Resilience | Russian River Watershed

Executive Summary

Russian River Watershed Resilience Plan

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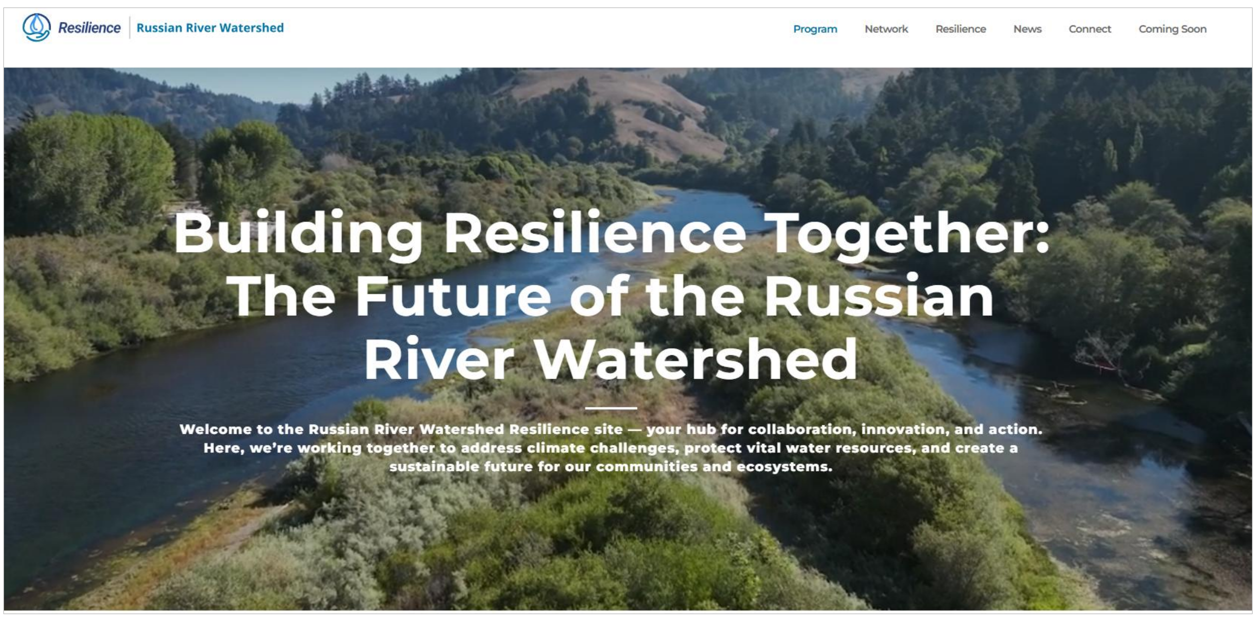
Executive Summary

The Russian River watershed has been experiencing the impacts of climate change in recent decades, and based on future climate projections, it will experience greater changes and more severe conditions in the future. The watershed community has been working diligently to strengthen climate resilience throughout the watershed. The California Department of Water Resources (DWR) launched the Watershed Resilience Program as part of the 2023 California Water Plan to support regions and watersheds by assessing climate risks at the watershed scale and developing strategies that address those challenges through collaboration and integrated solutions. The Russian River was one of five DWR-selected watersheds to pilot the elements of the program through the development of this Russian River Watershed Resilience Plan (WRP). The WRP emphasizes climate vulnerability assessments, multi-sector integration, and equity-centered planning. The Russian River Watershed Resilience Pilot (Pilot) was initiated in July 2024 when Sonoma County Water Agency (Sonoma Water) formally received grant funding from DWR. This WRP describes and documents the process, analysis, and findings of the Pilot.

This executive summary outlines the main elements, findings, and recommendations of the WRP. Details on the Pilot and the WRP process can be reviewed on the Pilot website: http://russianriverwatershedresilience.org (Figure ES-1).

Figure ES-1. Russian River Watershed Resilience Pilot Website



The Russian River Watershed Resilience website summarizes the process and provides data and documents pertaining to the Pilot and WRP.

ES.1 Watershed Resilience Program and Pilot Overview

To strengthen California's ability to adapt to climate change, DWR launched the Watershed Resilience Program as part of the 2023 California Water Plan. This program emphasizes the need to assess climate risks at the watershed scale and develop strategies that address those challenges through collaboration and integrated solutions. It builds on the foundation of the Integrated Regional Water Management Program, deepening its focus on climate vulnerability assessments, adaptation planning, watershed-based planning, multi-sector collaboration, and equity and inclusiveness. The program also prioritizes cross-sector collaboration across surface water supply, groundwater supply, flood management, ecosystems, water quality, hydropower, and recreation. Initial funding from the 2021 and 2022 Budget Acts enabled DWR to launch five pilot planning projects. These pilots are applying and testing the watershed resilience approach in diverse regions across the state, laying the groundwork for future efforts. The five pilot watersheds were selected by DWR and include the Russian River, American River, Ventura River, Pajaro River, and Calaveras River watersheds.

