is available from the Climate Ready Water Utilities Initiative at EPA, and the EFC Network can also provide orientations. Results from all these tools must, of course, be further evaluated by the utility to determine what the priorities are for risk mitigation, including consideration of how to pay.

3. Prioritize Risks Based on Consequences and Likelihood

No tool can in itself prioritize which risks must demand action now, or in the future, or maybe at all. As discussed in trainings, once the needed information on threats, consequences, and affected assets is collected, risk prioritization is a matter of judgment—hopefully well-informed by information the tools help you acquire. The simple depiction of this task in Figure 2 below points out the three important categories to consider. In the upper right hand are risks that are both very probable and of high impact. This is best described as a manifest threat like a hurricane bearing down on your region. The hurricane warning may be out or even just a watch due to the uncertainty of the exact landing of the coming storm. Nonetheless, an event is happening, and the impacts are possibly high. Some action should be taken such as emergency procedures, impact preparations for service disruption and water quality monitoring, protection of vital personnel, and so on.

In the lower right-hand square are more challenging risks to judge and act on. You may only expect a hurricane, or major flooding or an earthquake at some unknown point, perhaps years in the future. But the consequences if you are not making risk reduction preparations and investments in your physical plant and other resources could be catastrophic to your service. The challenge is uncertainty—you have

to spend now to manage risk from an event in the future (which may not happen at all). Some utilities now plan to combine risk reduction with upgrades needed for their system, with the information to build future protection into designs. The upgrades have benefits and there is a possible payoff in avoiding losses to service or assets in unlucky future events that may happen.

Finally, in the upper left-hand box are risks that have minor or limited impacts now, but which are more likely to occur. The judgment to act or not act on such risks may depend on the criticality of the asset involved to operations, the available funding, or other resources to address it. But it also should depend on an understanding of trends in a changing environment. Drought impacts are one example. Periodic limited droughts are now trending into major prolonged ones, such as the Southwest U.S. mega-drought. Losses of source water recharge require action for the long-term, such as finding new source water, improving water loss reduction, and changing treatment to cope with poorer supply water quality. Vulnerability may increase to a higher level of consequence if action is delayed too long. Risks that are inconvenient now but not so consequential can grow into major threats. A number of risks like this may be changing and increasing in possible impact due to climate change. For example, in another non-natural hazard arena, threats to your cybersecurity are growing from a nuisance to potential service-stopping events and now are recommended by EPA to be routinely planned for as very likely. That is an example just recently of a nuisance risk becoming more consequential.
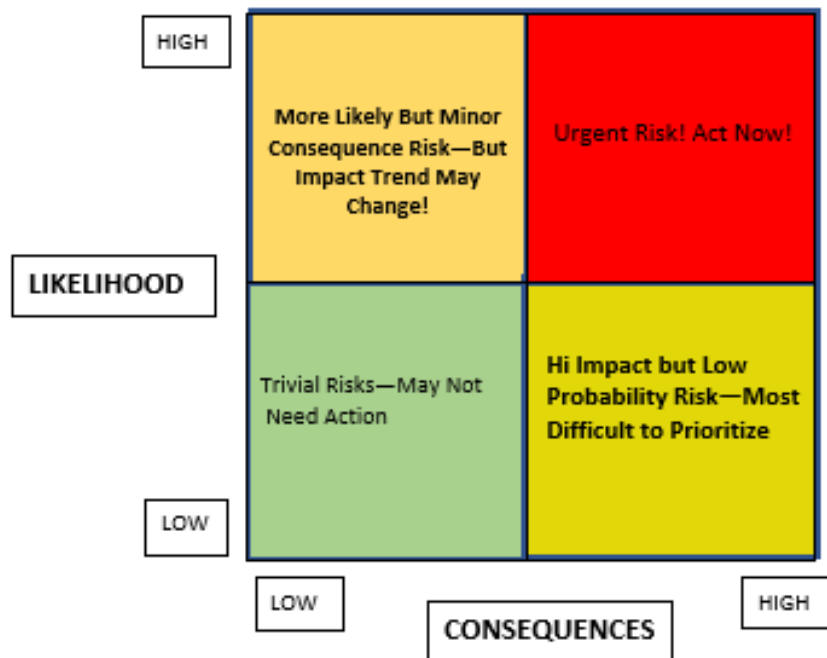

Figure 2. Basic Risk Prioritization

In the next two sections, we will look at tools aimed at such emerging threats to resilience.

