

Sonoma Water

Final Report



Sonoma Water

Climate Adaptation Plan

Executive Summary

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Executive Summary

Sonoma Water has developed this Climate Adaptation Plan (CAP) to guide the assessment of climate risks to water supply, flood management, wastewater systems infrastructure and operations, and to serve as a roadmap for developing, evaluating, and implementing adaptation strategies to improve the resilience of its systems. Sonoma Water's mission is to protect the drinking water supply of more than 600,000 North Bay residents, manage flood control facilities in Sonoma County that impact thousands of residents and homes, and provide wastewater collection and treatment for 75,000 Sonoma County residents. Increasingly, climate risks pose a serious threat to how Sonoma Water continues to operate and maintain these services to its community.

Plan Objectives

The key objectives of the CAP are to:

- **Improve the understanding** of the relationship between climate variability and change and regional water supply, flood management, and sanitation systems.
- **Document and describe** the historical and projected **climate and hydrologic threats** to Sonoma Water's water supply, flood management, and sanitation infrastructure and operations.
- **Assess the vulnerability** of Sonoma Water's **water supply, flood management, and sanitation infrastructure and operations** to past and future projected climate conditions.
- **Identify high-risk infrastructure and operations** and identify inter-related risks between critical system components.
- **Identify, prioritize, and cost adaptation measures** to improve the system resiliency.
- **Develop a strategy for improving the resilience** of Sonoma Water's infrastructure and operations, and to assist in guiding future operations and infrastructure investments.



Robust Resiliency Planning Framework

Sonoma Water has applied a robust five-step resiliency planning framework that has helped organize and guide the planning process (Figure ES-1). This structured approach has been widely used in climate adaptation and resiliency planning efforts. Through this approach, Sonoma Water can be certain the resulting plan addresses the major climate risks affecting its systems and provides a framework to implement resilience through Sonoma Water activities and regional partnerships. The five distinct steps are linked through a cycle, or adaptive planning process. The planning process involves:

1. Problem scoping – Frame the questions to be addressed and systems and bounds of study.
2. Hazard understanding and mapping – Understand historical and future climate influences on system.
3. Vulnerability and risk assessments – Assess system vulnerability and risks to a range of future climate projection.
4. Adaptation strategy development – Identify and develop strategies to address climate-related risks to the systems.
5. Implementation and monitoring – Recommend approaches to implement strategies and monitoring to support adaptive management.

Figure ES-1. Climate Adaptation Planning Framework Used to Guide Planning Process



As more information is gained on new science or monitoring, the process should be revisited and updated to address the changing understanding of risk.

Science-based Approach to Regional Climate Change

The CAP has evaluated the historical climate trends and a range of future climate projections to develop scenarios of climate threats in the region. Building on global climate model projections, statewide assessments, and regional downscaling, the CAP summarizes the state of climate science and uses consistent, best-available science projections to develop scenarios of increasing temperature, rising sea levels, increases in extreme precipitation and river flooding, and changes in drought and wildfire frequency and severity. Table ES-1 summarizes the range of climate change considered in the CAP.

Table ES-1. Summary of the Range of Climate Change Considered in CAP

Hydroclimate Variables		Projected Trends
	Temperature	<ul style="list-style-type: none"> Increases up to 1.3 to 3.1°C by mid-century Increased frequency of temperature extremes (days hotter than 30°C or 86°F)
	Sea Level Rise	<ul style="list-style-type: none"> MSL increases by 0.1 to 0.6 meter (0.3 to 2 feet) by mid-century Storm surge will cause additional increases
	Precipitation	<ul style="list-style-type: none"> Extreme precipitation increases (ARs) by 15% Increased winter, decreased summer precipitation (more variability)
	Drought	<ul style="list-style-type: none"> Increasing intensity of drought conditions Increasing frequency and duration of dry weather conditions
	Wildfire	<ul style="list-style-type: none"> More frequent and intense wildfires due to warmer temperatures and drier conditions Increase in probability of wildfires by 15 to 33%
	River Flooding	<ul style="list-style-type: none"> Potential increase in AR-driven floods on Russian River 100-year flood magnitudes could increase by 10 to 20%