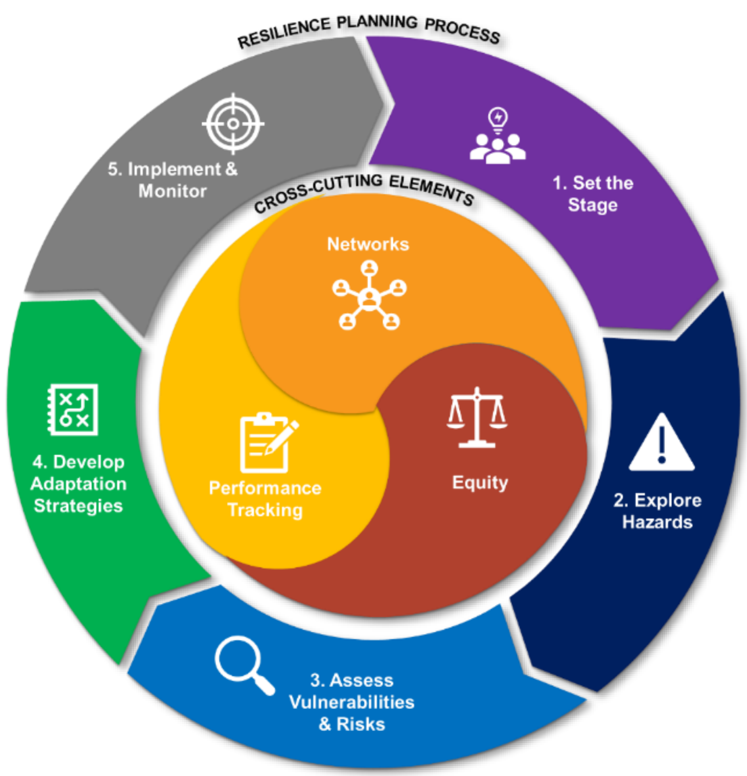
The Pilot was initiated in July 2024 when DWR formally awarded grant funding to Sonoma Water. After receiving the funding from DWR, Sonoma Water contracted with a consultant team to support execution of the project. Therefore, the project did not formally begin until October 2024. This WRP describes and documents the process, analysis, and findings of the Pilot.

The Pilot, led by Sonoma Water, is a $2 million initiative funded by DWR to develop a climate-resilient management plan for the 1,500-square-mile watershed. The Pilot study area supports over 700,000 people, 238 streams, and critical habitats for endangered salmonids and other species. The Pilot aligns with California's Water Plan Update 2023 and focuses on the following:

- **Climate Vulnerability Assessment:** Quantifying risks from reduced precipitation, drought, floods, wildfires, extreme heat, and sea level rise
- **Multi-Sector Integration:** Coordinating surface water supply, groundwater supply, flood management, ecosystems, water quality, hydropower, and recreation planning across jurisdictional boundaries
- **Equity-Centered Planning:** Engaging Tribes, disadvantaged and frontline communities, and agricultural communities and individuals in decision-making.

The Pilot applies a five-step resilience planning framework (Figure ES-2). This framework is consistent with DWR's Watershed Resilience Program planning framework with locally tailored priorities specific to the Russian River watershed.

