



Sonoma Water

Final Report

Appendix D. Adaptation Concepts

October 2021

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Adaptation Strategy Development

1.1 Introduction

The Sonoma Water Climate Adaptation Plan (CAP) team conducted two, multiple-day workshops with agency staff to focus on collecting ideas on how to best address various vulnerabilities and risks. Separate workshops were held to address the water supply, flood management, and sanitation system risks. Participants included Sonoma Water management, finance, engineering, operations, maintenance, and environmental staff, along with subject matter experts from the Jacobs consulting team. Several individuals participated in all workshops to ensure that cross-cutting ideas were captured.

The workshops consisted of two main steps: ensure that the participants understood the moderate and high vulnerable/risk areas, and collect a wide range of ideas based on the participant's expertise and understanding of the system. Participants were asked to think uninhibitedly and to not limit ideas due to potential implementation complexities. Ideas were generated during the workshops and compiled throughout subsequent sessions. During the course of the adaptation strategy workshops, over 250 initial ideas or concepts were documented. After review of the ideas and removal of redundancies, the CAP team performed a synthesis which resulted in nearly 80 individual project concepts. Each project concept was specifically aligned to address one or more vulnerabilities.

After compiling the list of project concepts, an evaluation was performed on each in order to provide a characterization with respect to criteria such as cost, feasibility, implementation timing and complexity, permitting, legal, environmental, and jurisdiction. The complete list of evaluation criteria is shown in Table D-1. For each criterion, a rating scale of "A" through "E" or 1 through 5 was used to characterize the project concept related to the specific measure. The CAP team provided project concept review and evaluation. The characterization of project concepts in this fashion allowed the CAP team to distinguish between concepts and ascertain where some rated better than others in a specific criterion.

This appendix includes the project concept summary and evaluation sheets considered in the CAP.

Table D-1. Evaluation Criteria Used to Characterize Adaptation Concepts

Criteria	Description	Rating A or 1	Rating B or 2	Rating C or 3	Rating D or 4	Rating E or 5
Cost	Estimate of capital and annual costs.	< \$1 million	< \$4 million	< \$10 million	< \$25 million	> \$25 million
Timing	Estimate of time required before project could be implemented considering planning, design, permitting, and implementation.	< 2 years	< 5 years	< 10 years	< 15 years	> 20 years
Environmental	Anticipated positive or negative impacts on the natural environment.	Significantly positive impacts are likely to exist, and negative impacts are not readily apparent	Moderately positive impacts are anticipated at some locations while other locations may or may not have negative impacts of a lesser degree	Option does not have an impact or impacts are expected to be neutral	Moderately negative impacts are anticipated at some locations while other locations may or may not have positive impacts of a lesser degree	Significant negative impacts are likely to exist, and positive impacts are not readily apparent
Feasibility	Maturity of the concept and technical ability to implement.	Regularly implemented in USA at scale proposed	Occasionally implemented somewhere in the world at similar scale	Regularly implemented but at smaller scales	Occasionally implemented somewhere in the world or has not been done, but peer review articles indicate promise	Has not been done and no peer review articles exist or they indicate challenges

Criteria	Description	Rating A or 1	Rating B or 2	Rating C or 3	Rating D or 4	Rating E or 5
Energy	Estimated change in energy required to implement and operate.	Requires no additional energy, or results in net positive generation	Minor increases in energy use (less than 5%)	Modest increases in energy use (less than 15%)	Large increases in energy use (less than 30%)	Major changes in energy use (greater than 30%)
Permitting/Legal	List of permits required and status if option has begun permitting process.	Does not require an Environmental Impact Report (EIR) or other major permits	Requires an EIR or other major permits, but similar projects of this scale have been approved in the past 20 years	Requires an EIR or other major permits, but similar projects of smaller scale have been approved in the past 20 years	Requires an EIR and no precedent exists for the option	Requires an EIR and similar options have been declined during the permit process
Social	Description of positive or negative socioeconomic effects.	Significantly positive impacts are likely to exist, and negative impacts are not readily apparent	Moderately positive impacts are anticipated at some locations while other locations may or may not have negative impacts of a lesser degree	Option does not have an impact or impacts are expected to be neutral	Moderately negative impacts are anticipated at some locations while other locations may or may not have positive impacts of a lesser degree	Significant negative impacts are likely to exist, and positive impacts are not readily apparent
Jurisdiction	Primary jurisdiction for implementation.	Primarily involves Sonoma Water facilities and control	Requires Sonoma Water and other County department actions	Requires Sonoma Water Contractor actions	Requires utility or state agency/ federal actions	Requires private citizens and landholder actions

1.2 Water Supply Adaptation Concepts

A list of the water supply adaptation concepts developed and considered in the CAP is shown in Table D-2 through D-2.32. These comprise 32 concepts to address water supply risks due to climate change.

Table D-2. Water Supply Adaptation Concepts Synthesized from Workshops

System	Project Concept
Water	Protect Critical Infrastructure at Wohler and Mirabel Collectors
Water	Floodproof Ely Booster Station
Water	Alternative Russian River Water Treatment
Water	Second Storage Tank at Kastania
Water	Bypass Ely Booster
Water	Operationalize Lake Mendocino Forecast Informed Reservoir Operations (FIRO)
Water	Improve Access to Water Diversion Facilities (Collectors)
Water	Increase Seasonal Source-Shifting or Transmission System Storage
Water	Install Operational Backup Power at River Road Chlorination Facility
Water	Improve Management in Water Quality Sensitive Watersheds
Water	Increase Groundwater Sources Located Along Aqueduct as Emergency Supply
Water	Increase System Storage at Lake Stafford-Soulajule Reservoir
Water	Increase Production and Use of Recycled Water
Water	Water Resiliency Study and Water Supply Action Strategy Implementation
Water	Increase Water Conservation
Water	Rate Structures to Adapt to Increased Variability and Volatility in Sales
Water	Strategic Engagement in Potter Valley Project Activities
Water	Increase Stormwater Detention and Recharge in Watershed
Water	Advanced Quantitative Precipitation Information (AQPI) Operational Support Tool
Water	Climate and Weather Modeling
Water	Support Coupled Groundwater and Surface-Water Flow Model (GSFLOW) and Hydrology/Hydraulics Modeling
Water	Protect Kawana Booster Station
Water	Expand or Reoperate Wilfred Booster

System	Project Concept
Water	Raise Coyote Valley Dam
Water	Fish Flow Project (Modification of D-1610)
Water	Lake Sonoma FIRO
Water	Lake Mendocino Variable Gates
Water	Flood-MAR on Russian River (Alexander Valley)
Water	Improve Water Demand Management on Russian River
Water	Protect Mirabel and Wohler Power Lines (relocate/undergrounding)
Water	Expand Onsite PLC Controls to Address Supervisory Control And Data Acquisition (SCADA) Vulnerabilities
Water	Mobile SCADA System

Table D-2.1. Project Concept #1A.1 – Protect Critical Infrastructure at Wohler and Mirabel Collectors

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Project Concept #1A.1 – Protect Critical Infrastructure at Wohler and Mirabel Collectors
Project Code	1A.1
Project Concept	The collector wells at Wohler and Mirabel provide the vast majority of drinking water that enters Sonoma Water’s transmission system. This project focuses on protecting critical infrastructure at Wohler and Mirabel collectors from rising flood stages and associated water quality risk at caisson entrances. All caissons would be retrofitted with submarine-type doors to seal from water entry during potential high flood events. Levee roads at Mirabel collectors would be raised 2 to 3 feet for allow for continued access at higher flows. Collector 6 would be raised 2 to 3 feet and strengthened to prioritize operation of this collector even under higher anticipated flood water levels.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on similar projects for pump station floodproofing New York Department of Environmental Protection (NYDEP) estimated in the range of 10 to 20% of original construction cost of facility. Total estimate in range of \$10 to 20 million.
Cost Rating	4
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Environmental impacts would likely be low as most of the construction-related effort would be associated with the upper portion of the collector and housing.
Environmental Rating	2
Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.

Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Unlikely to have permitting or legal challenges due to scale of project.
Permitting/Legal Rating	3
Social	No impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	2

Table D-2.2 Project Concept #1A.2 – Floodproof Ely Booster Station

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Project Concept #1A.2 – Floodproof Ely Booster Station
Project Code	1A.2
Project Concept	Ely Booster Station is a critical part of Sonoma Water's water transmission system due to its role in providing over 300,000 residents in Marin and Sonoma County potable water including the City of Petaluma, the North Marin Water District, and the Marin Municipal Water District. The station is currently vulnerable to a 100-year flood and the site was greatly impacted in December of 2014, nearly flooding the medium voltage electrical equipment, placing water delivery to southern Sonoma County and Marin County at risk. Flooding under future climate scenarios suggest water levels could rise several feet above existing 100-year floodplain, putting much of the equipment at risk, as well as the water supply for 300,000 North Bay residents. As of 2021 Sonoma Water is currently designing the Ely Booster Station Flood Resiliency project to reduce the flood risks of future flood events. The project will lift the electrical equipment above the existing 500 year floodplain. The project includes flood proofing the existing electrical switchgear and generator out of the floodplain. The project will also increase the structural integrity of the Station for additional seismic safety.
Vulnerability #1	Flood Risk to Ely Booster Station
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Total estimate is \$3.7 million in Capital Projects Plan (CPP) 2019 through 2024, but could be nearly \$10 million if relocated.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Environmental impacts would likely be low as most of the construction-related effort would be associated with the upper portion of the collector and housing.
Environmental Rating	1
Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.

Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Unlikely to have permitting or legal challenges due to scale of project.
Permitting/Legal Rating	1
Social	No impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.3. Project Concept #1B.1 - Alternative Russian River Water Supply Diversion and Treatment

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1B. Develop New Water Infrastructure
Project Concept Name	Project Concept #1B.1 - Alternative Russian River Water Supply Diversion and Treatment
Project Code	1B.1
Project Concept	<p>Sonoma Water’s riverbank filtration system has proven to be a safe and effective method for treating water entering the region’s water supply. However, uncertainty around increasing threats to water quality, such as increasing severity and frequency of wildfires, suggest that it would be prudent to investigate the feasibility of alternative methods of water treatment to supplement or replace riverbank filtration should water quality degrade significantly in the system in the future. This project concept focuses on the study of options for alternative drinking water infrastructure and/or processes that would address risks to water quality identified through the CAP process.</p> <p>The basis of cost estimates and full implementation is based on a new treatment plant that would permit diversion through existing collectors and treatment of minimum water delivery needs should the existing system be compromised for a period of time due to flooding or water quality conditions. The concept includes: a new conventional water treatment plant, pumping plant, and pipeline to connect the treated water to the existing aqueduct system. The treatment plant intake would utilize the existing collectors and the treatment plant, pumping plant, and pipeline would be designed for 30 million gallons per day (mgd).</p>
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on similar projects (Freeport Regional Water Project) is in the range of \$50 to 75 million.
Cost Rating	5
Timing	Estimated 7 to 10 years to complete from planning to construction.
Timing Rating	3

Environmental	Environmental impacts would primarily be associated with the construction and operation of the new screened intake. Given environmental sensitivity of river, impacts (real or perceived) are likely considerable.
Environmental Rating	4
Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.
Feasibility Rating	1
Energy	Additional energy required to operate treatment plant and pumping plant considered only moderately more intensive than current pumping.
Energy Rating	3
Permitting/Legal	Permitting and legal challenges may be considerable based on the similar projects and sensitivity of the river. If demonstrated as partial alternative to existing collector diversions, challenges may be lesser.
Permitting/Legal Rating	4
Social	Impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	2
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.4. Project Concept #1B.2 – Second Storage Tank at Kastania

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1B. Develop New Water Infrastructure
Project Concept Name	Project Concept #1B.2 – Second Storage Tank at Kastania
Project Code	1B.2
Project Concept	Due to the risk to Ely Booster Station during large rainfall events described previously, this project concept proposes a second storage tank at Kastania to allow greater storage if the Ely Booster Station becomes inoperable during winter and cannot be brought online by the time demands increase in summer. Additional storage at Kastania would permit continual water deliveries on the Petaluma Aqueduct during nighttime hours to make up for limited delivery capability in daytime hours should the Ely Booster become inoperable. For evaluation purposes, a second tank with capacity of 12 million gallons is proposed adjacent to the existing Kastania tank.
Vulnerability #1	Flood Risk to Ely Booster Station
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on similar cost in the CPP 2019 to 2024. Estimated at \$10 million.
Cost Rating	3
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Environmental impacts would likely be low as tank installation would be at existing tank site.
Environmental Rating	2
Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Unlikely to have permitting or legal challenges due to scale of project.
Permitting/Legal Rating	2

Social	No impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	2

Table D-2.5. Project Concept #2C.3 – Bypass Ely Booster

Strategy	2. Increase Operational Flexibility of Water Management Facilities
Action	2C. Optimize Transmission System Storage
Project Concept Name	Project Concept #2C.3 – Bypass Ely Booster
Project Code	2C.3
Project Concept	Due to the risk to Ely Booster Station during large rainfall events, this project concept proposes evaluation of the ability to bypass flow directly to Petaluma without the use of the booster in winter. Coordination with Petaluma and North Marin Water District (NMWD) would be required to evaluate winter demands, pressure needs, and ability to offset delivery of aqueduct water if needed. Higher operable storage would be recommended in the Cotati tanks and the ability to bypass Ely Booster would be investigated.
Vulnerability #1	Flood Risk to Ely Booster Station
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Evaluation and operational adjustments would be less than \$1 million.
Cost Rating	1
Timing	Could be operable in less than 2 years if found feasible.
Timing Rating	1
Environmental	No impacts due to operational nature.
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No anticipated change in energy needs.
Energy Rating	1
Permitting/Legal	Unlikely to have permitting or legal challenges due to scale of project.
Permitting/Legal Rating	1
Social	No impacts expected.
Social Rating	1
Jurisdiction	Requires coordination with Petaluma and NWMD.
Jurisdiction Rating	3