System Vulnerabilities and Risks

Climate threats to Sonoma Water’s water supply, flood management, and sanitation systems were comprehensively assessed. Climate change maps were developed; water supply and flood modeling were conducted on the Russian River and Santa Rosa Creek; and major facilities were visited and studied to assess vulnerabilities to future climate change. Vulnerability and risk assessments were conducted for the systems’ major components. The CAP identified the following major areas of risk:

Water Supply – Extreme drought on the Russian River; river flooding and wildfire risk at the Mirabel and Wohler diversion facilities; river flooding and extreme precipitation risk at the River Road and Wohler chlorination facilities; and extreme precipitation risk at the Ely and Kawana Booster Stations



Flood Management – Extreme precipitation, river flooding, and wildfire risk at Central Sonoma Watershed Project infrastructure; sea level rise and river flooding risk on the Petaluma River and on Sonoma Creek; river flooding risk on the upper Russian River; and sea level rise and river flooding risk on the lower Russian River and estuary

Sanitation – Extreme precipitation, river flooding, and sea level rise risks at wastewater treatment plants (WWTPs), collection systems, and reclamation systems

Table ES-2 summarizes the climate vulnerabilities identified in the CAP.

Table ES-2. Summary of Climate Vulnerabilities to Sonoma Water’s Water Supply, Flood Management, and Sanitation Systems (H=high, M=moderate, L=low vulnerability)

System	System Component	Temp	Sea Level Rise	Extreme Precipitation	River Flooding	Drought	Wildfire
Water Supply	Upper Russian River Supply (Watershed and Lake Mendocino)	Moderate	N/A	N/A	N/A	High	Moderate
Water Supply	Lake Sonoma	Moderate	N/A	N/A	N/A	Moderate	Moderate
Water Supply	Mirabel Diversion Facilities	N/A	N/A	N/A	High	Moderate	High
Water Supply	Wohler Diversion Facilities	N/A	N/A	N/A	High	Moderate	High
Water Supply	Wohler Chlorination and Corrosion Control	N/A	N/A	Moderate/High	Moderate/High	Moderate	Moderate/High
Water Supply	Mirabel Chlorination and Corrosion Control	N/A	N/A	Low	Low	N/A	Low
Water Supply	River Road Chlorination	N/A	N/A	Moderate/High	High	N/A	N/A
Water Supply	Ely Booster	N/A	N/A	High	N/A	N/A	N/A
Water Supply	Kawana Booster	N/A	N/A	Moderate	N/A	N/A	N/A
Flood Management	Central Sonoma Watershed Project (Zone 1A) – Detention Basins	N/A	N/A	High	High	N/A	Moderate
Flood Management	Central Sonoma Watershed Project (Zone 1A) – Triple Box Culvert	N/A	N/A	High	High	N/A	Moderate
Flood Management	Central Sonoma Watershed Project (Zone 1A) – Channels	N/A	N/A	High	High	N/A	Moderate
Flood Management	Petaluma River (Zone 2A)	N/A	High	High	High	N/A	N/A
Flood Management	Sonoma Creek (Zone 3A)	N/A	Moderate	Moderate	Moderate	N/A	N/A
Flood Management	Upper Russian River (Zone 4A)	N/A	N/A	N/A	Moderate	N/A	N/A
Flood Management	Lower Russian River (Zone 5A)	N/A	Moderate	N/A	Moderate	N/A	N/A
Sanitation	Russian River CSD - WWTP	N/A	N/A	High	High	N/A	Moderate
Sanitation	Russian River CSD - Collection	N/A	N/A	High	High	N/A	Moderate
Sanitation	Sonoma Valley CSD - WWTP	N/A	Moderate/High	Moderate	Moderate	N/A	Moderate/ Low
Sanitation	Sonoma Valley CSD – Collection	N/A	N/A	High	High	N/A	Moderate