Figure ES-2. Watershed Resilience Planning Process



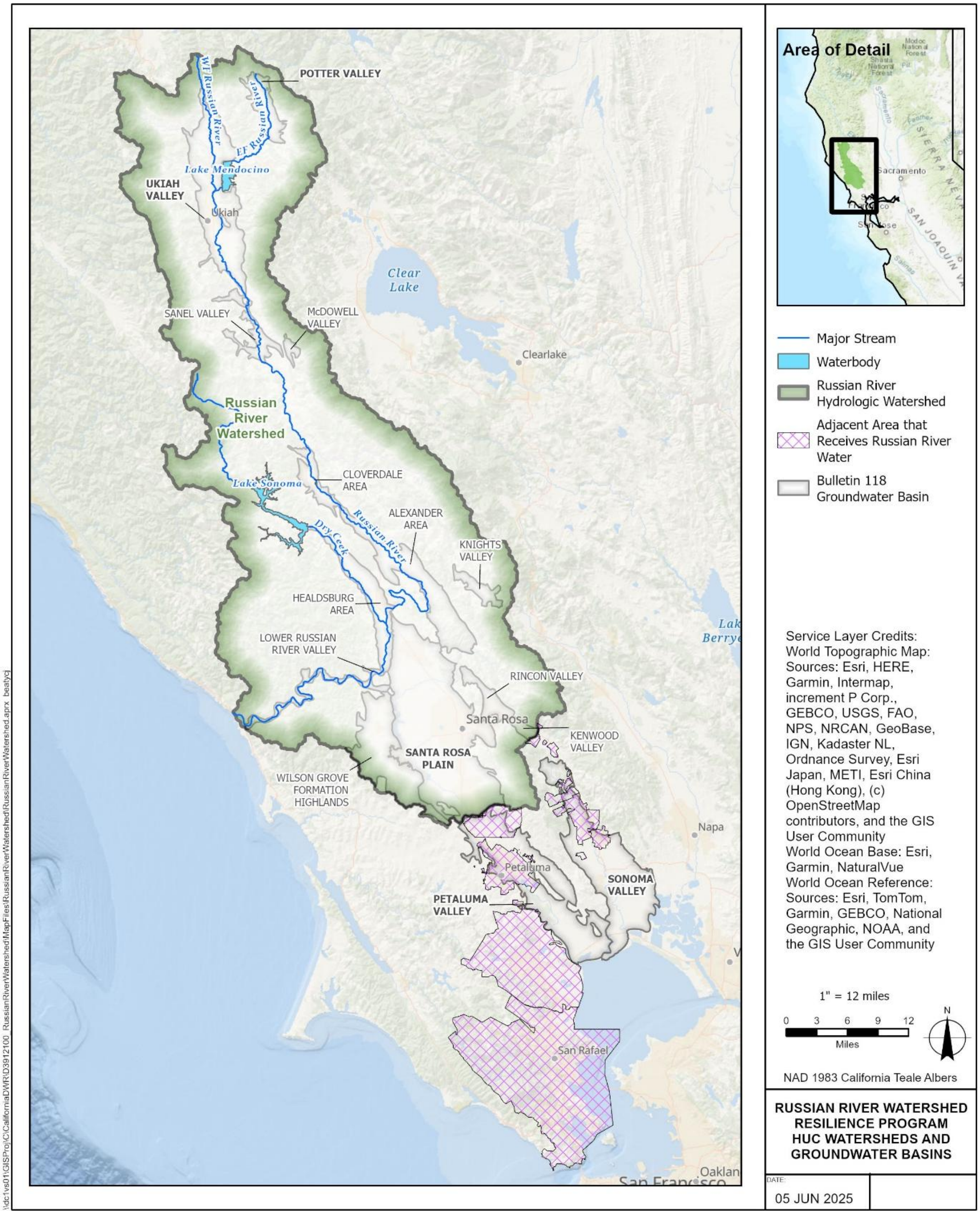
ES.2 Russian River Watershed and Study Area

The Russian River watershed is a crucial resource for Northern California, supplying drinking water to more than 700,000 residents across Sonoma, Mendocino, and Marin counties, including numerous Native American Tribes. The health and resilience of the Russian River watershed are central to sustaining the environment, local economies, and quality of life for the many communities that depend on it.

Stretching approximately 110 miles from its headwaters in the Redwood and Potter Valleys to its mouth at the Pacific Ocean in Jenner, the Russian River and its watershed encompass almost 1,500 square miles. This region features a rich mosaic of forests, agricultural lands (most notably vineyards), wetlands, and urban communities.

For the Pilot, the study area boundary adopts the HUC-8 Russian River watershed delineation from the *California Watershed Resilience Assessment* (DWR 2024) and adds adjacent areas in Sonoma and Marin counties that receive Russian River water supply. Figure ES-3 depicts the watershed study area, outlining the Russian River hydrological watershed in green and representing the adjacent areas south of the watershed that receive Russian River water as hatched areas.

Figure ES-3. Russian River Watershed Resilience Pilot Study Area



The Russian River watershed has a long and dynamic history shaped by Indigenous stewardship, European settlement, and modern development. In the early 19th century, Russian fur traders established settlements along the coast, giving the river its current name. They were followed by American settlers, whose logging, agriculture, and urbanization transformed the landscape. This intervention by settlers with a focus on resource extraction irreversibly altered the lands and the cultural landscape, which had been shaped and sustainably tended by Indigenous communities in the watershed for thousands of years. Over time, the watershed's resources have become a critical resource for farming, particularly vineyards, and for the expanding communities of Sonoma and Mendocino counties. Today, the Russian River watershed serves as a critical environmental and economic foundation that supplies drinking water to more than 700,000 people (including Tribal communities), supports agriculture, and attracts millions of visitors each year.