Table D-2.6 Project Concept #2A.1 - Operationalize Lake Mendocino FIRO

Strategy	2. Increase Operational Flexibility of Water Management Facilities
Action	2A. Operationalize Lake Mendocino FIRO
Project Concept Name	Project Concept #2A.1 - Operationalize Lake Mendocino FIRO
Project Code	2A.1
Project Concept	FIRO is a tool that improves flood control and water supply operations by allowing reservoir releases to be more closely tied to better forecasting technology and modeling. This strategy advances FIRO by operationalizing the existing pilot project at Lake Mendocino for U.S. Army Corps of Engineers (USACE) implementation. The FIRO Preliminary Viability Assessment demonstrated water supply benefits of up to 25 to 30 thousand acre-feet annually. This pool of water would permit enhanced water supply operations in variable years and saved water could be stored upstream, delivered, or stored in water contractor facilities or groundwater basins.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Primary costs are involved in maintaining the current program to demonstrate viability of FIRO, supporting precipitation forecasting programs, federal-state policy support, and staffing. Estimated at less than \$1 million annually.
Cost Rating	1
Timing	Could be completed within 2 years.
Timing Rating	1
Environmental	Likely negligible environmental impacts due to only modest changes in extreme flood flows.
Environmental Rating	1
Feasibility	Technically feasible. Only requires changes in operations. Few example projects such as Folsom Reservoir operations exist.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1

Permitting/Legal	Permitting/legal concerns are primarily associated with the process for USACE to continue to allow major deviations to Lake Mendocino operations. Current progress and USACE support suggest promising path, but still some uncertainty until proven over wider range of conditions.
Permitting/Legal Rating	2
Social	Designed to be of "no impact" to flood risk. No expected impact on socio--economics or vulnerable communities.
Social Rating	1
Jurisdiction	Requires USACE participation and approval
Jurisdiction Rating	4

Table D-2.7. Project Concept #2B.1 - Improve Access to Water Diversion Facilities (Collectors)

Strategy	2. Increase Operational Flexibility of Water Management Facilities
Action	2B. Improve Access to Water Management Facilities
Project Concept Name	Project Concept #2B.1 - Improve Access to Water Diversion Facilities (Collectors)
Project Code	2B.1
Project Concept	Increasing frequency and severity of floods along the Russian River would cut off access to Wohler and Mirabel facilities. This project includes planning and implementation of actions to improve access to critical facilities during flood events. First, this project includes continued study and modeling of floods, river scour, and operational impacts to diversion facilities initiated under the CAP. Second, this project includes the physical improvements to access roads to Wohler and Mirabel facilities (especially in the Ya-Ka-Ama area) to ensure agency staff access. Third, two boats would be purchased to allow for access to the collectors when river flooding is severe and access roads are inundated.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #4	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on similar projects for pump station floodproofing (NYDEP) and boat purchase. Total estimate in range of \$1 to 2 million.
Cost Rating	2
Timing	Could be completed within 2 years.
Timing Rating	1
Environmental	Environmental impacts would likely be low as most of the construction-related effort would be associated with the upper portion of the collector and housing.
Environmental Rating	2
Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1

Permitting/Legal	Unlikely to have permitting or legal challenges due to scale of project.
Permitting/Legal Rating	2
Social	No impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.8. Project Concept #2C.1 - Increase Seasonal Source-Shifting or Transmission System Storage

Strategy	2. Increase Operational Flexibility of Water Management Facilities
Action	2C. Optimize Transmission System Storage
Project Concept Name	Project Concept #2C.1 - Increase Seasonal Source-Shifting or Transmission System Storage
Project Code	2C.1
Project Concept	This project incentivizes “source-shifting” or diversification of contractor water supplies to allow for a reduction of demand on Russian River supplies during critical periods, such as during extreme river flooding, seasonal or long-term drought, or during water quality disturbances following fire events. Santa Rosa plain wells would be operated at higher capacity and water contractors would be provided incentive to maximize their independent supplies (groundwater, local surface water, etc.). Sonoma Water transmission system storage would be maximized to permit limited delivery for longer periods if river diversions were interrupted.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #4	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #5	0
Cost	Increased operational costs may be incurred by operating wells at higher capacity and providing financial incentive for contractors to maximize local supply usage. Estimated costs expected to be less than \$1 million annually.
Cost Rating	1
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Environmental impacts likely negligible.
Environmental Rating	1
Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.
Feasibility Rating	1
Energy	Minor increase in energy usage due to well pumping vs diversion costs, and higher pumping to fill winter storage.

Energy Rating	2
Permitting/Legal	Unlikely to have permitting or legal challenges due to project being largely operational. Messaging this as emergency management would likely facilitate water contractor support.
Permitting/Legal Rating	1
Social	No impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	1
Jurisdiction	Requires actions and approval by water contractors.
Jurisdiction Rating	3

Table D-2.9. Project Concept #2C.2 - Install Operational Backup Power at River Road Chlorination Facility

Strategy	2. Increase Operational Flexibility of Water Management Facilities
Action	2C. Optimize Transmission System Storage
Project Concept Name	Project Concept #2C.2 - Install Operational Backup Power at River Road Chlorination Facility
Project Code	2C.2
Project Concept	Planned power outages are becoming more common as a method to reduce fire risk during red flag conditions. Current backup power at the River Road Chlorination Facility consists of a generator that only permits operation of the analyzers and does not supply enough power to operate the full chlorination facility operations. This project would install/expand operational backup power at this facility to enable uninterrupted chlorination should there be loss of grid power.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #4	0
Vulnerability #5	0
Cost	Costs associated with installation of backup power estimated as less than \$100k.
Cost Rating	1
Timing	Could be completed within 1 year
Timing Rating	1
Environmental	Environmental impacts likely negligible.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No increase in energy usage
Energy Rating	1
Permitting/Legal	None
Permitting/Legal Rating	1
Social	No impacts
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.10. Project Concept #4B.1 - Improve Management in Water Quality Sensitive Watersheds

Strategy	4. Improve Watershed and Natural Resource Management
Action	4B. Improve Forest and Wildland Management
Project Concept Name	Project Concept #4B.1 - Improve Management in Water Quality Sensitive Watersheds
Project Code	4B.1
Project Concept	<p>This program includes four main components that target improving management of the watersheds that are most critical for Sonoma Water’s ability to continue providing safe clean drinking water in the face of increasing frequency and severity of wildfires. First, Sonoma Water would work with partners to develop a decision support framework that includes mapping and identification of critical lands that present a high fire risk and a high likelihood to impact Sonoma Water’s operations through post-fire degradation of water quality (sediment, carbon, contaminants). This decisions support framework would then be used to focus Sonoma Water’s resources on management in high priority locations that would reduce fire risk, improve the health of watersheds, and reduce risk to the region’s water supply. The second component of this program includes collaboration with various partners, including fire departments, special districts, County departments, Resource Conservation Districts, UC Cooperative Extension, Tribes, and various non-governmental organizations to carry out management activities in high priority locations to reduce fire risk. These management activities may include prescribed burns, grazing, employment of hand crews, and other methods on private or public land to reduce fire risk and improve the health and resilience of these lands. The third component of this program includes the continued support of and potential expansion of the existing Alert Wildfire fire camera network. The existing fire camera Alert Wildfire network for Lake Sonoma may be extended if coverage is inadequate for identified watershed areas. Sonoma Water would expand collaboration with Open Space for acquiring land or easements to improve/protect water quality in these sensitive watersheds. Fourth, this program would include the promotion of fire awareness and defensible space around agency owned facilities, such as the diversion facilities at Wohler and Mirabel.</p>
Vulnerability #1	Water Quality Risk at Diversion Facilities
Vulnerability #2	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #4	0
Vulnerability #5	0

Cost	Estimate costs associated with mapping/identification and expanded fire cameras estimated in the range of \$1 to 2 million.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Likely positive environmental impacts since full implementation would manage watersheds in natural conditions.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No increase in energy usage
Energy Rating	1
Permitting/Legal	Minor permitting for installation of additional fire cameras. Potential higher permitting challenges if land acquisition or easements sought.
Permitting/Legal Rating	2
Social	Likely positive socioeconomic impacts as fire risk would be reduced.
Social Rating	1
Jurisdiction	Requires engagement and participation with other agencies and private landowners.
Jurisdiction Rating	5

Table D-2.11. Project Concept #3C.1 - Increase Groundwater Sources Located Along Aqueduct as Emergency Supply

Strategy	3. Improve System Integration and Regional Resilience
Action	3C. Enhance Conjunctive Use Opportunities
Project Concept Name	Project Concept #3C.1 - Increase Groundwater Sources Located Along Aqueduct as Emergency Supply
Project Code	3C.1
Project Concept	This project concept focuses on identifying and utilizing additional groundwater resources located along the existing aqueduct transmission system. For evaluation of this concept, it is assumed that five new aquifer storage and recovery (ASR) wells, producing up to 500 gallons per minute each, would be developed and connected to the aqueduct system with chlorination, and piping costs are minimal due to proximity of aqueduct. Water could be stored in the basin during wetter periods and only extracted during periods of high need or sold to local groundwater sustainability agencies for extraction for their needs. Alternatively, if native yield is not already adjudicated in the basin, these wells could be sole extraction wells.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Flood Risk to Russian River Diversion Facilities
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on similar projects. Approximately \$7 to 9 million for new ASR wells development, chlorination, and piping costs. Operating costs in the range of \$25 to 50/acre-feet per year.
Cost Rating	3
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Limited environmental impact due to recharge/storage nature of operations and assumed broad distribution of wells. However, will cause localized drawdown.
Environmental Rating	4
Feasibility	Technically feasible. ASR is now commonplace in most of California.
Feasibility Rating	1

Energy	Minor increase in energy usage for both the injection and extraction processes, and need to match pressure of transmission system.
Energy Rating	2
Permitting/Legal	New well integration within Sustainable Groundwater Management Act (SGMA) process and rights to any native yield are likely to present moderate permitting challenges.
Permitting/Legal Rating	3
Social	Likely negligible impact to socio-economics or disadvantaged communities.
Social Rating	1
Jurisdiction	Requires actions and approval by water contractors, county, and GSAs.
Jurisdiction Rating	4

Table D-2.12. Project Concept #3A.1 - Increase System Storage at Lake Stafford-Soulajule Reservoir

Strategy	3. Improve System Integration and Regional Resilience
Action	3A. Investigate a Regional Integrated Water Resource Management Strategy
Project Concept Name	Project Concept #3A.1 - Increase System Storage at Lake Stafford-Soulajule Reservoir
Project Code	3A.1
Project Concept	This project concept focuses on increasing storage of Sonoma Water supplies in Marin County to augment reliability of the system during either extreme droughts or in the event that the Russian River diversion is interrupted or reduced. A pipeline would be constructed to connect Lake Stafford with Sonoma Water's Petaluma Aqueduct. Water would be pumped into the Lake Stafford during wet years, stored, and released for delivery during extreme dry periods or during periods of Russian River interruption.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Quality Risk at Diversion Facilities
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Order of magnitude cost estimate based on similar Sonoma Water pipeline costs. Approximately \$30 million for new pipeline and valving.
Cost Rating	3
Timing	Estimated 5 to 7 years to complete.
Timing Rating	3
Environmental	Moderate impact of constructing new pipeline to Lake Stafford.
Environmental Rating	2
Feasibility	Technically feasible. Limited storage capacity in Lake Stafford may limit benefit.
Feasibility Rating	1
Energy	Likely increase in energy to deliver water to Lake Stafford rather than Sonoma Water transmission storage.
Energy Rating	3
Permitting/Legal	Permitting/legal may be challenging, but unlikely to substantially impact project.
Permitting/Legal Rating	3

Social	Likely negligible impact to socio-economics or disadvantaged communities.
Social Rating	1
Jurisdiction	Requires actions and approval by some water contractors.
Jurisdiction Rating	3

Table D-2.13. Project Concept #3A.2 - Increase Production and Use of Recycled Water

Strategy	3. Improve System Integration and Regional Resilience
Action	3A. Investigate a Regional Integrated Water Resource Management Strategy
Project Concept Name	Project Concept #3A.2 - Increase Production and Use of Recycled Water
Project Code	3A.2
Project Concept	This project concept seeks to increase the use of recycled water to diversify the region's water supply portfolio and lessen the reliance on Russian River supply during critical periods. Building off of successful reuse programs such as the North Bay Water Reuse Program, this concept would seek to expand or accelerate projects with the long-term goal of providing all large irrigation customers within Sonoma Water contractor services areas with recycled water. For evaluation purposes, it is assumed that this project would generate and deliver an additional 5,000 AFY of recycled water.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Quality Risk at Diversion Facilities
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Order of magnitude cost estimate based on North Bay Water Reuse Program (NBWRP) Phase 1 costs. Approximately \$100 million for treatment and transmission.
Cost Rating	5
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Moderate environmental impact due to construction and operation of new facilities. Pipelines may need further review.
Environmental Rating	3
Feasibility	Technically feasible. Numerous similar projects in the region and throughout the state.
Feasibility Rating	1
Energy	Likely increase in energy needs due to additional treatment, pumping and transmission.
Energy Rating	3

Permitting/Legal	Permitting/legal may be challenging, but unlikely to substantially impact project.
Permitting/Legal Rating	3
Social	Likely negligible impact to socio-economics or disadvantaged communities.
Social Rating	1
Jurisdiction	Requires actions and approval by water contractors and other groundwater users in the basins.
Jurisdiction Rating	3

Table D-2.14. Project Concept #3A.3 - Water Resiliency Study and Water Supply Action Strategy Implementation