System	System Component	Temp	Sea Level Rise	Extreme Precipitation	River Flooding	Drought	Wildfire
Sanitation	Penngrove SZ – Collection	N/A	Low	High	High	N/A	Moderate/ Low
Sanitation	Occidental County SZ – WWTP & Collection	N/A	N/A	Moderate	N/A	N/A	Moderate
Sanitation	Geyserville SZ - WWTP	N/A	N/A	Moderate	Moderate	N/A	N/A
Sanitation	Geyserville SZ – Collection	N/A	N/A	High	High	N/A	N/A
Sanitation	Airport SZ – WWTP	N/A	N/A	Moderate	Moderate	N/A	N/A
Sanitation	Airport SZ - Collection	N/A	N/A	Low	N/A	N/A	Moderate

Adaptation Strategies

Sonoma Water’s CAP team identified a range of adaptation project concepts and strategies to improve resilience through a series of interactive workshops. Over 250 specific concepts were initially suggested and through synthesis, about 80 concepts were retained and evaluated. Adaptation strategies and portfolios of projects were developed for water supply, flood management, and sanitation systems to improve climate resiliency.

Adapting to the impacts of climate change often involves the recognition that no single action can address every adaptation need or be robust enough to respond to the future conditions. Essentially, there is no single silver bullet, even when considering only one system. The substantial and diverse set of climate risks to Sonoma Water’s systems necessitated the development of an equally diverse set of potential adaptation responses.

The CAP team developed portfolios of adaptation strategies for water supply, flood management, and sanitation that considered several factors. Each major action associated with an adaptation strategy is represented with several promising concepts that, if achieved, would reduce risks and/or improve resiliency. *Anchor* project concepts were linked to each major action and reflect the hallmark concept(s) that would substantially “move the needle” on climate adaptation, could be substantially directed by Sonoma Water, and have targeted funding sources. These anchor project concepts are combined with several *supporting* concepts to help achieve the goals.

Water Supply Adaptation Strategy

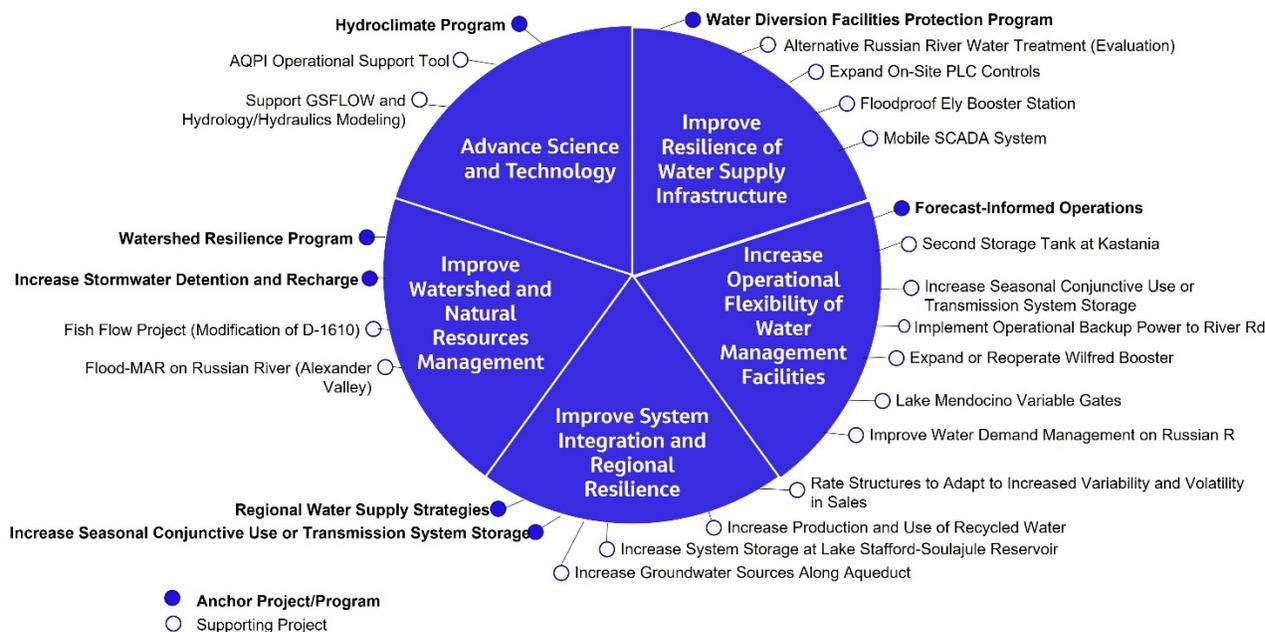
The recommended water supply adaptation strategy consists of five major actions that are believed to best put Sonoma Water on a path for adapting to climate change (Figure ES-2):