Guidance from DWR for the WRP and each of the pilots included addressing each of the following seven water resource sectors: surface water supply, groundwater supply, flood management, ecosystems, water quality, recreation, and hydropower. These are sectors that are dependent on, or impacted by, variations in the hydrologic cycle as driven by climate change.

ES.3 Building Resilience with a Watershed Network

The Watershed Network is central to advancing the priorities of the Watershed Resilience Program, ensuring that resilience planning reflects the unique and diverse perspectives and knowledge of the communities within the Russian River watershed. A Watershed Network was convened with members from diverse perspectives and knowledge from across water sectors, communities, and the watershed. The Watershed Network is currently composed of 125 active individuals spanning a wide range of organizations including cities and towns, county agencies, federal and state agencies, groundwater sustainability agencies, Native American Tribes, non-governmental organizations, resource conservation districts, special districts, and watershed associations.

Watershed Network members collaboratively designed a vision statement that captured the shared purpose of the Watershed Network. Crucially, the Watershed Network contributed local knowledge regarding vulnerabilities and risks to resources and systems and suggested hundreds of adaptation strategies to address those risks.

Vision Statement

Actively steward the resources of the Russian River watershed to be increasingly climate resilient by working together across water resource sectors in collaboration with local and Tribal communities.

Over the 18-month study period, the following engagement activities occurred: six Watershed Network meetings corresponding to key project milestones, two technical review meetings, 16 meetings with individual key partners, and two meetings with Mendocino, Lake, Sonoma Tribal Environmental Professionals. Across these scheduled events, 110 organizations participated in the Russian River Watershed Network. In addition, Watershed Network members collaborated during interactive mapping sessions and a canoe paddle on the Russian River to experience some key features firsthand.

Figure ES-4. Watershed Network Paddle on the Russian River (September 17, 2025)

Tribes remain active partners in ongoing watershed restoration, resource management, and climate adaptation efforts. Recognizing the critical importance of Tribal participation and sovereignty, Sonoma Water, as the project convenor, offered formal government-to-government consultation process, as well as participation in the Watershed Network, or both. With the assistance of the California Native American Heritage Commission, 29 Tribes were identified within the Russian River watershed boundary. Some Tribes requested formal consultation, some joined the Watershed Network, and others did both. Sonoma Water, as convenor of the Pilot, continued to share Watershed Network meeting invitations and notes, materials, and opportunities for feedback to the Tribes in the watershed throughout the duration of the Pilot. Several key considerations were identified: data sovereignty, diversity of Tribal interests, incorporation of Traditional Ecological Knowledge, preservation of government-to-government consultation, direct consultation with Tribes outside of a Network environment, and the timing of the Pilot grant cycle being a potential barrier to Tribal participation. The expedited timing of the Pilot did pose a challenge to establishing new, meaningful relationships with Tribes in the watershed, and to incorporating formal feedback at each milestone before moving to the next.

ES.4 Climate Change in the Watershed

The Russian River watershed has experienced major weather-related events in recent decades. Rising temperatures and greater variability in precipitation have contributed to more frequent and intense floods and wildfires, prolonged droughts, and significant disruptions to water resources and ecosystems. Droughts during 1976–1977, 1988–1992, 2012–2016, and the most severe 2020–2022 period have led to record low reservoir levels, groundwater declines, severe water restrictions, and stress on ecosystems. Conversely, major atmospheric rivers in the wet years have generated extreme rainfall and runoff (e.g., February 1986 and February 2019), leading to widespread flooding in the Russian River from Cloverdale to Guerneville and Jenner. Recent wildfires, such as the Sonoma Complex Fires in 2017, Mendocino Complex Fire in 2018, and Wallbridge Fire in 2020, have been the most extreme in history and led to numerous deaths, destruction of property, and changes in watershed lands. The Russian River watershed is among the most impacted of California's watersheds due to weather-related events. Understanding these historic patterns is essential for identifying current vulnerabilities and developing effective resilience strategies.

Future climate change is projected to affect the Russian River watershed in several ways. Climate projections indicate that significant changes are likely to occur as shown in Table ES-1.