Strategy	3. Improve System Integration and Regional Resilience
Action	3A. Investigate a Regional Integrated Water Resource Management Strategy
Project Concept Name	Project Concept #3A.3 - Water Resiliency Study and Water Supply Action Strategy Implementation
Project Code	3A.3
Project Concept	This project concept is to continue to invest in regional water resiliency strategies and the Water Supply Action Plan strategies to facilitate diversification of supplies and demands during changed conditions and reduce regional risks.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Quality Risk at Diversion Facilities
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Cost for studies and coordination estimated at \$1 to 2 million.
Cost Rating	1
Timing	Could be completed in less than 2 years.
Timing Rating	1
Environmental	No impact
Environmental Rating	1
Feasibility	Study
Feasibility Rating	1
Energy	No impact
Energy Rating	1
Permitting/Legal	Study itself would not require permitting. Individual projects that follow may require permitting.
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Requires actions and approval by water contractors.
Jurisdiction Rating	3

Table D-2.15. Project Concept #3A.4 - Increase Water Conservation

Strategy	3. Improve System Integration and Regional Resilience
Action	3A. Investigate a Regional Integrated Water Resource Management Strategy
Project Concept Name	Project Concept #3A.4 - Increase Water Conservation
Project Code	3A.4
Project Concept	This project concept seeks to increase water conservation potential for Sonoma Water contractor customers to diversify the region's water supply portfolio and lessen the reliance on Russian River supply during critical periods. Building off of successful programs in the region already, this concept would seek to expand or accelerate conservation programs. Specific emphasis may be directed toward rapid water savings potential in the outage or shortage events. Program may look to expand "interruptible" contracts, and incentivize reduced outdoor water use with a regional "resiliency" fund. For evaluation purposes, it is assumed that this project would generate an additional 5,000 AFY of water savings.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Quality Risk at Diversion Facilities
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Order of magnitude cost estimate based on middle estimates from California water conservation studies. Approximately \$4 million annually for water conservation program and incentives.
Cost Rating	2
Timing	Could be completed in less than 2 years.
Timing Rating	1
Environmental	Likely negligible impact.
Environmental Rating	1
Feasibility	Technically feasible. Numerous similar projects in the region and throughout the state.
Feasibility Rating	1
Energy	Net reduction in energy use.
Energy Rating	1

Permitting/Legal	Negligible permitting or legal challenges
Permitting/Legal Rating	1
Social	Some impacts to sectors involved in irrigation and landscaping.
Social Rating	2
Jurisdiction	Requires actions and approval by water contractors and water users.
Jurisdiction Rating	3

Table D-2.16. Project Concept #3A.5 - Rate Structures to Adapt to Increased Variability and Volatility in Sales

Strategy	3. Improve System Integration and Regional Resilience
Action	3A. Investigate a Regional Integrated Water Resource Management Strategy
Project Concept Name	Project Concept #3A.5 - Rate Structures to Adapt to Increased Variability and Volatility in Sales
Project Code	3A.5
Project Concept	This project concept involves a study and implementation of alternative rate structures that can adapt to increasing variability or volatility in water sales due to climate- and weather-related events. Potential to shift rate structure to incur more of the water delivery costs into "fixed" portions and reduce the "usage" portions. Ultimately goal is to seek financial stability over multi-year period even under stressed water sales due to drought or sustained outage of facilities.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Quality Risk at Diversion Facilities
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimate for rate study and scenario analysis to be in the range of \$1 to 2 million.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Study
Feasibility Rating	1
Energy	No impact
Energy Rating	1
Permitting/Legal	Study itself would not require permitting.
Permitting/Legal Rating	1
Social	Depending on ultimate rate structure changes, small impacts to sectors may be felt.
Social Rating	3
Jurisdiction	Will require considerable participation of water contractors.
Jurisdiction Rating	3

Table D-2.17. Project Concept #3A.5 - Strategic Engagement in Potter Valley Project Activities

Strategy	3. Improve System Integration and Regional Resilience
Action	3B. Engage in Potter Valley Project Activities
Project Concept Name	Project Concept #3A.5 - Strategic Engagement in Potter Valley Project Activities
Project Code	3B.1
Project Concept	This project concept is an extension of the strategic engagement of the agency and region in Potter Valley Project activities. Sonoma Water in coordination with its water contractors and other agencies may develop an engagement strategy that ensures that outcomes of Potter Valley Project Federal Energy Regulatory Commission processes are favorable or at least not surprising to those water users on the Russian River who depend on the Potter Valley Project supply into Lake Mendocino. Strategy may range from coordination and tracking to partnerships and leadership. At a minimum, the agency will ensure technical sufficiency of study of alternatives and continually assess impacts to water supply reliability of Sonoma Water and the region.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimate for continual engagement in Potter Valley Project activities at approximately \$1 to 2 million annually for staff, studies, and contracts.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Study
Feasibility Rating	1
Energy	No impact
Energy Rating	1

Permitting/Legal	Study itself would not require permitting.
Permitting/Legal Rating	1
Social	Depending on ultimate Potter Valley Project outcome, impacts to various communities may be observed.
Social Rating	2
Jurisdiction	Some engagement will require participation of water contractors.
Jurisdiction Rating	3

Table D-2.18. Project Concept #4C.1 - Increase Stormwater Detention and Recharge in Watershed

Strategy	4. Improve Watershed and Natural Resource Management
Action	4C. Improve Stormwater Detention and Recharge
Project Concept Name	Project Concept #4C.1 - Increase Stormwater Detention and Recharge in Watershed
Project Code	4C.1
Project Concept	Project would address the need to "slow the flow" in order to both protect against growing flood risk and to enhance infiltration and groundwater recharge. Study (perhaps identified through the SGMA GSP process) would identify areas of flooding and areas of higher recharge potential. Detention ponds or enhanced recharge areas would be constructed in strategic areas. Concept would fall into the broad domain of Flood-Managed Aquifer Recharge (Flood-MAR) projects being supported by California Department of Water Resources. Project concept assumes up to 10 promising areas would be identified and detention/recharge elements would be developed. Elements could be constructed new or managed through easements with existing landholders.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on land values and detention/recharge area size. Assuming 10 areas of 5 acres each with half through easements. Approximately \$8 million for land purchase/easements and detention/recharge area development/enhancement.
Cost Rating	3
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Likely negligible to positive environmental impact. Project could bring some lands closer to natural state and enhance other working lands into more dynamic hydrologic regime.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1

Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	Permitting/legal challenges will include land acquisition or easements. Could be reduced if done in conjunction with Open Space.
Permitting/Legal Rating	4
Social	Likely negligible impact to socio-economics or disadvantaged communities.
Social Rating	1
Jurisdiction	Requires participation with private landholders.
Jurisdiction Rating	5

Table D-2.19. Project Concept #5A.1 - AQPI Operational Support Tool

Strategy	5. Advance Science and Technology
Action	5A. Increase Use of Weather Forecasting and Climate Prediction
Project Concept Name	Project Concept #5A.1 - AQPI Operational Support Tool
Project Code	5A.1
Project Concept	The San Francisco Bay Area AQPI system contains advanced radar throughout the Bay Area, which will provide more precise rainfall forecasting for atmospheric rivers. Sonoma Water could integrate the advanced radar information with existing weather forecasting infrastructure and services to support FIRO, Stormwater Management - Groundwater Recharge, and Flood Protection/Stream Maintenance. Project concept focuses on ensuring that the AQPI information is accessible and used in critical relevant programs and operations.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Order of magnitude estimate of \$1 to 2 million annually for AQPI support and integration.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Likely integrated with other county programs
Jurisdiction Rating	2

Table D-2.20. Project Concept #5A.2 - Climate and Weather Modeling

Strategy	5. Advance Science and Technology
Action	5A. Increase Use of Weather Forecasting and Climate Prediction
Project Concept Name	Project Concept #5A.2 - Climate and Weather Modeling
Project Code	5A.2
Project Concept	<p>Sonoma Water has been leading climate science and adaptation planning. This project concept focuses on Sonoma Water continued role in supporting and enhancing collaborations and investments in Subseasonal to Seasonal (S2S) forecasts of precipitation, streamflows, and reservoirs levels. Advanced applications of remote sensing-based products could support Sonoma Water for drought warnings, regional groundwater recharge mapping, improved understanding of groundwater-surface water interactions and soil moisture mapping. Sonoma Water has applied state-of-the-art climate model simulations from Phase 3 of the Coupled Model Intercomparison Project (CMIP3) and Phase 5 of the Coupled Model Intercomparison Project (CMIP5), which were part of United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) and Fifth Assessment Report (AR5), respectively. National and International climate modeling groups are currently working on newer climate models, which will be part of IPCC Sixth Assessment Report (AR6). Sonoma Water should integrate climate model simulations from newer climate model simulations to update climate assessments to evaluate climate risk of their Water Supply, Sanitation, and Flood Control Services. Multiple downscaling approaches exist for translating coarse resolution climate model outputs to regional climate patterns. Downscaling can be performed statistically, dynamically using physically-based equations, or a combination of the two. There are uncertainties in climate model downscaling methods, in addition to continuing to apply and invest on downscaled climate model simulations from statistical downscaling method, Sonoma Water could collaborate and apply, for limited assessments, downscaled climate model projections using Dynamical Downscaling method.</p>
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Order of magnitude estimate of \$1 million annually for climate and weather modeling support.
Cost Rating	2

Timing	Estimated 5 to 7 years to complete.
Timing Rating	3
Environmental	No impact
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction, but also involves state and federal partners.
Jurisdiction Rating	2

Table D-2.21. Project Concept #5B.1 - Support GSFLOW and Hydrology/Hydraulics Modeling

Strategy	5. Advance Science and Technology
Action	5B. Develop and Enhance Models
Project Concept Name	Project Concept #5B.1 - Support GSFLOW and Hydrology/Hydraulics Modeling
Project Code	5B.1
Project Concept	Sonoma Water would continue to collaborate and invest in on integrated modeling system, for e.g., modeling system consisting of surface water, groundwater and reservoir operations. Sonoma Water and collaborators should take advantage of available satellite products (for e.g., remote sensing products available from NASA). Other improvements may include advanced applications of uncertainty analysis for Short-to-Medium range hydrologic forecasts, increased monitoring and measurement of temperature, precipitation and soil moisture to better calibrate GSFLOW and other Hydrology/Hydraulic models.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	Water Quality Risk at Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #4	Flood Risk to Ely Booster Station
Vulnerability #5	Flood Risk to Kawana Booster Station
Cost	Order of magnitude estimate of \$1 million annually for modeling support.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.22. Project Concept #1A.4 - Protect Kawana Booster Station

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Project Concept #1A.4 - Protect Kawana Booster Station
Project Code	1A.4
Project Concept	Kawana Booster Station is a component of the water transmission system that helps move drinking water to Santa Rosa. Kawana Booster is situated in a low-lying area that is subject to flooding from the adjacent roadway (Highway 12 berm) creek. Flood risk is anticipated to worsen with climate change. Currently, roadway dividers are used to divert heavy overland flow from entering the booster station. This project concept would improve the drainage at the booster and construct flood walls to ensure that floodwater does not enter the booster motors and electrical equipment.
Vulnerability #1	Flood Risk to Kawana Booster Station
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude estimate of \$1 million for drainage control and minor flood walls.
Cost Rating	2
Timing	Could be completed in less than 2 years.
Timing Rating	1
Environmental	Limited to no impact.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.23. Project Concept #1A.3 - Expand or Reoperate Wilfred Booster

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Project Concept #1A.3 - Expand or Reoperate Wilfred Booster
Project Code	1A.3
Project Concept	Kawana Booster is situated in a low-lying area that is subject to flooding from the adjacent roadway (Highway 12 berm) creek. Current roadway dividers are used to divert heavy overland flow from entering booster. This project concept would evaluate expanded pumping at Wilfred Booster to eliminate the need for the Kawana Booster. The expanded Wilfred operation could either be made permanent or added as a redundancy if the Kawana Booster should become inoperable for a period of time due to localized flooding.
Vulnerability #1	Flood Risk to Kawana Booster Station
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimated cost of valving and expanded pumping capacity at Wilfred could range from approximately \$1 to 3 million.
Cost Rating	2
Timing	Could be completed in less than 2 years.
Timing Rating	1
Environmental	Limited to no impact.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	Unknown impact on energy use. Wilfred would be required to increase lift, but Kawana would be out of operation.
Energy Rating	2
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-2.24. Project Concept #1A.5 - Raise Coyote Valley Dam

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Project Concept #1A.5 - Raise Coyote Valley Dam
Project Code	1A.5
Project Concept	In order to adapt to a more variable hydrologic regime, additional storage in the upper Russian River system would allow for greater water control of larger inflows. This project concept considers an increase in the height of Coyote Valley Dam to increase the operable storage by approximately 25,000 acre-feet. The additional storage created by raising the dam height would be considered "water supply" pool and operations of this pool would be dictated by Sonoma Water downstream needs. The pool could also be used for enhanced flood protection at extreme high inflows.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Potter Valley)
Vulnerability #4	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #5	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Cost	Order of magnitude cost of reservoir expansion \$50 to 75 million based on other reservoir enlargement projects.
Cost Rating	5
Timing	Likely to take 10 to 15 years to complete
Timing Rating	4
Environmental	Significant environmental impact on Russian River and will trigger multiple environmental reviews.
Environmental Rating	5
Feasibility	Technically feasible, but not commonly implemented. Would require substantial geotechnical and seismic evaluations to determine feasibility.
Feasibility Rating	3
Energy	Likely to increase hydropower generation at the Dam
Energy Rating	1