1. **Improve Resilience of Water Supply Infrastructure** – The anchor project for this action is the development of a *Water Diversion Facilities Protection Program* to protect Wohler and Mirabel diversion infrastructure and access during floods and wildfires.
2. **Increase Operational Flexibility of Water Management Facilities** – The anchor project for this action is an expanded *Forecast-Informed Reservoir Operations Program* to consolidate of Forecast-Informed Reservoir Operations (FIRO) efforts related to Lake Mendocino, Lake Sonoma, and flood control structures into a combined program to improve water supply and flood management operations.
3. **Improve System Integration and Regional Resilience** – The anchor project for this action is the development of *Regional Water Supply Strategies* that continues investments such as the Regional Water Supply Resiliency Study and the Water Supply Action Plan that facilitate diversification of supplies and demands during changed conditions and reduce regional water supply risks.
4. **Improve Watershed and Natural Resources Management** – Anchor projects for this action include the development of a *Watershed Resilience Program* that focuses on

healthy headwaters, hydrologic and sediment management, land and vegetation management for flood attenuation, and water quality benefits during extreme hydrologic events post- wildfire; and *Increasing Stormwater Detention and Recharge* by enhancing detention, infiltration, and groundwater recharge.

- 5. Advance Science and Technology** – The anchor project associated with this action is the initiation of a *Hydroclimate Program* that will Integrate multiple, related efforts of climate, weather, and hydrological measurement, data assimilation, prediction and modeling into a program to support Sonoma Water more effectively as a whole.

Figure ES-2. Recommended Water Supply Adaptation Portfolio



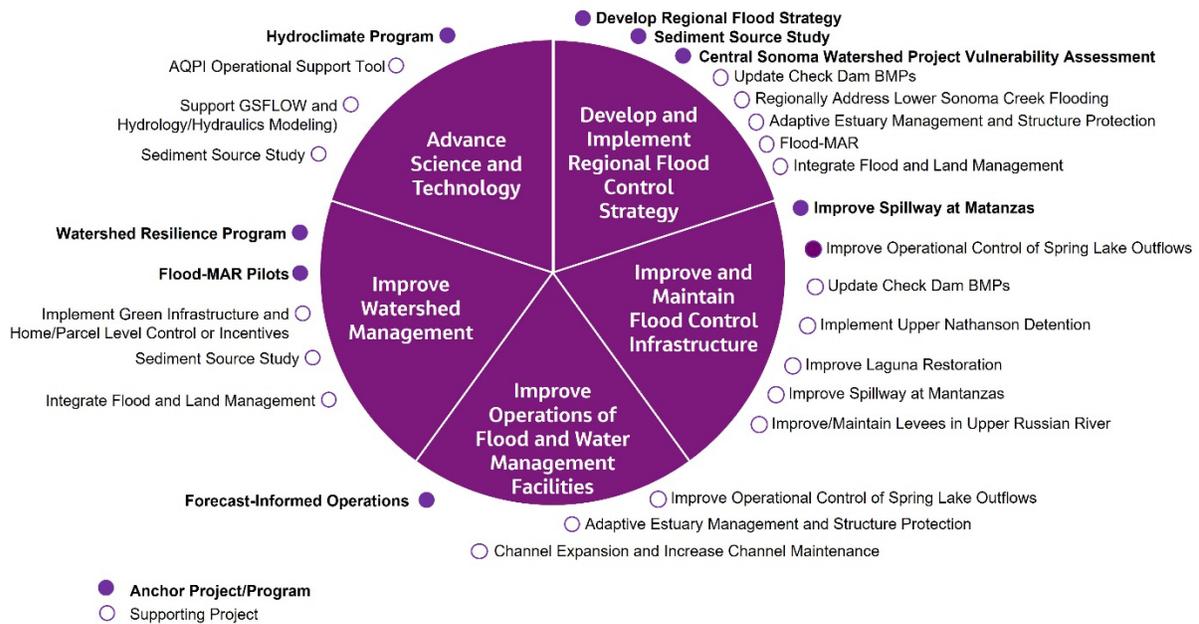
Flood Management Adaptation Strategy

The recommended flood management adaptation strategy consists of five major actions that are believed to best put Sonoma Water on a path for adapting to climate change (Figure ES-3):