4. Special Topics

Here are three aspects of resiliency management currently getting heightened attention, followed by some suggested resources for the ongoing necessity of financial resilience.

a. Getting a Handle on Climate

There is a great deal of current information on climate change on the web. It is a challenge to evaluate and understand it all without a navigator, such as your state's climatologist or resource specialist, or a local university scientist good at communication. The uncertainty about when and what change, and impacts, will occur is no easy task even for the specialists. A good, practical starting point is to see what the trends are in your region and the types of vulnerabilities to consider. You can start with the National Oceanic and Atmospheric Administration (NOAA) State Climate Summaries which have been updated through 2022. The brief, readable summaries highlight key trends and further sources of information. The EPA's Creating Resilient Water Utilities initiative (noted in Section 2 above) provides several accessible sources of climate trend information including the stand-alone Climate Scenarios Projection Map which is part of the CREAT tool; the Storm Surge Inundation Map; and the Streamflow Projection Map. These interactive maps and others provide planning-level information that is useful for an overall picture of important threat trends in different areas of the United States. The Climate Module in the CREAT tool uses all this information to allow a utility to construct selectively tailored future climate scenarios for initial planning. Information is also available from NOAA's climate hub, and from the organization Climate Central. Also useful to water supply utilities is the U.S. Drought Monitor, again at a general level. The next step is to be sure to connect with your State Hydrologist office and/or State Climatologist office for current information on source water supply, hazards, and future trends.

b. Cybersecurity

Malevolent acts can disrupt online control and SCADA (Supervisory Control and Data Acquisition) systems, and other computer-based business functions. Theft of billing information and denial of computer service attacks are now recognized as serious vulnerabilities for our utilities. In 2021, the federal government raised the likelihood standard for risk from 0.10 for control systems like SCADAs, and 0.30 for business functions like financial systems, to 1.0 in 2021. That means the existing odds of a 1 in 10 or 10 percent risk per year for control systems and 30 percent or almost 1 in 3 odds for ordinary billing and financial systems has been raised to an extraordinary 1.0 risk level or 100 percent. This means that utility managers should always expect that cyber threats can happen and should adopt constant, ongoing practices for protection. The EFC Network has recently published a concise blog on

basics of cybersecurity with links to several national resources. This is an excellent single starting point. Every lifeline utility needs to practice what are today called good "cyber hygiene practices."

USEPA has also instituted a free ongoing cybersecurity technical assistance service specifically for water utilities via arrangement with a key water sector contractor. Over 100 utilities have received various help with preparedness, response and recovery for cyber incidents of all kinds through mid-2022. The Cybersecurity and Infrastructure Security Agency (CISA) is a program within the federal Department of Homeland Security (DHS) that offers information and assistance. The Water Information Security and Analysis Center (Water ISAC) is a non-profit membership program that provides security alerts and guidance for the water infrastructure sector nation-wide in cooperation with federal agencies. The National Cybersecurity Alliance is a non-profit aimed at businesses which provides useful educational resources.

c. External and Community Partners

More attention is being paid to "Community-Based Water Resiliency" (CBWR) in the water utility sector and in EPA's technical assistance efforts. Ideally any utility should have mutual aid agreements with emergency response resources appropriate to their needs. This is supported by joining their state WARN (Water and Wastewater Agency Response Network). Increasingly complex and multi-faceted hazards and risks have led to recognition that a water utility needs to go "beyond the billing relationship" and beyond traditional incident-focused mutual aid arrangements with other water utilities and first responders to engage both those that depend on them (e.g., customers and institutions like hospitals) and those that utilities themselves depend on for critical resources (e.g., electric power providers, key vendors, other public agencies) on a regular basis.

Interdependency is the vital idea when it comes to Community-Based Water Resiliency. One example is how safe drinking water utilities must engage cooperation from their customers to manage demand during both short-term supply shortfalls and extended ones due to drought or other impacts. More than a one-way communication, this requires an ongoing relationship that cannot be effectively created overnight. Some utilities have begun meeting annually with key community organizations as well as providers the utility itself will depend on in some situations. This creates understanding and robust lines of communication. Resources for CBWR now include a Community-Based Water Resiliency Guidebook and a do-it-yourself resource package for conducting training and exercises for community-based water resilience practices. Read the blog by the National Association of Development Organizations (an EFC Network partner) on the benefits of regionalization and the role councils of government can play as community partners with small utilities.

d. Don't Overlook Financial Resilience

Small utility finance needs have always been a core focus of the EFCs, and many resources are available to assist with rate-setting, general financial review, capital planning, and basic financial good practices

training. This [recent blog focuses on financial resilience](). Direct links are provided to a special financial resilience assessment tool. There are links to other basic finance tools in the blog as well, including rates dashboards and the full [financial health "check-up" tool]().

Regionalization is another strategy for sustainable financial resilience for small and rural water utilities, where it is appropriate and feasible. An [introduction to regionalization blog]() is available from the University of North Carolina EFC, and links to many resources on this topic.

5. Connect With Additional Resources and Training Opportunities

We have presented highlights of good places to start on various aspects of building resilience for your water system. For every topic there are additional training and assistance opportunities offered directly by the United State Environmental Protection Agency staff and/or programs and providers that EPA sponsors, including the Environmental Finance Centers. In addition to the hazards-specific and resilience topics discussed above, the EFCN provides training, technical assistance, and information resources on the wide variety of core business functions that resilience depends on (as illustrated in Figure 1 above). For example, responding to impacts without good asset management information, durable workforce preparation, and adequate financial basics can be difficult. These and other core topics are included in the portfolio of types of assistance the EFCN can offer. To make an inquiry and explore a match to your needs, visit the [EFC Network web page]() where you can request access to free training, one-on-one technical assistance, and a variety of resources in podcasts, blog articles, tools, dashboards, and more. [Click here to navigate to the EFCN Help Request forms]() (https://efcnetwork.org/get-help). We look forward to hearing from you.