Permitting/Legal	Significant permitting and legal considerations. Depending on impacts and public interest, challenges could delay or stop project.
Permitting/Legal Rating	5
Social	Changes in river flows could impact recreational uses, but not expected to be large.
Social Rating	3
Jurisdiction	Requires multiple agencies and public to weigh in and participate in project development and approval.
Jurisdiction Rating	5

Table D-2.25. Fish Flow Project (Modification of D-1610)

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Fish Flow Project (Modification of D-1610)
Project Code	1A.5
Project Concept	The Fish Flow project concept continues to adapt Decision 1610 hydrologic index and update of water rights permit. Concept would seek to ensure that future changes adapt to an evolving hydrologic conditions and add flexibility and reliability to Lake Mendocino operations. The changes would help to buffer the impacts to water supply, water quality (temps), and beneficial uses along the Russian River from changes to upstream conditions and operations.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #4	
Vulnerability #5	
Cost	Estimated cost \$1 to 3 million.
Cost Rating	2
Timing	Could be completed within 3 to 5 years.
Timing Rating	2
Environmental	Limited to no impact. Would implement adaptive management to environmental and water supply.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No anticipated change to energy use.
Energy Rating	1
Permitting/Legal	Requires changes to state permit and water right.
Permitting/Legal Rating	2
Social	No impact
Social Rating	1
Jurisdiction	Sonoma Water and its contractors
Jurisdiction Rating	2

Table D-2.26. Lake Sonoma FIRO

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Lake Sonoma FIRO
Project Code	1A.5
Project Concept	This project concept would expand the FIRO program from Lake Mendocino to Lake Sonoma operations. Study to evaluate whether FIRO would increase operational flexibility and allow for deviation in flood operations. FIRO is a substantial tool that could evolve and adapt to the changing climate and hydrologic regime. This pool of water would permit enhanced water supply operations in variable years and saved water could be stored upstream, delivered, or stored in water contractor facilities or groundwater basins.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Sonoma)
Vulnerability #2	
Vulnerability #3	
Vulnerability #4	
Vulnerability #5	
Cost	Primary costs are involved in expanding program to Lake Sonoma supporting precipitation forecasting programs, federal-state policy support, and staffing. Estimated at less than \$1 million annually.
Cost Rating	1
Timing	Could be completed within 3 to 5 years.
Timing Rating	2
Environmental	Likely negligible environmental impacts due to only modest changes in extreme flood flows.
Environmental Rating	1
Feasibility	Technically feasible. Only requires changes in operations. Few example projects such as Folsom Reservoir operations exist.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1

Permitting/Legal	Permitting/legal concerns are primarily associated with the process for USACE to continue to allow major deviations to Lake Mendocino operations. Current progress and USACE support suggest promising path, but still some uncertainty until proven over wider range of conditions.
Permitting/Legal Rating	2
Social	Designed to be of "no impact" to flood risk. No expected impact on socio--economics or vulnerable communities.
Social Rating	1
Jurisdiction	Requires USACE participation and approval
Jurisdiction Rating	4

Table D-2.27. Lake Mendocino Variable Gates

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Lake Mendocino Variable Gates
Project Code	1A.5
Project Concept	This project concept would include the study, design, and installation of variable gates at Lake Mendocino to increase operational flexibility to meet instream flows and water management operations. Outlet work modification would be required and would install variable gates to release water from differing depths and temperatures. This project concepts would enhance Sonoma Water's ability to fine-tune releases as conditions require, particularly to better implement FIRO and the Fish Flow Project.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	Flood Risk to Russian River Diversion Facilities
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Potter Valley)
Vulnerability #4	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #5	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Cost	Order of magnitude cost of variable gates estimated at \$50 to 75 million.
Cost Rating	5
Timing	Likely to take 15+ years to complete
Timing Rating	5
Environmental	Significant environmental impact on Russian River and will trigger multiple environmental reviews.
Environmental Rating	5
Feasibility	Technically feasible, but not commonly implemented. Would require substantial geotechnical, seismic, and lake modeling evaluations to determine feasibility.
Feasibility Rating	2
Energy	May result in minor decreases in hydro generation depending on operations
Energy Rating	2
Permitting/Legal	Significant permitting and legal considerations. Depending on impacts and public interest, challenges could delay or stop project.

Permitting/Legal Rating	5
Social	Changes in river flows could impact recreational uses, but not expected to be large.
Social Rating	3
Jurisdiction	Requires multiple agencies and public to weigh in and participate in project development and approval.
Jurisdiction Rating	5

Table D-2.28. Flood-MAR on Russian River (Alexander Valley)

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Flood-MAR on Russian River (Alexander Valley)
Project Code	1A.5
Project Concept	Project concept includes implementation of a pilot Flood-Managed Aquifer Recharge project on the Russian River in Alexander Valley. Assumes up to 10 acres would be managed for spreading of floodwaters from the Russian River during certain hydrologic conditions to reduce flood flows and to increase aquifer recharge in Alexander Valley.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #4	
Vulnerability #5	
Cost	Order of magnitude cost estimate up to \$10 million for land acquisition/right of way, improvements, and partnership.
Cost Rating	3
Timing	Estimated up to 10 years to complete.
Timing Rating	3
Environmental	Likely negligible to positive environmental impact. Project could bring some lands closer to natural state and enhance other working lands into more dynamic hydrologic regime. But some impacts due to setting changes may impact
Environmental Rating	3
Feasibility	Technically feasible, but pilot nature of concept may not fully achieve benefits.
Feasibility Rating	2
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	Permitting/legal challenges will include land acquisition or easements. Could be reduced if done in conjunction with Open Space.

Permitting/Legal Rating	4
Social	Likely low impact to socio-economics or disadvantaged communities, but likely will involve changes to private and public lands.
Social Rating	2
Jurisdiction	Requires participation with private landholders.
Jurisdiction Rating	5

Table D-2.29. Improve Water Demand Management on Russian River

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Improve Water Demand Management on Russian River
Project Code	1A.5
Project Concept	Project concept would focus on the development of short-term forecasting and real-time demand management system for the Russian River. Improved coordination, metering/data, communication, linked to forecasts of frost and heat wave events would enable Sonoma Water to fine-tune, and therefore reduce reservoir releases during non-flood (water supply) operations.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Lake Mendocino)
Vulnerability #2	Water Supply Reliability under Increasing Hydrologic Variability (Lake Sonoma)
Vulnerability #3	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #4	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #5	
Cost	Information system would require \$2 to 3 million to facilitate integration.
Cost Rating	2
Timing	Could be completed within 3 to 5 years.
Timing Rating	2
Environmental	Limited to no impact. May improve environmental flow control.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No anticipated change to energy use.
Energy Rating	1
Permitting/Legal	Limited permitting as it is an information control system.
Permitting/Legal Rating	2
Social	No impact
Social Rating	1
Jurisdiction	Primarily Sonoma Water, but would require engagement with Russian River water users.
Jurisdiction Rating	3

Table D-2.30. Protect Mirabel and Wohler Power Lines (relocate/undergrounding)

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Protect Mirabel and Wohler Power Lines (relocate/undergrounding)
Project Code	1A.5
Project Concept	Sonoma Water-owned OH power lines connecting Mirabel to Wohler for both primary and backup power are vulnerable to fire. Climate change is anticipated to increase the frequency and severity of fire, which increases the risk of damage to power lines at Wohler and Mirabel facilities. Destruction of power lines would make these critical water supply facilities inoperable, potentially for extended periods, which could impact firefighting capabilities and drinking water supplies in Sonoma Water's service area. This project concept would evaluate and implement measures to protect the power lines from fire (or relocate them). A design for undergrounding has previously been prepared previously but, if used, would need modifications for seismic-related safety due to liquefaction potential in the project area.
Vulnerability #1	Water Supply Reliability under Increasing Hydrologic Variability (Wohler)
Vulnerability #2	Water Supply Reliability under Increasing Hydrologic Variability (Mirabel)
Vulnerability #3	
Vulnerability #4	
Vulnerability #5	
Cost	Estimated cost of \$10 million. To be confirmed.
Cost Rating	3
Timing	Could be completed within 3 to 5 years.
Timing Rating	2
Environmental	Moderate low impact, but will require habitat evaluations and access.
Environmental Rating	3
Feasibility	Technically feasible, but liquefaction risk will need to be addressed.
Feasibility Rating	3
Energy	No anticipated change to energy use.
Energy Rating	1
Permitting/Legal	Will require permitting
Permitting/Legal Rating	2

Social	Limited impact
Social Rating	2
Jurisdiction	Primarily Sonoma Water
Jurisdiction Rating	1

Table D-2.31. Expand On-Site PLC Controls to Address SCADA Vulnerabilities

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Expand On-Site PLC Controls to Address SCADA Vulnerabilities
Project Code	1A.5
Project Concept	Sonoma Water’s SCADA program provides monitoring/logic controls from the operations center to the entire water transmission system. Given an array of SCADA related vulnerabilities, the current Sonoma Booster Station project is implementing onsite PLC control in the event of SCADA failure. Similar to the approach being taken at Sonoma Booster Stations, this project concept proposes to expand implementation of on-site PLC controls at multiple water transmission system facilities to promote more reliable independently remote and automated operation in the event of SCADA or remote communication failures due to increased flood/fire risks.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	
Vulnerability #3	
Vulnerability #4	
Vulnerability #5	
Cost	Estimated cost \$1 to 3 million.
Cost Rating	2
Timing	Could be completed within 3 to 5 years.
Timing Rating	2
Environmental	Limited to no impact.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No anticipated change to energy use.
Energy Rating	1
Permitting/Legal	No or limited permitting
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily Sonoma Water
Jurisdiction Rating	1

Table D-2.32. Mobile SCADA System

Strategy	1. Improve Resilience of Water Supply Infrastructure
Action	1A. Protect or Adapt Existing Infrastructure
Project Concept Name	Mobile SCADA System
Project Code	1A.5
Project Concept	A mobile SCADA vehicle is an excellent opportunity to spend one time funds on a long-term asset. In recent years, fires have caused Sonoma Water multiple communications failures and required the complete evacuation from our headquarters. This vehicle would provide insurance against the demonstrably high risk of voice, data, and radio communications failure in the event of fire, floods, or other disasters. If Sonoma Water’s operations center headquarters were unavailable due to another fire, an earthquake, or a civil disturbance, a mobile SCADA vehicle would give Sonoma Water the flexibility and capability to continue to operate and communicate both internally and externally.
Vulnerability #1	Flood Risk to Russian River Diversion Facilities
Vulnerability #2	
Vulnerability #3	
Vulnerability #4	
Vulnerability #5	
Cost	Estimated cost \$1 million.
Cost Rating	1
Timing	Could be completed within 3 to 5 years.
Timing Rating	2
Environmental	Limited to no impact.
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No anticipated change to energy use.
Energy Rating	1
Permitting/Legal	No or limited permitting
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily Sonoma Water
Jurisdiction Rating	1

1.3 Flood Management Adaptation Concepts

A list of the flood management adaptation concepts developed and considered in the CAP is shown in Table D-3 through D-3.25. These comprise of 25 concepts to help address flood management risks due to climate change.

Table D-3. Flood Management Adaptation Concepts Synthesized from Workshops

System	Project Concept
Flood	Increase In-Channel and Off-Channel Flood Detention Basins (Zone 1A)
Flood	Update Check Dam Best Management Practices (BMPs) for Flood Management Design Manual guidance in Upper Watershed (Zone 1A) and Petaluma River (Zone 2A)
Flood	Implement Upper Nathanson Detention for Stormwater Management (Zone 3A)
Flood	Channel Expansion and Increase Channel Maintenance (Zone 2A)
Flood	Channel Expansion and Increase Channel Maintenance (Zone 4A)
Flood	Adaptive Estuary Management and Structure Protection (Zone 5A)
Flood	Improve Operational Control of Outflows from Spring Lake
Flood	Implement Green Infrastructure and Home/Parcel Level Control or Incentives
Flood	Develop Regional Flood Strategy
Flood	Regionally Address Lower Sonoma Creek Flooding (Zone 3A)
Flood	Promote Flood and Brackish Tolerant Crop Growth (Zone 2A and Zone 3A)
Flood	Improve Laguna Restoration (Zone 5A)
Flood	Acquire and Use Middle Reach Hanson Gravel Ponds
Flood	Improve Sediment Management - Sediment Management Study
Flood	Raise Coyote Dam and Improve Sediment Management (Zone 4A)
Flood	Forecast-Informed Operations to Flood Control Structures & Sediment Basins
Flood	Widen Santa Rosa Creek and Remove/Daylight Triple Box Culvert
Flood	Improve Spillway at Matanzas
Flood	Implementation of Forecast-Informed Operations for Lake Mendocino
Flood	Increase Watershed Resilience to Wildfire
Flood	Flood-Managed Aquifer Recharge (Flood-MAR)
Flood	Integrate Flood Management and Land Management
Flood	AQPI Operational Support Tool
Flood	Climate and Weather Forecasting
Flood	Support and Develop Hydrology/Hydraulics and Sediment Modeling

Table D-3.1. Project Concept #1A.1 - Increase In-Channel and Off-Channel Flood Detention Basins (Zone 1A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1A. Increase Flood Detention
Project Concept Name	Project Concept #1A.1 - Increase In-Channel and Off-Channel Flood Detention Basins (Zone 1A)
Project Code	1A.1
Project Concept	<p>Increase the construction and use of stormwater detention basins, both in-channel and off-channel to effectively manage for flooding and erosion. Identify suitable locations to improve stormwater management, flood protection and other multiple benefits. This project concept includes the siting, design, and construction of five in-channel and off-channel multi-benefit projects that will reduce peak flood flows, reduce sediment loading, increase groundwater recharge, and enhance habitat on drainages in Zone 1A (Santa Rosa Creek, Cook Creek, Copeland Creek, and others). Siting of projects is unknown at this time, but should be located to emphasize reduction in historical 10- to 25-year flood peak attenuation. Individual projects could include off-channel sedimentation basins, new channels within existing flood conveyance, or expanded flood channels utilizing levee setbacks or agricultural land flooding (easements). While individual projects could be implemented in isolation, substantial flood/sediment load reduction benefits will likely require a suite of coordinated projects. Flooding and sediment removal in drainages in Zone 1A represent significant challenge under current climate and hydrologic conditions. Sediment removal in this Zone ranges from \$500,000 to over \$1 million annually (2010 through 016 data) with the majority of the cost associated with Santa Rosa Creek and the Upper Laguna. Future climate projections indicate substantial increases in flooding occurrence and magnitude that will have nonlinear impacts on sediment loading and stream maintenance.</p>
Vulnerability #1	Flood Conveyance Channels (Zone 1A)
Vulnerability #2	Detention Basins (Zone 1A)
Vulnerability #3	Upper Watershed (Zone 1A)
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost estimate based on similar projects in CPP, approximately \$2 million per project for a total of \$10 to 15 million.
Cost Rating	3
Timing	Estimated 10 or more years to complete.