Table ES-1. Summary of Projected Climate Changes in the Russian River Watershed

Climatological/ Hydrological Parameter	Projected Changes
Temperature	Annual average temperatures are projected to increase by 3°F by mid-century and 6°F by late-century. Extreme heat days (days with maximum temperatures above 95°F) are projected to double by mid-century and triple by late-century.
Precipitation	Annual average precipitation is projected to increase only modestly (less than 5%), although some parts of the watershed may experience small decreases. Extreme precipitation is projected to increase up to 20%, largely driven by higher magnitude atmospheric rivers fueled by warmer temperatures and higher evaporation over the Pacific Ocean.
Sea Level	Tidal measurements have indicated approximately 0.35 foot of recent sea level rise. Under future conditions, sea levels at the Russian River Estuary (modeled at Point Reyes) could experience further rise of between 0.8 to 1.3 feet by 2050, and 3.1 to 6.6 feet by 2100.
Drought	Future droughts are expected to exceed historical events in terms of cumulative deficit, duration, and frequency, with more sustained multi-year droughts becoming increasingly common. These projected changes reflect the combined influence of higher ambient air temperatures, higher variability in precipitation patterns, and earlier seasonal drying.
Wildfires	Projections indicate increases in both the frequency and severity of wildfire events. The probability of a wildfire occurring each decade is projected to rise by more than 20% by the late-century.
Flooding	Projections indicate an increase in 1-day and 3-day flood magnitudes of approximately 8% to 9% by late-century.

Over the coming decades, the Russian River watershed is projected to experience increases in average ambient air temperatures, a greater number of extreme heat days per year, and a higher frequency and magnitude of extreme precipitation events. Ultimately, hydrologic variability is anticipated to increase, with more frequent swings between dry and wet periods. These shifts are projected to alter conditions across the watershed and exacerbate many of the historical hazards that have affected the region over the last century, including droughts, wildfires, and flooding, resulting in more common and more severe occurrences of these events.

ES.5 Water Resource Vulnerabilities

The Pilot employs an integrated vulnerability assessment to evaluate how evolving climate hazards are projected to impact a series of eight water-related sectors across the planning area. These sectors include surface water supply, groundwater supply, flood management, ecosystems, water quality, recreation, hydropower, and community and equity considerations.

In summary, nine water-related sectors across the Russian River watershed were evaluated using input from the Watershed Network and qualitative and quantitative methods of identifying areas of high vulnerability to changing climate conditions. Table ES-2 provides an overview of key vulnerabilities that were identified through each sector-specific assessment.

Table ES-2. Overview of Key Vulnerabilities Identified for Each Water-related Sector

Sector	Key Vulnerabilities
Surface Water Supply	▪ Impaired water supply resiliency for Upper Russian River water users due to a higher frequency of water shortages driven by the reduction in unimpaired base flow exacerbated by reductions in Eel River transfers ▪ Lower Lake Mendocino annual storage due to more frequent and severe drought conditions exacerbated by reduced transfers from the Eel River ▪ Impaired water supply resiliency for Lower Russian River water users and Lake Sonoma annual storage during periods of severe drought
Groundwater Supply	▪ Reduction in dry-season Russian River flows due to temperature-driven increases in evapotranspiration and reductions in Lake Mendocino storage and releases, which in turn can reduce the total recharge of surface water to the alluvial groundwater system ▪ Reduction in groundwater storage and commensurate declines in groundwater levels during dry periods leading to greater proportion of recharge of surface water to the alluvial aquifer system from already diminished surface water flows.
Flood Management	▪ Increased flood risk for residential communities near Santa Rosa Creek due to increasing severity of extreme precipitation events under future conditions ▪ Increased flood risk for populated areas of Cloverdale, Healdsburg, and Guerneville due to higher peak flows along the Russian River, as well as more rural areas like the Alexander Valley ▪ Increased flood risk to structures and populations near Mark West Creek and Green Valley Creek due to backwater effects from increased stages along the Russian River and increased runoff; increased flood risk in the Laguna de Santa Rosa through Sebastopol
Water Quality	▪ Reduced Lake Mendocino cold water pool due to warmer reservoir inflows and decreased reservoir water surface elevations ▪ Additional stress to fisheries due to lower flows, increased water temperatures, and reduced dissolved oxygen ▪ Impacts to Coyote Valley Dam hatchery operations due to increases in water temperature from Lake Mendocino reservoir releases ▪ Sea level rise and seawater intrusion in the Russian River Estuary and Petaluma Valley and Sonoma Valley groundwater basins ▪ Higher likelihood of harmful algal blooms as a result of increased water temperatures