- 1. Develop and Implement Regional Flood Management** – Three anchor projects were identified for this action: the development of a *Regional Flood Management Strategy* that seeks to address the current lack of an integrated regional flood management strategy; development of a *Sediment Source Study* to identify major sources of sediment within each watershed and quantify historical and future sediment loads using the modeling; and the *Central Sonoma Watershed Project Vulnerability Assessment* to better understand the vulnerabilities in the city of Santa Rosa and along Santa Rosa Creek, Mark West Creek, and the Laguna, and addressing flooding in Lower Sonoma Creek.

2. **Improve and Maintain Flood Management Infrastructure** – Two anchor projects for this action are *Improve Spillway at Matanzas* and *Improving Operational Control of Spring Lake Outflows*. Collectively, these projects could reduce facility and downstream flood risks.
3. **Improve Operations of Flood and Water Management Facilities** – The principal project for this action is the development of *Forecast-Informed Reservoir Operations* that consolidates FIRO efforts related to Lake Mendocino, Lake Sonoma, and Flood Control structures into a combined program.
4. **Improve Watershed Management** – The main anchor project for this action is the development of a *Watershed Resilience Program* that focuses on healthy headwaters, hydrologic and sediment management, land and vegetation management for flood attenuation, and water quality benefits during extreme hydrologic events post- wildfire.
5. **Advance Science and Technology** – The anchor project associated with this action is the initiation of a *Hydroclimate Program* that will Integrate multiple, related efforts of climate, weather, and hydrological measurement, data assimilation, prediction and modeling into a program to support Sonoma Water more effectively as a whole.

Figure ES-3. Recommended Flood Management Adaptation Portfolio



Sanitation System Adaptation Strategy

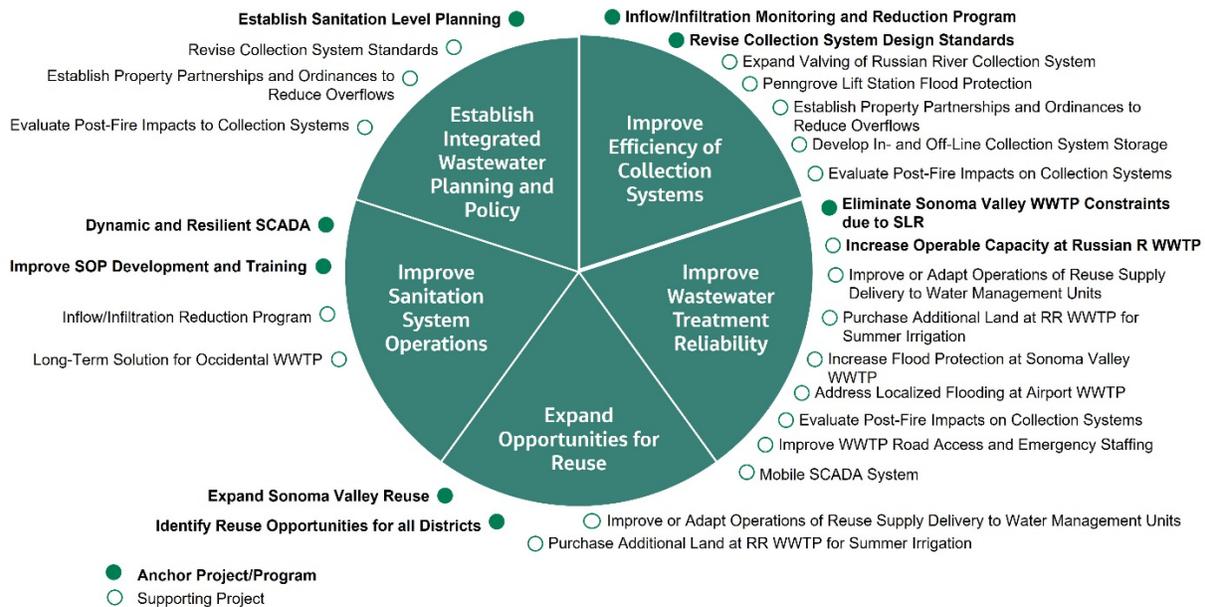
The recommended sanitation adaptation strategy consists of five major actions that are believed to best put Sonoma Water on a path for adapting to climate change (Figure ES-4):