Timing Rating	4
Environmental	Environmental impacts would likely be low, but would need to be demonstrated that habitat would be improved.
Environmental Rating	3
Feasibility	Technically feasible. Similar projects in watershed.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Channel modification or new off-channel detention basins will require permitting and like EIR. Programmatic may be considered. Right of way issues could be complicated.
Permitting/Legal Rating	5
Social	Likely positive impacts to local landholders due to flood reduction, sediment resource, and local economy.
Social Rating	1
Jurisdiction	Flood management would fall within current agency jurisdiction, but new opportunities as part of the program may require partnerships with adjacent landowners or land acquisition.
Jurisdiction Rating	5

Table D-3.2. Project Concept #1A.2 - Update Check Dam BMPs for Upper Watershed (Zone 1A) and Petaluma River (Zone 2A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1A. Increase Flood Detention
Project Concept Name	Project Concept #1A.2 - Update Check Dam BMPs for Upper Watershed (Zone 1A) and Petaluma River (Zone 2A)
Project Code	1A.2
Project Concept	Update best management practices and design criteria for inclusion in Flood Management Design Manual. Updates to include projected changes in timing, frequency, and duration of extreme precipitation under future climate. Adaptive criteria should be considered based facility life and to permit periodic updates for projection uncertainty and planning horizon. Historically, check dams have been constructed throughout the upper watersheds to attenuate runoff and reduced sediment and erosion. Design criteria and best management practices for check dams and other flood attenuation measures on small drainages are based on historical climate and hydrology. Criteria for Sonoma Water flood management measures are outlined Flood Management Design Manual most recently updated in 2019. Rainfall intensity estimates are based on historical records and methods described in National Oceanic and Atmospheric Administration (NOAA) Atlas 14. These precipitation-frequency estimates have not been modified to reflect recent changes and projected changes in extreme precipitation. BMPs and design criteria would be developed in consultation with U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) practice standards.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Petaluma River (Zone 2A)
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Updates to design manual and other BMPs could be implemented and institutionalized for approximately \$500,000 to \$1 million.
Cost Rating	1
Timing	Could be completed in 5 to 7 years.
Timing Rating	3
Environmental	Expected improved environmental conditions
Environmental Rating	1

Feasibility	Technically feasible. Several stormwater utilities in U.S. are implementing adaptive climate flood criteria.
Feasibility Rating	2
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Updates to Sonoma Water and County Flood Management criteria not likely to require changes in permits.
Permitting/Legal Rating	1
Social	Likely positive impacts to landholders due to flood and erosion reduction.
Social Rating	1
Jurisdiction	Flood management criteria and guidance primarily in jurisdiction of Sonoma Water and County.
Jurisdiction Rating	2

Table D-3.3. Project Concept #1A.3 - Implement Upper Nathanson Detention (Zone 3A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1A. Increase Flood Detention
Project Concept Name	Project Concept #1A.3 - Implement Upper Nathanson Detention (Zone 3A)
Project Code	1A.3
Project Concept	Design and construct stormwater detention basin(s) in the Nathanson Creek subwatershed to manage stormwater for multiple benefits, including reducing peak flood flows and increasing groundwater recharge. Sonoma Water is currently working with Sonoma Ecology Center to identify sites feasible for large and small scale stormwater management projects that provide flood reduction and groundwater recharge benefits in the upper Nathanson Creek watershed. Implementation of multiple benefit stormwater projects on Nathanson Creek are included in the Southern Sonoma County Storm Water Resource Plan. The goal is to create a measurable cumulative impact of stormwater management and flood reduction benefits for the City of Sonoma through the implementation of small, medium and large-scale projects. It is assumed three projects would be included. Flood studies may confirm negligible impacts due to sea level rise.
Vulnerability #1	Sonoma Creek (Zone 3A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost included in 2019 Stormwater Resource Plan for three projects on Upper Nathanson Creek \$8.3 million.
Cost Rating	3
Timing	Could be completed in 3 to 7 years
Timing Rating	3
Environmental	Expected improved environmental conditions
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1

Permitting/Legal	Already included in Stormwater Resource Plan. Likely needs programmatic permit.
Permitting/Legal Rating	2
Social	Likely positive impacts to landholders due to flood and erosion reduction.
Social Rating	1
Jurisdiction	Flood management would fall within current agency jurisdiction, but new opportunities as part of the program may require partnerships with adjacent landowners or land acquisition.
Jurisdiction Rating	5

Table D-3.4. Project Concept #1B.1 - Channel Expansion and Increase Channel Maintenance (Zone 2A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1B. Improve Flood Conveyance
Project Concept Name	Project Concept #1B.1 - Channel Expansion and Increase Channel Maintenance (Zone 2A)
Project Code	1B.1
Project Concept	Sea level rise and increased precipitation intensities will likely cause increased flooding on the Petaluma River and Adobe Creek leading to higher sedimentation rates and changing channel gradient in Lower Petaluma River (Zone 2A). Localized flooding already occurs for return interval events on the order of 10 years, increased rainfall intensity will further reduce this interval between flooding events. Flood conveyance in Adobe Creek is vulnerable to increased flows and associated sediment and trash/debris transport due to future climate risk of multiple storms per year causing limits to conveyance, greater frequency of sediment mobilizing events and reduced gradient, and increased localized flooding. The Adobe Creek instream sedimentation basins has been cleared of significant volumes of sediment every year since 2010. Future climate may provide multiple storms per year capable of delivering sufficient quantities of sediment to Adobe Creek to limit conveyance and cause localized flooding. Deposition could be shifted upstream due to a decreased gradient in the creek because of sea level rise. This project concept involves increased stream maintenance on Adobe Creek to account for likely greater frequency of sediment mobilizing events and reduced gradient. In addition, the concept would explore the potential for flood channel expansion on the Lower Petaluma River and Adobe Creek. The Petaluma River Flood Control Project freeboard design assumptions should be reviewed for an accommodation of future sea level rise. It is currently understood that changes in future sea level were not addressed in the Flood Control Project and a comprehensive revisit to the flood risks be addressed.
Vulnerability #1	Petaluma River (Zone 2A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost for increased stream maintenance on Adobe Creek and study of Petaluma River Flood Control design is estimate at \$3 million.
Cost Rating	2
Timing	Could be completed in 2 to 3 years.

Timing Rating	2
Environmental	Additional channel maintenance may temporarily disturb environmental conditions, but relatively small impact.
Environmental Rating	3
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	Small increase in energy needs
Energy Rating	2
Permitting/Legal	Continuation of current sedimentation basin clearing activities.
Permitting/Legal Rating	2
Social	Likely positive impacts to landholders due to flood and erosion reduction.
Social Rating	1
Jurisdiction	Flood management would fall within current agency jurisdiction, but any revision to Petaluma River Flood Control will require federal and local partnerships.
Jurisdiction Rating	5

Table D-3.5. Project Concept #1B.2 - Channel Expansion and Increase Channel Maintenance (Zone 4A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1B. Improve Flood Conveyance
Project Concept Name	Project Concept #1B.2 - Channel Expansion and Increase Channel Maintenance (Zone 4A)
Project Code	1B.2
Project Concept	Develop focused study for flood and sediment management alternatives in Zone 4A (Russian River). This study would evaluate opportunities for channel expansion through either levee setbacks or raising levee heights along the Russian River near Cloverdale and include a study of sediment management, particularly on Big Sulphur Creek, to reduce downstream flooding risk and more effectively manage the larger sediment loads that are expected to occur more frequently. Levee maintenance or enhancement alternatives (setback or raising) have not yet been evaluated. The Russian River near Cloverdale is expected to exceed its channel capacity during the 100 year event. Federal Emergency Management Agency (FEMA) mapping of the 100- and 500-year floodplains indicate that expected inundation extends over fields on the eastern bank and over light industrial areas, including the All-Coast property, and fields on the western bank. Sediment load from Big Sulphur Creek is high. The deposition of sediment can cover 90 percent of the channel width bank to bank. The evolution of the main channel through these deposits can focus the river into the levee. Sonoma Water has maintenance responsibilities on certain levees along the Russian River (Zone 4A) as part of their cost share partnership in the Coyote Valley Dam Project. Climate projections indicate that 50-year flow could increase by more than 25% bring this flow closer to the existing 100-year flow.
Vulnerability #1	Russian River Levees (Zone 4A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Flood and levee evaluation study expected to be \$500,000 to \$1 million.
Cost Rating	1
Timing	Study could be completed within 2 years.
Timing Rating	1
Environmental	Environmental impact unknown at this time. Levee setbacks could increase the floodplain habitat.

Environmental Rating	3
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No change in energy needs
Energy Rating	1
Permitting/Legal	Due to project likely involving changes to levees, permitting for actual implementation would be more complex.
Permitting/Legal Rating	3
Social	Likely positive impacts to landholders due to flood and erosion reduction.
Social Rating	1
Jurisdiction	Flood management in this Zone is a partnership with other entities. Sonoma Water will need to partner with others to implement flood measures.
Jurisdiction Rating	4

Table D-3.6. Project Concept #1B.3 - Adaptive Estuary Management and Structure Protection (Zone 5A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1B. Improve Flood Conveyance
Project Concept Name	Project Concept #1B.3 - Adaptive Estuary Management and Structure Protection (Zone 5A)
Project Code	1B.3
Project Concept	Develop focused study to determine a set of beach management, structure protection and salmonid habitat protection actions to adaptively and effectively manage the Russian River Estuary. The study includes policy and incentives for elevating or protecting low-lying structures in the estuary zone near Jenner, including houses, visitor centers, and gas stations. The management of the Russian River Estuary is sensitive to climate change, as sea level rise will increase wave energy at the beach, requiring modifications to the management plan and the study would address management scenarios at different hinge points (or sea level rise). Given the lack of demonstrable success of the natural berm in maintaining lagoon closure for the desired periods, future climate induced stressors acting against berm stability could further reduce the viability of this approach. Increased Russian River flood flows are also anticipated to increase leading to inland stressors. Sonoma Water should anticipate the inland migration of the ocean-riverine influence and subsequent inland movement of region of sediment deposition, barrier beach, and lagoon. Concept is a considered a study but would lead to physical and policy/management actions in the future, likely including modifications to Reasonable Prudent Alternatives in current Biological Opinion.
Vulnerability #1	Estuary (Zone 5A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Evolving Estuary study expected to be \$500,000 to \$1 million.
Cost Rating	1
Timing	Study could be completed within 2 years.
Timing Rating	1
Environmental	Environmental impact unknown at this time. Study would result in options to improve aquatic habitat.

Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No change in energy needs
Energy Rating	1
Permitting/Legal	Likely will involve many parties (NOAA, coastal commission, private landowners) which would add complexity to actual implementation of recommended actions.
Permitting/Legal Rating	3
Social	Recommendations would likely improve the resilience to neighboring communities.
Social Rating	1
Jurisdiction	Sonoma Water manages the breach actions, but requires consultation with federal, state, and local players.
Jurisdiction Rating	4

Table D-3.7. Project Concept #1B.4 - Improve Operational Control of Outflows from Spring Lake

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1B. Improve Flood Conveyance
Project Concept Name	Project Concept #1B.4 - Improve Operational Control of Outflows from Spring Lake
Project Code	1B.4
Project Concept	Rehabilitate and upgrade critical flood infrastructure to improve operational control of outflows from Spring Lake. This project concept involves three elements: study to investigate in detail existing reservoir and spillway hydraulics, modification of the Spring Lake auxiliary spillway with gated control to provide flexibility in operations of reservoir outflow (throttling control), and upgrade to the Santa Rosa Vortex Tube to rehabilitate from excessive wear on structure from sediment scour. The diversion structures and conveyance components that control diversion and outflow of Spring Lake (Santa Rosa Creek diversion structure, channel and vortex tube, Spring Creek diversion and channel) are vulnerable to blockage from sediment and woody debris. Increases in extreme precipitation and sediment loading is projected to increase and exacerbate existing operational challenges. Operation of these structures is primarily passive leading to little or no operational control.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Hydraulic study expected in the range of \$500,000 to \$1 million. Vortex Tube replacement \$2.9 million (2019 CPP). Spring Lake auxiliary spillway modification estimated at \$2 million. Total cost of study and upgrades expected to be \$6 to 7 million.
Cost Rating	3
Timing	Study and upgrades would need 3 to 4 years for completion.
Timing Rating	2
Environmental	Limited environmental impact expected. Fish ladder at Vortex tube would function more effectively with upgrade.
Environmental Rating	3
Feasibility	Technically feasible, but peak flow estimation and hydraulics are complex in the drainage.