Sector	Key Vulnerabilities
Ecosystems	▪ Reduced mainstem Russian River juvenile rearing due to increased water temperatures, reduced dissolved oxygen, and decreased flows in the late spring ▪ Lower tributary over-summer survival due to reduced flows and a higher frequency of seasonal drying, resulting in reduced availability of wetted habitat and degraded water quality ▪ Risks to egg incubation during late winter and spring due to higher peak flows and increased water temperatures ▪ Challenges for adult Chinook salmon migration due to the reduction of early fall flows ▪ Decreased Russian River Estuary juvenile steelhead rearing and other salmonid life stages due to reductions in flows outside of the wet season, more frequent inlet closure events, and increased water temperatures
Recreation	▪ Decreased boat ramp access for recreation at Lake Mendocino due to a higher frequency of periods with lower storage ▪ Reduced opportunities for boating and fishing along the Russian River due to a higher frequency of flows below key recreation thresholds
Hydropower	▪ Decreased hydropower production at Lake Mendocino due to more frequent lower minimum instream flow requirements
Tribal	▪ For thousands of years, Tribal communities have stewarded and relied upon the water resources and ecosystems within the Russian River watershed. ▪ These resources have significant beneficial uses to the Tribes, including Native American Culture and Subsistence Fishing uses which may be vulnerable throughout the watershed
Community and Equity	▪ Heightened risk for socially vulnerable communities in Santa Rosa, Ukiah Valley, the Cloverdale-Healdsburg-Windsor corridor, and surrounding Lake Mendocino due to increased floodplain inundation footprints, more frequent wildfires, extreme heat exposure, and longer and more severe drought events ▪ Economic impacts stemming from reduced water availability and flooding to agriculture in dry and wet years, respectively

ES.6 Adaptation Strategies to Increase Resilience

After careful review of the primary climate vulnerabilities, initial ideas on adaptation strategies were compiled from the Watershed Network. Network participants have a wealth of knowledge about various watershed conditions and potential adaptation approaches and were engaged to provide initial ideas on potential strategies. In the end, over 250 adaptation concepts were compiled from direct Watershed Network input, review of existing report recommendations, and individual group input. Adaptation concepts were compiled for all water resource sectors and in all regions of the watershed.

A total of 13 climate adaptation strategies were developed based on this input. These strategies were developed to target one or more climate vulnerabilities and include elements related to water management infrastructure, operations, land and water stewardship and management, policy and governance, and science and technology. Each climate adaptation strategy has been developed to address one or more vulnerabilities. In many cases, the benefits derived from a strategy are anticipated to span several water resource sectors:

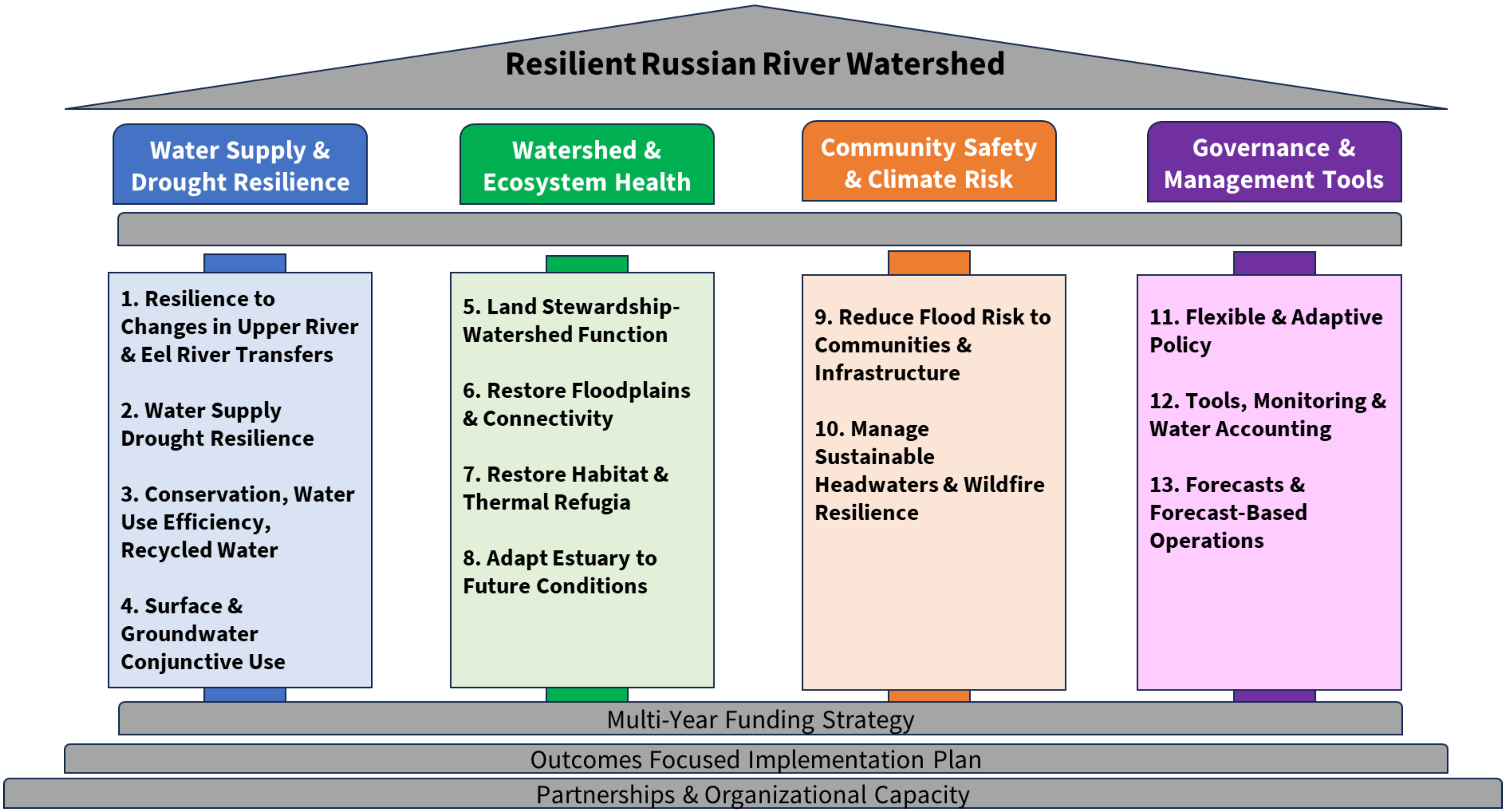
1. Increase Resilience to Changes in Upper River and Eel River Transfers
2. Increase Water Supply Resilience to Drought
3. Increase Water Conservation, Water Use Efficiency, and Recycled Water Supply
4. Expand Conjunctive Use of Surface Water and Groundwater
5. Promote Land Stewardship Measures to Restore Watershed Function
6. Restore Floodplains and Connectivity
7. Restore Hydrological Function, Habitat, and Thermal Refugia in Tributaries
8. Adapt Russian River Estuary to Future Conditions
9. Reduce Flood Risk to Communities and Infrastructure
10. Manage Sustainable Headwaters and Support Wildfire Resilience
11. Support Flexible and Adaptive Policy for Resilient Watershed Management
12. Enhance Tools, Monitoring, and Water Accounting Methods
13. Improve Forecasts and Forecast-Based Operations

The overarching goal of the WRP is to help make the Russian River watershed more resilient to current and future climates. The WRP organizes the13 climate adaptation strategies around four main pillars, as shown on Figure ES-5:

- Water Supply & Drought Resilience
- Watershed & Ecosystem Health
- Community Safety & Climate Risk
- Governance & Management Tools

Each of these pillars incorporates several related strategies that help to achieve similar outcomes. These pillars are supported by foundational implementation elements including multi-year funding, an outcomes-focused implementation plan, and partnerships and organization capacity.

Figure ES-5. An Integrated Russian River Resilience Strategy



Adaptation strategy input received from the Watershed Network and those compiled through other sources and meetings varied in the level of detail and specificity. Most input was not what could be described as "projects" in that it lacked definition, specific location, and detailed description. However, the next step in this adaptation strategy development process is to work with project proponents to compile and develop a more comprehensive, living database of projects aligned with each strategy and action.

ES.7 Implementation Strategies

This WRP makes it clear that there is much work to be done to build the resilience needed to withstand the expected impacts of climate change. With its multiple jurisdictions—including three counties, multiple cities and towns, multiple watershed-wide organizations, and hundreds of identified adaptation concepts—implementation of the WRP requires a thoughtful and deliberate approach. Successful implementation of a plan of this scale requires ongoing investment in and cultivation of durable partnerships, organizational capacity, and development and execution of a funding strategy and an outcomes-focused implementation plan. Together, these three elements set the foundation for skillful and effective program implementation (Figure ES-6).