1. **Improve Efficiency of Collection Systems** –The principal anchor project is the development of *Infiltration/Inflow (I/I) Monitoring and Reduction Program*. Many of the sanitation

collection systems, but most acutely the Sonoma Valley and Russian River collection systems, suffer from high I/I during storm events which can also result in sanitary system overflows. In addition, projects such as *Revised Collection System Design Standards* will further reduce I/I through improved design/construction practices and consideration of higher frequency and magnitude of rainfall during storm events associated with climate change.

2. **Increase Wastewater Treatment Reliability** – The anchor project for this action is to *Eliminate Sonoma Valley WWTP Constraints due to Sea Level Rise*. During the wet season (November 1 to April 30), treated wastewater is discharged into Schell Slough, a tidally influenced waterbody downstream of Schell Creek. This project would increase the operational effluent pumping capacity and increase equalization storage capacity to respond to sea level rise.
3. **Expand Opportunities for Reuse** – The anchor project for this action is to *Expand Sonoma Valley Reuse*. Sonoma Valley WWTP generates more treated wastewater in winter than it currently has demand. Future climate change will likely exacerbate water supply challenges and increase saltwater intrusion in the Sonoma Valley groundwater basin. This project includes the expansion of partnerships with wineries and other irrigators, groundwater management entities, and regional entities to increase utilization of reuse supplies.
4. **Improve Sanitation System Operations** – The anchor project for this action is the development of *Dynamic and Resilient Supervisory Control and Data Acquisition System* to further implement automation pilots at Sonoma Valley and Russian River WWTPs, along with a mobile supervisory and control data acquisition (SCADA) system for continuity of operations during emergencies.
5. **Establish Integrated Wastewater Planning and Policy** – The principal anchor project for this action is to *Establish Sanitation Level Planning*. Many of the sanitation systems that are currently managed by Sonoma Water were conceived and built by other entities in isolation and no system-wide assessment of sanitation needs, assets, and strategies has been developed. This project would establish a Strategic Sanitation Systems Plan (or similar) that would compile the state of each sanitation system, identify risks and opportunities to these systems, and recommend local or regional solutions to address the challenges.

Figure ES-4. Recommended Sanitation Adaptation Portfolio



Integrated Strategies

Some common, integrated concepts have been identified that will likely provide the greatest improvements in climate resiliency across all core functions of Sonoma Water:

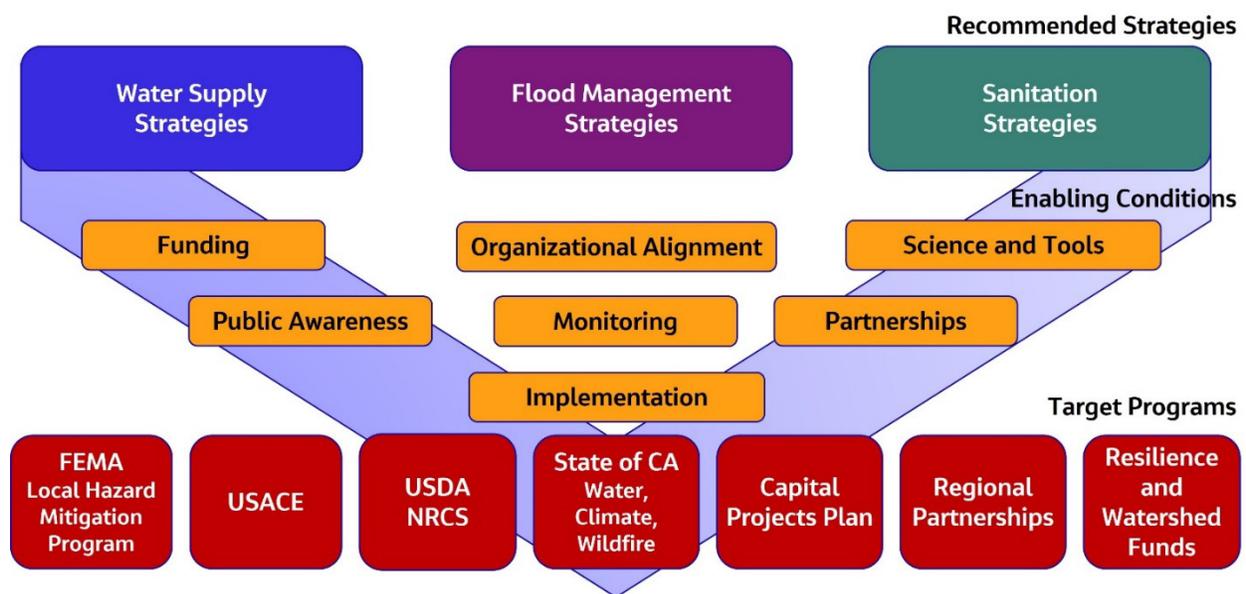
- Watershed Resilience Program
- Water Diversion Facilities Protection Program
- Regional Water Supply Strategies
- Forecast-Informed Operations
- Regional Flood Management Strategy
- Hydroclimate Program
- Dynamic and Resilient SCADA
- Integrated Sanitation Level Planning

Moving Toward Implementation

Adapting to climate change requires a systematic, but flexible approach to move from planning and strategy development to implementation and monitoring. As presented in the previous sections, climate change adaptation involves a range of adaptation approaches, including infrastructure development and improvements, operations, distributed actions throughout the watersheds, policies and ordinances, organizational changes, and planning. Thus, the implementation of adaptation strategies for Sonoma Water's systems must consider an equally diverse set of approaches.

An approach has been developed that links the climate change adaptation strategies to possible implementation programs. Figure ES-5 shows this approach, which considers the various enabling conditions that facilitate the successful and sustainable implementation of adaptation strategies. These enabling conditions include funding, science and tools, organizational alignment, partnerships, public awareness, project and program implementation, and monitoring.

Figure ES-5. Approach for Linking Adaptation Strategies, Enabling Conditions, and Potential Implementation Programs.



Next Steps

Sonoma Water’s CAP represents a significant step forward for Sonoma Water to address climate risks to its water supply, flood management, and sanitation system infrastructure and operations. The CAP describes the approach and results of the vulnerability and risk assessments for each of these systems and identifies those with the greatest climate risk. The CAP outlines a range of potential adaptation measures to address these climate-related risks and provides a set of adaptation portfolio recommendations that integrate various concepts within and across the systems. To move toward implementation of adaptation strategies, several considerations and enabling conditions are necessary including funding, science and tools, organization alignment, partnerships and public awareness, and monitoring.

The suggested next steps are focused on ensuring Sonoma Water can deliver on the recommendations provided in the CAP. Specifically, the immediate next steps include:

- Obtain Board approval and support for recommendations in the CAP.
- Map the implementation pathway and prioritization for each project within the recommended portfolios, including target program and enabling conditions.
- Actively identify and pursue available funding sources and explore innovative resilience funds.
- Organize Sonoma Water staff and build internal structure to mainstream climate resilience within the organization.
- Develop, build, and expand partnerships and outreach with federal, state, regional, local and county entities.
- Establish a robust monitoring plan and timeline for updating the CAP.

The urgency of climate change in the region is upon us. In the past 5 years, multiple wildfires have severely impacted the region, flooding has caused inundation in many areas, and power shutoffs due to fire risk have led to emergency operations. Now, severe drought is being experienced throughout the western United States and acutely in the Russian River watershed. Sonoma Water is on the right path for achieving climate resilience. Ensuring support for the recommendations in the plan and accelerating implementation of the most robust actions will provide significant benefit to Sonoma Water, its stakeholders, and the region as a whole.

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