Feasibility Rating	2
Energy	No change in energy needs
Energy Rating	1
Permitting/Legal	Changes to flood management and Santa Rosa Creek flows will required involvement of federal, state, and local partners increasing complexity.
Permitting/Legal Rating	3
Social	Improvements would be designed to reduce flood risk to downstream communities.
Social Rating	1
Jurisdiction	Structures are maintained by Sonoma Water, but flood control agencies and City of Santa Rosa would likely be partners in any improvements other than rehabilitation.
Jurisdiction Rating	4

Table D-3.8. Project Concept #1C.1 - Implement Green Infrastructure and Home/Parcel Level Control or Incentives

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1C. Increase Regional Flood Attenuation (non-physical/natural infrastructure)
Project Concept Name	Project Concept #1C.1 - Implement Green Infrastructure and Home/Parcel Level Control or Incentives
Project Code	1C.1
Project Concept	Update policy and technical standards for low impact development and update Flood Management Design Manual. A range of actions is included, such as updating policy and technical standards for low impact development (LID), incentivizing and streamlining processes to expand LID to reduce runoff at the parcel level (new and existing homes, commercial properties, streets, etc.), and providing input the General Plan to encourage LID. This project concept includes a regional and parcel-level approach to reduce these risks. Sonoma Water would lead in promoting, incentivizing, and encouraging expansion of green infrastructure and LID practices. Rainfall intensity is projected to increase under future climate, leading to increased flood peaks, increased erosion and sediment loading, and potential degraded water quality. Precipitation-frequency estimates have not been modified to reflect recent changes and projected changes in extreme precipitation.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Petaluma River (Zone 2A)
Vulnerability #3	Sonoma Creek (Zone 3A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Project costs are largely related to changes in policy and technical criteria. Incentives are expected to be cost-shared with other entities and could be capped to less than \$500,000 to \$1 million. Note: updates to Flood Management Design Manual are included as separate project concept.
Cost Rating	3
Timing	Policy and technical guidance could be included in less than 2 to 3 years.
Timing Rating	1
Environmental	Improved environmental conditions due to restoring some lands to more natural hydrologic response.
Environmental Rating	1
Feasibility	Technically feasible.

Feasibility Rating	1
Energy	No change in energy needs
Energy Rating	1
Permitting/Legal	Updates to General Plan may be more complex, but much of this concept is policy and technical criteria.
Permitting/Legal Rating	2
Social	Improvements would be designed to reduce flood risk to downstream communities.
Social Rating	1
Jurisdiction	Requires participation by other county departments and perhaps cities.
Jurisdiction Rating	2

Table D-3.9. Project Concept #1C.2 - Develop Regional Flood Strategy

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1C. Increase Regional Flood Attenuation (non-physical/natural infrastructure)
Project Concept Name	Project Concept #1C.2 - Develop Regional Flood Strategy
Project Code	1C.2
Project Concept	Develop a Regional Flood Management Strategy that would integrate various elements, including specific goals and metrics for flood protection, common approaches for flood risk reduction, regional and local policies, and investment strategies. The Strategy may include broad objectives such as developing open space buffers, reestablishing floodplains and river function, sacrificial first floors in high risk areas, flood detention, and support for cities to implement flood management within a regional context. This regional strategy could be modeled after the Regional Flood Management Plans that were developed under the Central Valley Flood Protection Plan. The assessment of climate change-related flood impacts has identified changing risks in all flood zones and in both upper and lower watersheds. Review of existing flood plans has revealed a lack of an integrated Regional Flood Management Strategy that if implemented, could provide for effective multi-jurisdictional management.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Petaluma River (Zone 2A)
Vulnerability #3	Sonoma Creek (Zone 3A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Estimated project cost to develop the regional strategy is likely in the \$1 to 2 million range. Cost share would be expected from other county departments and cities.
Cost Rating	2
Timing	Likely 2 to 3 years due to necessary partnerships and outreach.
Timing Rating	2
Environmental	Anticipate positive environmental impacts from resulting integration and strategies.
Environmental Rating	1
Feasibility	Technically feasible. Can be modeled after existing California flood plans.
Feasibility Rating	1

Energy	No change in energy needs
Energy Rating	1
Permitting/Legal	Permitting is unlikely as a strategy document, but will involve multiple jurisdictions that may lead to greater complexity.
Permitting/Legal Rating	2
Social	Improvements would be designed to reduce flood risk to downstream communities.
Social Rating	1
Jurisdiction	Requires participation by other county departments and perhaps cities.
Jurisdiction Rating	2

Table D-3.10. Project Concept #1C.3 - Regionally Address Lower Sonoma Creek Flooding (Zone 3A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1C. Increase Regional Flood Attenuation (non-physical/natural infrastructure)
Project Concept Name	Project Concept #1C.3 - Regionally Address Lower Sonoma Creek Flooding (Zone 3A)
Project Code	1C.3
Project Concept	Implement a regional approach toward addressing flooding in the lower Sonoma Creek. Implementation of multiple benefit stormwater projects in the lower Sonoma Creek are included in the Southern Sonoma County Storm Water Resource Plan. The goal is to create a measurable cumulative impact of stormwater management and flood reduction benefits for the City of Sonoma through the implementation of small, medium, and large-scale projects. It is assumed three projects would be included. Flood studies may confirm negligible impacts due to sea level rise.
Vulnerability #1	Sonoma Creek (Zone 3A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost included in 2019 Stormwater Resource Plan for three projects on Upper Nathanson Creek \$8.3 million.
Cost Rating	3
Timing	Could be completed in 3 to 7 years
Timing Rating	3
Environmental	Expected improved environmental conditions
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Already included in Stormwater Resource Plan. Likely needs programmatic permit.

Permitting/Legal Rating	2
Social	Likely positive impacts to landholders due to flood and erosion reduction.
Social Rating	1
Jurisdiction	Flood management would fall within current agency jurisdiction, but new opportunities as part of the program may require partnerships with adjacent landowners or land acquisition.
Jurisdiction Rating	5

Table D-3.11. Project Concept #1C.4 - Promote Flood and Brackish Tolerant Crop Growth (Zone 2A and Zone 3A)

Strategy	1. Develop and Implement a Regional Flood Control Strategy
Action	1C. Increase Regional Flood Attenuation (non-physical/natural infrastructure)
Project Concept Name	Project Concept #1C.4 - Promote Flood and Brackish Tolerant Crop Growth (Zone 2A and Zone 3A)
Project Code	1C.4
Project Concept	As sea levels rise and inland-coastal flooding becomes more prevalent, the region of brackish or tidally influenced water may expand upstream on the Petaluma River and Sonoma Creek. This project concept seeks to facilitate vegetation adaptations by promoting brackish tolerant crops in the wetland areas. Areas that are now predominantly upland and supplied with freshwater (or recycled water) may become intertidal and necessitate an adaptation of vegetation. Opportunities could be sought to transition some of the managed wetlands to plants that could support biodiesel.
Vulnerability #1	Petaluma River (Zone 2A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Costs are unknown at this time, but anticipated to be less than \$500,000.
Cost Rating	1
Timing	Re-vegetation would occur slowly over a number of years to adapt to vegetation stability and anticipated sea level rise (SLR).
Timing Rating	3
Environmental	Positive environmental impacts
Environmental Rating	1
Feasibility	Technically feasible. Managed marsh projects existing throughout California.
Feasibility Rating	1
Energy	No change in energy needs. Potential positive benefits if biodiesel fuel is generated as a result.
Energy Rating	1

Permitting/Legal	Likely limited additional permitting if existing managed wetlands are utilized. Regional Water Quality Control Board coordination if associated with expanded use of Sonoma Valley WWTP recycled water.
Permitting/Legal Rating	2
Social	Small positive impact on communities with green energy source.
Social Rating	1
Jurisdiction	Supply of water to management units would fall within current agency jurisdiction, but change in vegetation may require partnerships.
Jurisdiction Rating	5

Table D-3.12. Project Concept #2A.1 - Improve Laguna Restoration (Zone 5A)

Strategy	2. Improve and Maintain Flood Control Infrastructure
Action	2A. Improve Estuary Management
Project Concept Name	Project Concept #2A.1 - Improve Laguna de Santa Rosa Restoration (Zone 5A)
Project Code	2A.1
Project Concept	Develop focused restoration plan and implement actions in collaboration with partners. The San Francisco Estuary Institute (SFEI) Restoration Plan for the Laguna de Santa Rosa is in progress and this concept would support an integrated Laguna strategy for targeted improvements for flood peak attenuation, nutrient management, and habitat management. Flooding to the Lower Russian River is influenced by the combined upstream flows in the upper Russian River, Mark West Creek, and Santa Rosa Creek. The Laguna de Santa Rosa serves as a natural flood attenuation and inland wetland at the confluence of these three waterways. Projections indicate increased peak flood flows and flood potential on the lower river. This project concept seeks to restore much of the natural flood detention capacity and habitat of the Laguna. Several projects are currently underway or planned to restore portions of the Laguna as part of the Laguna Foundation. Restoration of Mark West channel alignment and seasonal wetlands as part of the SFEI Vision would provide opportunities for increased flood attenuation. Several projects are planned or currently underway to restore portions of the Laguna, led by the Laguna Foundation.
Vulnerability #1	Lower Russian River (Zone 5A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Restoration Plan is being prepared by SFEI for about \$1 million. Unknown cost of individual projects as part of vision, but likely range of \$10 million or more. Sonoma Water would likely support, but not necessarily lead. Cost sharing likely.
Cost Rating	3
Timing	Restoration likely to require 10 years to begin to achieve function
Timing Rating	3
Environmental	High positive impacts as restoration of large, important habitat is achieved.
Environmental Rating	1

Feasibility	Technically feasible. But large-scale, complex ecosystem adds complexity.
Feasibility Rating	2
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Substantial permitting for restoration plan and project implementation (EIR/S)
Permitting/Legal Rating	3
Social	Positive impact on communities, recreation, and flood protection.
Social Rating	1
Jurisdiction	Multi-jurisdictional project will involve local, state, and federal entities.
Jurisdiction Rating	5

Table D-3.13. Project Concept #2B.1 - Acquire and Use Middle Reach Hanson Gravel Ponds

Strategy	2. Improve and Maintain Flood Control Infrastructure
Action	2B. Improve Stream Maintenance
Project Concept Name	Project Concept #2B.1 - Acquire and Use Middle Reach Hanson Gravel Ponds
Project Code	2B.1
Project Concept	Acquire and restore the Middle Reach Hanson gravel ponds to address flood risk. The 358-acre Hanson property, west of Windsor, includes four retired gravel ponds. A feasibility study has been completed to identify restoration alternative that achieves the primary project goal of reestablishing a stable seasonal river-floodplain interface. This reconnection will improve flood attenuation and salmonid habitat. The Middle Reach Valley of the Russian River, where the Hanson Russian River Ponds Floodplain Restoration Project is located, has approximately 800 acres of gravel ponds. The ponds are separated from the river by an unstable levee system preventing the river from connecting with the floodplain, thus eliminating ecologically critical off-channel slow shallow water floodplain habitats.
Vulnerability #1	Russian River (Zone 4A)
Vulnerability #2	Lower Russian River (Zone 5A)
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimated cost of land acquisition and restoration for the 358 acres is in the range of \$20 to 25 million based on limited property value search.
Cost Rating	5
Timing	Restoration likely to require 5 to 10 years to begin to achieve function
Timing Rating	3
Environmental	High positive impacts as restoration is relatively large. Reconnecting floodplain will increase salmonid habitat.
Environmental Rating	1
Feasibility	Technically feasible, but reconnecting with active river will add complexity.
Feasibility Rating	2
Energy	No change in energy needs.
Energy Rating	1

Permitting/Legal	Substantial permitting for restoration plan and project implementation (EIR/S)
Permitting/Legal Rating	3
Social	Positive impact on communities, recreation, and flood protection.
Social Rating	1
Jurisdiction	Acquisition could be conducted by county. Restoration would require participation from state and federal agencies.
Jurisdiction Rating	4

Table D-3.14. Project Concept #2C.1 - Sediment Source Study for Improve Sediment Management

Strategy	2. Improve and Maintain Flood Control Infrastructure
Action	2C. Improve Sediment Control and Management
Project Concept Name	Project Concept #2C.1 - Sediment Source Study for Improve Sediment Management
Project Code	2C.1
Project Concept	Develop sediment management plan to improve sediment management for flood protection, water quality and habitat improvement. The sediment management plan will include a sediment source analysis, sediment modeling and sediment budget, management strategies, permit compliance, and monetization opportunities. Plan will identify major sources of sediment for each watershed, quantify historical and future sediment loads, and recommend strategies for source control and effective management. In addition, the study would quantify the expected changes in frequency and magnitude of sediment removal. Programmatic permits would be updated for increases in sediment and opportunities to recapture cost through sale of sand and gravel would be explored. Future changes in precipitation and flood flows will substantial increase sediment loading in the region's watersheds. A complete understanding of the sources of historical sediment loading, management of source areas, removal of sediment, and opportunities for monetization of removed sediment and gravel does not exist.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Russian River Levees (Zone 4A)
Cost	Sediment source and management study cost expected in the range of \$300 to 500 thousand.
Cost Rating	1
Timing	Could be completed in 2 years.
Timing Rating	1
Environmental	Study only. Sediment source control would have positive environmental impact.
Environmental Rating	1
Feasibility	Technical feasible

Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Study only. No permitting challenges.
Permitting/Legal Rating	1
Social	Potential positive if monetization of removed sediment is possible.
Social Rating	1
Jurisdiction	Study only. Coordination with other county departments.
Jurisdiction Rating	2

Table D-3.15. Project Concept #2C.2 - Raise Coyote Dam and Improve Sediment Management (Zone 4A)