Figure ES-6. Three Foundational Elements for Effective Program Implementation

Partnerships and Organizational Capacity – *Evolving the Watershed Network to Be Purpose Built for Implementation*

The Russian River watershed communities have a long and strong legacy of collaboration and organizing across sectors and geographies to pursue common goals of watershed health. Tribes, agencies, jurisdictions, and watershed organizations joined the Watershed Network with many strong relationships already in place. The future Watershed Network will need to evolve to have the ability to guide implementation partners through a complex process of project development, prioritization, funding, and decision-making.

Project Implementation – *From Planning to Resilience Outcomes*

Over the last 18 months, the Watershed Network, through the WRP process, has made significant progress, identifying climate hazards, understanding how those hazards impact water resources sectors across the watershed, and identifying adaptation strategies. Now, the tasks ahead are focused on continuing current momentum on achieving resilience outcomes including planning, project prioritizing, funding, design, and implementation that achieve project objectives. In essence, the next phase is to move from the WRP to resilience outcomes with the recognition that several resilience projects are currently being implemented.

Funding Strategy – *Matching and Developing Funding Mechanisms to Projects*

A successful funding approach for the WRP will need to leverage a portfolio of funding sources and develop a strategy that identifies evolving funding needs over time while continuously matching needs and opportunistically acting on relevant funding sources. Funding will be needed for both project implementation and organizational capacity for the Watershed Network and its members to continue to work collaboratively to fulfill the intent of this WRP. State, federal, and other sources of funding are identified and should be aligned with each of the 13 strategies and numerous actions identified to achieve resilience in the Russian River watershed. An immediate focus is on securing funding through Proposition 4, but this approach will need to evolve into a more robust funding portfolio over time.

ES.8 Performance Tracking

Performance tracking will be a critical element of the Russian River WRP as it moves from plan to implementation. Measuring and tracking performance is important to understand the progress, trends, and gaps in watershed resilience, program implementation, Watershed Network engagement, and community and equity. Performance tracking for watershed resilience should link measurable indicators and metrics to specific resilience and functional goals of the Watershed Network and program.

Performance indicators are organized into four types that track different dimensions of implementation progress and outcomes:

- **Watershed Resilience Indicators.** Watershed resilience indicators focus on the state of the watershed system and whether implementation efforts are contributing to improved resilience capacity over time.
- **Program and Implementation Indicators.** Program and implementation indicators track whether specific resilience actions and projects are moving forward towards their respective goals.
- **Watershed Network Indicators.** Watershed Network indicators track the health of the Network and the level of engagement and support evaluation of partnerships throughout the watershed.
- **Community and Equity Indicators**. Community and equity outcome indicators track where and how resilience benefits are delivered, verifying that implementation aligns with equity objectives identified in the WRP.

Performance indicators are used to track resilience trends in the watershed and support adaptive management and informed implementation of the Russian River Watershed Resilience Program. Periodic review of performance information provides a structured opportunity to apply indicator results to ongoing decision-making across the watershed.

Performance indicators must be applied and interpreted in the appropriate context. Their primary value lies in supporting adaptive management, improving coordination, and guiding future implementation decisions. In order to support transparency, bolster Watershed Network coordination, and communicate program progress and effectiveness, it is recommended that an online performance tracking dashboard be developed for the Russian River WRP moving forward. In addition, the Watershed Network and DWR should continue to coordinate to evaluate integration with the draft California Watershed Resilience Hub tool managed by DWR.

ES.9 Recommendations

The WRP incorporated a robust analysis of climate impacts to the water resources in the Russian River watershed; identified various resilience strategies and actions; and received input from an engaged Watershed Network on vulnerabilities, adaptation strategies, and engagement of the Watershed Network. It is recognized that the WRP was limited in time and scope, and that implementation actions are described generally in this plan. Based on the analysis, findings, and strategies, the following nine recommendations are provided that can help the WRP become more robust, implementation focused, and eventually successful in achieving resilience benefits for the Russian River watershed:

1. Maintain and Support the Collaborative Watershed Network to Adapt to a Programmatic and Implementation Focus
2. Accelerate Project Definition and Project Prioritization
3. Tackle the Most Pressing Climate Challenges Head-On
4. Encourage a Portfolio Approach to Resilience Action
5. Build Traditional Ecological Knowledge, Nature-Based Solutions, and Systems Thinking into Resilience Strategies and Actions
6. Ensure that Equity Priorities Are Integral to Resilience Planning and Action
7. Position the Russian River Watershed for Upcoming Funding
8. Build a Program Tracking System and Key Performance Indicators to Guide and Monitor Watershed Resilience Implementation
9. Encourage State to Fully Support and Fund the Watershed Resilience Program Throughout California