Strategy	2. Improve and Maintain Flood Control Infrastructure
Action	2C. Improve Sediment Control and Management
Project Concept Name	Project Concept #2C.2 - Raise Coyote Dam and Improve Sediment Management (Zone 4A)
Project Code	2C.2
Project Concept	In order to adapt to a more variable hydrologic regime, additional storage in the upper Russian River system would allow for greater water control of larger inflows. This project concept considers an increase in the height of Coyote Valley Dam to increase the operable storage by approximately 25,000 AF. The additional storage created by raising the dam height would be considered a managed pool and operations of this pool would be dictated by Sonoma Water downstream needs for water supply and for enhanced flood protection at extreme high inflows. In conjunction with the raise, sediment removal would be implemented to either increase or maintain the existing operable storage in Lake Mendocino.
Vulnerability #1	Russian River Levees (Zone 4A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost of reservoir expansion \$50 to 75 million based on other reservoir enlargement projects.
Cost Rating	5
Timing	Likely to take 10 to 15 years to complete
Timing Rating	4
Environmental	Significant environmental impact on Russian River and will trigger multiple environmental reviews.
Environmental Rating	5
Feasibility	Technically feasible, but not commonly implemented. Would require substantial geotechnical and seismic evaluations to determine feasibility.
Feasibility Rating	2
Energy	Likely to increase hydropower generation at the Dam

Energy Rating	1
Permitting/Legal	Significant permitting and legal considerations. Depending on impacts and public interest, challenges could delay or stop project.
Permitting/Legal Rating	5
Social	Changes in river flows could impact recreational uses, but not expected to be large.
Social Rating	3
Jurisdiction	Requires multiple agencies and public to weigh in and participate in project development and approval.
Jurisdiction Rating	5

Table D-3.16. Project Concept #3A.1 - Forecast-Informed Operations to Flood Control Structures & Sediment Basins

Strategy	3. Improve Operations of Flood and Water Management Facilities
Action	3A. Expand Forecast-Informed Operations to Flood Control Structures
Project Concept Name	Project Concept #3A.1 - Forecast-Informed Operations to Flood Control Structures & Sediment Basins
Project Code	3A.1
Project Concept	Improve flood management operations on Central Sonoma Watershed Project reservoirs through adaptation of FIRO approaches and forecasts. Test the viability of adapting FIRO to Central Sonoma Watershed Project to improve flood management. Building off successful viability assessment for forecast-informed operations at Lake Mendocino, other flood control structures could utilize similar short-term forecasts to improve flood operation. Operations on Spring Creek, Matanzas Creek, and others could potential be improved to reduce magnitude and timing of downstream flooding.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Feasibility study cost expected in the range of \$300 to 500 thousand.
Cost Rating	1
Timing	Could be completed in 2 years.
Timing Rating	1
Environmental	Study only.
Environmental Rating	1
Feasibility	Technical feasible
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Study only. No permitting challenges.
Permitting/Legal Rating	1

Social	Potential positive if flood risk reduction can be proved.
Social Rating	1
Jurisdiction	Study only. Coordination with other county departments.
Jurisdiction Rating	2

Table D-3.17. Project Concept #3B.1 - Widen Santa Rosa Creek and Remove/Daylight Triple Box Culvert

Strategy	3. Improve Operations of Flood and Water Management Facilities
Action	3B. Optimize Flood Control Facility Operations for Santa Rosa Creek
Project Concept Name	Project Concept #3B.1 - Widen Santa Rosa Creek and Remove/Daylight Triple Box Culvert
Project Code	3B.1
Project Concept	Conduct a feasibility study to restore, widen and daylight Santa Rosa Creek to decrease severe flood risk. In downtown Santa Rosa, Santa Rosa Creek and Matanzas Creek are routed through constructed box culverts under City owned land that houses City Hall, among other buildings. There are two box culverts to convey Santa Rosa Creek. A third box culvert conveys Matanzas Creek to Santa Rosa Avenue. Updated HEC-RAS modeling under both historical and future precipitation, indicates a severe flooding risk at this Triple Box Culvert. Flood flows greater than 10- to 25-year return period were found to exceed channel capacity and overland flow in large parts of the City of San Rosa occurs. This project concept includes the "daylighting" of the creeks and removal of the culverts in the section between E St and Santa Rosa Ave. Restoration of the natural river pathway would require relocation of properties (government) that currently overly the culverts and the re-development of a wider channel to carry 100-year flow. The river channel would likely need to be widened to occupy the land currently between 1st St and Sonoma Ave. Recent high-resolution flood modeling from 2016 is available to support additional study.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Feasibility study cost expected in the range of \$300 to 500 thousand. Restoration of the channel in this downtown environment would exceed \$25 million.
Cost Rating	5
Timing	Feasibility study could be completed in 5 years from initiation. More than 15 years to implementation.
Timing Rating	4
Environmental	Improved environmental conditions as current condition is fully engineered.
Environmental Rating	1

Feasibility	Technical feasible, but hydraulically complex.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Complex permitting challenges. Relocation of properties, instream modifications, likely legal challenges.
Permitting/Legal Rating	3
Social	During construction, disruption of downtown. However, restoration of natural channels and floodplain could add to City's assets.
Social Rating	2
Jurisdiction	Primarily outside of the management of Sonoma Water. City of Santa Rosa would need to lead.
Jurisdiction Rating	4

Table D-3.18. Project Concept #3B.2 - Improve Spillway at Matanzas

Strategy	3. Improve Operations of Flood and Water Management Facilities
Action	3B. Optimize Flood Control Facility Operations for Santa Rosa Creek
Project Concept Name	Project Concept #3B.2 - Improve Spillway at Matanzas
Project Code	3B.2
Project Concept	Improve spillway at Matanzas Creek reservoir. This project is currently in planning phase, led by federal project sponsor, USDA NRCS. This facility upgrade project identifies improvements needed to the reservoir's outlet structure to meet NRCS dam design guidelines set forth in Technical Release NO. 60. TR-60 requires that the principle spillway be designed to pass the 100-year rainfall without causing the auxiliary spillway to activate. A recent dam assessment performed by California NRCS found the current reservoir does not meet the TR-60 standard, and recommendations were made to coordinate with NRCS to explore options for bringing the reservoir into compliance with respect to TR-60, and also investigate downstream flooding impacts from any proposed principal spillway improvements. This project concept augments the 2019 CPP project by ensuring that climate change projections of extreme rainfall are considered in the outlet improvements.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimated in cost at \$1.2 million
Cost Rating	2
Timing	Could be completed within 2 to 3 years.
Timing Rating	2
Environmental	Likely negligible environmental impact expected.
Environmental Rating	1
Feasibility	Technical feasible
Feasibility Rating	1
Energy	No change in energy needs
Energy Rating	1

Permitting/Legal	Requires updates to ensure compliance with TR-60.
Permitting/Legal Rating	1
Social	Improvements would be designed to reduce flood risk to downstream communities.
Social Rating	1
Jurisdiction	Structure maintained by Sonoma Water.
Jurisdiction Rating	1

Table D-3.19. Project Concept #3C.1 - Implementation of Forecast-Informed Operations for Lake Mendocino

Strategy	3. Improve Operations of Flood and Water Management Facilities
Action	3C. Operationalize Lake Mendocino FIRO
Project Concept Name	Project Concept #3C.1 - Implementation of Forecast-Informed Operations for Lake Mendocino
Project Code	3C.1
Project Concept	Continue to promote and develop FIRO application for Lake Mendocino operations. Work to make Major Deviation of Lake Mendocino flood operations permanent to support improved flood control and water supply operations. FIRO is a substantial tool that could evolve and adapt to the changing climate and hydrologic regime. The FIRO Preliminary Viability Assessment demonstrated maintenance of flood control while generating water supply benefits of up to 25 to 30 thousand acre-feet annually. The flexibility of this approach could also be used to adapt to changing hydrologic regime without increasing downstream flood risks.
Vulnerability #1	Russian River (Zone 4A)
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Primary costs are involved in maintaining the current program to demonstrate viability of FIRO, supporting precipitation forecasting programs, federal-state policy support, and staffing. Estimated at less than \$1 million annually.
Cost Rating	1
Timing	Could be completed within 2 years.
Timing Rating	1
Environmental	Likely negligible environmental impacts due to only modest changes in extreme flood flows.
Environmental Rating	1
Feasibility	Technically feasible. Only requires changes in operations. Few example projects such as Folsom Reservoir operations exist.
Feasibility Rating	1
Energy	No change in energy needs.

Energy Rating	1
Permitting/Legal	Permitting/legal concerns are primarily associated with the process for USACE to continue to allow major deviations to Lake Mendocino operations. Current progress and USACE support suggest promising path, but still some uncertainty until proven over wider range of conditions.
Permitting/Legal Rating	2
Social	Designed to be of "no impact" to flood risk. No expected impact on socio--economics or vulnerable communities.
Social Rating	1
Jurisdiction	Requires USACE participation and approval
Jurisdiction Rating	4

Table D-3.20. Project Concept #4A.1 - Increase Watershed Resilience to Wildfire

Strategy	4. Improve Watershed Management
Action	4A. Increase Watershed Resilience to Fire
Project Concept Name	Project Concept #4A.1 - Increase Watershed Resilience to Wildfire
Project Code	4A.1
Project Concept	Increases in wildfire and subsequent flooding with high sediment loads has been identified as a substantial to the flood control system (and water supply/water quality). This project concept seeks to identify improve the watershed resilience to wildfire. This project includes a set of measures that target improving management of the most sensitive watersheds for flood impacts and sediment loading. Project includes mapping and identification of the critical watersheds or subwatersheds that represent high fire risk and also likely to represent high flood management impact (sediment) to agency's operations. Existing fire camera Alert Wildfire network for Lake Sonoma may be extended if coverage is inadequate for identified watershed areas. Sonoma Water would coordinate the resource conservation district (RCD), CalFire, UC Coop, private landowners to steer improve watershed management to reduce wildfire fuels. Expand collaboration with Open Space for acquiring land or easements to improve/protect land management in these sensitive watersheds. Promote fire awareness and defensive space around agency owned facilities. Coordinate to develop Community Wildfire Protection Plan/Vegetation Management Plan and promote post-fire BMPs that will reduce flood risk.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Estimate costs associated with mapping/identification and expanded fire cameras estimated in the range of \$1 to 2 million. Developing Community Wildfire Protection Plan (CWPP) estimated at \$500,000.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Likely positive environmental impacts since full implementation would manage watersheds in natural conditions.
Environmental Rating	1

Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No increase in energy usage
Energy Rating	1
Permitting/Legal	Minor permitting for installation of additional fire cameras. Potential higher permitting challenges if land acquisition or easements sought.
Permitting/Legal Rating	2
Social	Likely positive socioeconomic impacts as fire and flood risk would be reduced.
Social Rating	1
Jurisdiction	Requires engagement and participation with other agencies and private landowners.
Jurisdiction Rating	5

Table D-3.21. Project Concept #4B.1 - Flood-Managed Aquifer Recharge (Flood-MAR)

Strategy	4. Improve Watershed Management
Action	4B. Reduce Runoff through Watershed and Urban BMPs
Project Concept Name	Project Concept #4B.1 - Flood-Managed Aquifer Recharge (Flood-MAR)
Project Code	4B.1
Project Concept	<p>Conduct feasibility study and implement three Flood-MAR type projects in three flood zones to improve water supply reliability and reduce flood risk. One strategy Sonoma Water is investigating to address these challenges is recharging groundwater aquifers with excess flood waters, simultaneously lowering the risk of flooded communities while improving stressed groundwater resources. Sonoma Water is investigating opportunities in four watersheds to implement this strategy through the “Stormwater Management-Groundwater Recharge Initiative”. These include the Laguna-Mark West watershed, the Alexander Valley watershed, the Sonoma Creek watershed and the Upper Petaluma River watershed. Sonoma Water would investigate the use of Flood-MAR to improve integration of surface and groundwater resources. The Flood-MAR strategy utilizes flood waters resulting from, or in anticipation of, rainfall and snow melt for managed aquifer recharge. The aquifer recharge locations targets agricultural lands and working landscapes such as refuges, floodplains and flood bypasses. Investigation of Flood-MAR can also help to ensure that information provided by the “Stormwater Management-Groundwater Recharge” studies will be implemented in relevant programs and operations. Water supply reliability will continue to be challenged by large, heavy winter storms that flood local communities and periodic droughts that stress groundwater and surface water resources. This project concept includes the implementation of three Flood-MAR type projects in the studied watersheds.</p>
Vulnerability #1	Petaluma River (Zone 2A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Russian River (Zone 4A)
Vulnerability #4	Lower Russian River (Zone 5A)
Vulnerability #5	0
Cost	Project concept cost estimated at \$3 million.
Cost Rating	2
Timing	Could be implemented in 2 to 3 years
Timing Rating	2
Environmental	Likely positive impact as restoring some of watershed flood function

Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No increase in energy usage
Energy Rating	1
Permitting/Legal	Assuming partnering with landowner, no permitting should be required
Permitting/Legal Rating	1
Social	Likely positive socioeconomic impacts as flood risk would be reduced and payment to landowner.
Social Rating	1
Jurisdiction	Requires engagement and participation with other agencies and private landowners.
Jurisdiction Rating	5

Table D-3.22. Project Concept #4C.2 - Integrate Flood Management and Land Management

Strategy	4. Improve Watershed Management
Action	4C. Integrate Land and Vegetation Management Programs
Project Concept Name	Project Concept #4C.2 - Integrate Flood Management and Land Management
Project Code	4C.2
Project Concept	Changes in flood risk in the watershed due to climate change necessitates strategic collaboration on the intersection of flood and land management. This project concept includes focused engagement with a range of upper and lower watershed groups, cities and agricultural landholders, county, state, and federal agencies with land management responsibilities, and regulators. The overall objective of this engagement is to positively influence land management practices that increase flood detention/attenuation and to discourage practices that put more people and property in high flood risk areas. Where high flood risk development cannot be reduced, Sonoma Water would seek to lower the risk through actions such as flood easements, raising structures, non-critical first floors, and others.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Cost is for staff to engage in the flood/land areas. Estimate at \$200k
Cost Rating	2
Timing	Could begin within 1 year.
Timing Rating	1
Environmental	Unknown, but likely positive
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges

Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Sonoma Water coordination with other parties, including other county departments.
Jurisdiction Rating	5

Table D-3.23. Project Concept #5A.1 - AQPI Operational Support Tool

Strategy	5. Advance Science and Technology
Action	5A. Increase Weather Forecasting and Application
Project Concept Name	Project Concept #5A.1 - AQPI Operational Support Tool
Project Code	5A.1
Project Concept	Develop AQPI Operational Support tool for use in critical relevant programs and operations for Sonoma Water's water supply, flood protection, and sanitation systems. The support tool ensures that AQPI information is accessible for adaptive management. The San Francisco Bay Area AQPI system contains advanced radar throughout the Bay Area, which will provide more precise rainfall forecasting for atmospheric rivers. Sonoma Water could integrate the advanced radar information with existing weather measurement and forecasting infrastructure and services (for e.g., Real-time Rainfall, River-Stream, Reservoir Data, Weather forecast data and modeling) to support FIRO, Stormwater Management - Groundwater Recharge, and Flood Protection/Stream Maintenance.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Order of magnitude estimate of \$1 to 2 million annually for AQPI support and integration.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Technically feasible.
Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	Right of way issues.
Permitting/Legal Rating	3
Social	No impact
Social Rating	1

Jurisdiction	Likely integrated with other county programs, including County Emergency Management.
Jurisdiction Rating	2

Table D-3.24. Project Concept #5A.2 - Climate and Weather Forecasting

Strategy	5. Advance Science and Technology
Action	5A. Increase Weather Forecasting and Application
Project Concept Name	Project Concept #5A.2 - Climate and Weather Forecasting
Project Code	5A.2
Project Concept	Sonoma Water continues to lead locally and regionally on climate science and adaptation planning and continues to enhance, support, collaborate, and invest in Subseasonal to Seasonal (S2S) forecasts of precipitation, streamflows, and reservoirs levels. Sonoma Water will integrate climate model simulations from newer climate model simulations to update climate assessments to evaluate climate risk of their Water Supply, Sanitation, and Flood Control Services. Multiple downscaling approaches exist for translating coarse resolution climate model outputs to regional climate patterns. Advanced applications of remote sensing-based products could support Sonoma Water for drought warnings, regional groundwater recharge mapping, improved understanding of groundwater-surface water interactions and soil moisture mapping. Sonoma Water has applied state-of-the-art climate model simulations from Phase 3 of the Coupled Model Intercomparison Project (CMIP3) and Phase 5 of the Coupled Model Intercomparison Project (CMIP5), which were part of United Nations IPCC Fourth Assessment Report (AR4) and Fifth Assessment Report (AR5), respectively. National and International climate modeling groups have continued development and refinements of climate models, and are becoming available under the IPCC Sixth Assessment Report (AR6).
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Order of magnitude estimate of \$1 million annually for climate and weather modeling support.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Technically feasible.

Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-3.25. Project Concept #5B.1 - Support and Develop Hydrology/Hydraulics and Sediment Modeling

Strategy	5. Advance Science and Technology
Action	5B. Improve System Knowledge of Flood Risks
Project Concept Name	Project Concept #5B.1 - Support and Develop Hydrology/Hydraulics and Sediment Modeling
Project Code	5B.1
Project Concept	Support and develop flood and sediment management modeling for Russian River and key subwatersheds, Petaluma River watershed and Sonoma Creek watershed. Develop an integrated system-wide flood model for the Russian River inclusive of upstream creeks such as Mark West Creek and Santa Rosa Creek. The integration of these models would allow a better understanding of the flood risks throughout the watershed, especially in the interconnected channels at the Laguna. Separate flood models should be updated for the Petaluma River and Sonoma Creek watersheds. In addition, sediment modeling would be integrated with the flood modeling tools to be able to address questions of sediment loading under varying hydrologic and vegetation/soil (pre-/post-fire) conditions. Through the effort to evaluate regional climate impacts to flooding, multiple hydrology/hydraulics models were utilized and many operated on differing approaches (continuous vs event) and/or assumptions. Updates have occurred in some models but not in others, depending on the specific need.
Vulnerability #1	Upper Watershed (Zone 1A)
Vulnerability #2	Sonoma Creek (Zone 3A)
Vulnerability #3	Petaluma River (Zone 2A)
Vulnerability #4	Russian River (Zone 4A)
Vulnerability #5	Lower Russian River (Zone 5A)
Cost	Estimated cost is \$500,000 to 800,000 for integrated model development and sediment modeling.
Cost Rating	2
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	No impact
Environmental Rating	1
Feasibility	Technically feasible.

Feasibility Rating	1
Energy	No changes in energy use.
Energy Rating	1
Permitting/Legal	No permitting challenges
Permitting/Legal Rating	1
Social	No impact
Social Rating	1
Jurisdiction	Partnership with cities
Jurisdiction Rating	4

1.4 Sanitation Adaptation Concepts

A list of the sanitation adaptation concepts developed and considered in the CAP is show in Tables D-4 through D-4.20. These comprise of 20 concepts to address sanitation risks due climate change.

Table D-4. Sanitation Adaptation Concepts Synthesized from Workshops

System	Project Concept
Sanitation	Expand Valving of Russian River Collection System
Sanitation	Study Potential for Vacuum System for Russian River Collection
Sanitation	Implement Inflow/Infiltration Monitoring and Reduction Program
Sanitation	Eliminate Sonoma Valley Wastewater Treatment Plant (WWTP) Hydraulic Constraints due to Sea Level Rise
Sanitation	Improve or Adapt Operations of Reuse Supply Delivery to Management Units
Sanitation	Expand Opportunities for Sonoma Valley Reuse
Sanitation	Penngrove Lift Station Flood Protection
Sanitation	Revise Collection System Design Standards
Sanitation	Increase Operable Capacity at Russian River WWTP
Sanitation	Purchase Additional Land at Russian River WWTP for Summer Irrigation
Sanitation	Increase Flood Protection at Sonoma Valley WWTP
Sanitation	Establish Sanitation Level Planning
Sanitation	Implement SCADA Master Plan and Automation
Sanitation	Long-Term Solution for Occidental WWTP
Sanitation	Establish Property Partnerships and Ordinances to Reduce Overflows
Sanitation	Develop In-Line or Off-Line Collection System Storage
Sanitation	Improve Standard Operating Procedure (SOP) Development and Training
Sanitation	Address Localized Flooding at Airport WWTP
Sanitation	Evaluate Post-Fire Impacts on Collection Systems
Sanitation	Improve WWTP Road Access and Emergency Staffing

Table D-4.1. Project Concept #1A.1 – Expand Valving of Russian River Collection System

Strategy	1. Improve Efficiency of Collection Systems
Action	1A. Reduce Collection System Infiltration and Inflow
Project Concept Name	Project Concept #1A.1 – Expand Valving of Russian River Collection System
Project Code	1A.1
Project Concept	This project focuses on identifying and expanding the areas of the collection system to be valved so that they can be closed during high flood events. Climate projections suggest a greater frequency and magnitude of flood events on the Russian River. Installing valves in the Russian River County Sanitation District (CSD) collection system would shut off evacuated areas of the collection system and reduce the amount of flood waters entering the collection system and the likelihood of overwhelming the wastewater treatment facility areas such as trailer parks that experience chronic flood water infiltration would be prioritized for shut off valving. Extent of areas needing additional valving is currently unknown, but assume approximately 2 miles of sewer mains would be valved off the trunk annually.
Vulnerability #1	Russian River Collection
Vulnerability #2	Russian River WWTP
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost based on sewer main valving projects.
Cost Rating	2
Timing	Estimated 1 to 3 years to complete.
Timing Rating	2
Environmental	Positive impact on environment due to reduced SSOs
Environmental Rating	1
Feasibility	Highly feasible to implement, but may not be substantially effective.
Feasibility Rating	3
Energy	Unlikely to have impacts on energy use.
Energy Rating	1
Permitting/Legal	No permitting needed to valve system.
Permitting/Legal Rating	2

Social	Positive impact on communities due to reduced SSOs
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction. May need easements.
Jurisdiction Rating	2

Table D-4.2. Project Concept #1A.2 – Study Potential for Vacuum System for Russian River Collection

Strategy	1. Improve Efficiency of Collection Systems
Action	1A. Reduce Collection System Infiltration and Inflow
Project Concept Name	Project Concept #1A.2 – Study Potential for Vacuum System for Russian River Collection
Project Code	1A.2
Project Concept	This project focuses on a feasibility study to evaluate the potential and cost of implementing a vacuum collection system for the Russian River CSD. During Russian River flood events the current collection system infiltrates large volumes of river water and resulting flow rates that exceed the treatment plant's hydraulic capacity to process. A vacuum system could substantially reduce river flow and high groundwater infiltration and could significantly reduce peak flows in the collection system. At present, this concept includes a study of the vacuum system but not implementation.
Vulnerability #1	Russian River Collection
Vulnerability #2	Russian River WWTP
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost of study estimated at \$500,000 to evaluate potential.
Cost Rating	1
Timing	Estimated 1 to 3 years to complete.
Timing Rating	2
Environmental	Positive impact on environment due to reduced SSOs
Environmental Rating	1
Feasibility	Feasibility in this particular terrain, hydrology, and size of system is uncertain. While vacuum systems are used in many difficult water table conditions, the feasibility for the Russian River needs to be evaluated.
Feasibility Rating	4
Energy	Energy impact will need to be assessed.
Energy Rating	2

Permitting/Legal	Permitting with the Regional Water Quality Control Board (RWQCB) would be required, but if proven more effective than current system may be relatively straightforward.
Permitting/Legal Rating	3
Social	Positive impact on communities due to reduced SSOs
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction, but will require coordination with other departments.
Jurisdiction Rating	2

Table D-4.3. Project Concept #1A.3 – Implement Inflow/Infiltration Monitoring and Reduction Program

Strategy	1. Improve Efficiency of Collection Systems
Action	1A. Reduce Collection System Infiltration and Inflow
Project Concept Name	Project Concept #1A.3 – Implement Inflow/Infiltration Monitoring and Reduction Program
Project Code	1A.3
Project Concept	Many of the Sanitation District and Zone collection systems, but most acutely the Sonoma Valley and Russian River collection systems, suffer from high infiltration and inflow (I/I) during storm events. Sanitary Sewer Overflows, SSOs, are fairly common in the Sonoma Valley and Russian River system. The relatively poor understanding of these flows and the likelihood that future climate change will increase I/I in these systems requires focused effort. This project concept would establish an I/I Monitoring and Reduction program that would seek to better understand areas of systems that have large I/I contributions, implement a monitoring system on critical collection system segments in Sonoma Valley and Russian River, and implement asset management program to upgrade sewer capacity and strategically replace aging sewer lines. This program would build from current sewer replacement projects included in the 2019 Capital Projects Improvement Plan, CPP. Could be expanded to other collection systems in a similar manner.
Vulnerability #1	Sonoma Valley Collection System
Vulnerability #2	Russian River Collection
Vulnerability #3	Penngrove Collection System
Vulnerability #4	Airport Collection
Vulnerability #5	0
Cost	Cost of monitoring and reduction program up to \$1 million, plus estimated \$20 million for sewer replacements. Could be scaled.
Cost Rating	4
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Positive impact on environment due to reduced SSOs
Environmental Rating	1
Feasibility	Feasible and part of current programs
Feasibility Rating	1

Energy	No change to energy use.
Energy Rating	1
Permitting/Legal	Positive impact of reducing SSOs and fines from RWQCB. Would lessen permitting/legal issues.
Permitting/Legal Rating	1
Social	Positive impact on communities due to reduced SSOs
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction
Jurisdiction Rating	1

Table D-4.4. Project Concept #2A.1 – Eliminate Sonoma Valley WWTP Hydraulic Constraints due to Sea Level Rise

Strategy	2. Improve Wastewater Treatment Reliability
Action	2A. Reduce Hydraulic Constraints at Treatment Plants
Project Concept Name	Project Concept #2A.1 – Eliminate Sonoma Valley WWTP Hydraulic Constraints due to Sea Level Rise
Project Code	2A.1
Project Concept	Sea levels have risen in the past several decades and are projected to rise up to 2 feet by mid-century. During the wet season (November 1-April 30), treated wastewater from Sonoma Valley wastewater treatment plant is discharged to Schell Slough, a tidally influenced waterbody downstream of Schell Creek. During the dry season, tertiary treated effluent is discharged to Wetland Management Units 1 and 3 to maintain freshwater marshlands and ponds for wetland habitat enhancement. Between May 1 and October 31, treated wastewater is also used for irrigation of dairy fodder crops and vineyards. SLR will effectively reduce the hydraulic capacity of effluent discharge and recycled water delivery due to more frequent tide gate closure and increasing hydraulic constraint. Project concept focuses on increasing the operational effluent pumping capacity and increase equalization storage capacity.
Vulnerability #1	Sonoma Valley WWTP
Vulnerability #2	Sonoma Valley Reclamation
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Specific cost estimate would depend on operational pumping limits. Order of magnitude cost estimate in the range of \$5 to 10 million.
Cost Rating	3
Timing	Estimated 5+ years to complete.
Timing Rating	3
Environmental	Limited change in environmental impact
Environmental Rating	2
Feasibility	Feasible within small ranges of SLR. Larger SLR would mean the effluent pumping would be substantially against the tide.
Feasibility Rating	2
Energy	Increased energy needs to pump against higher SLR.

Energy Rating	3
Permitting/Legal	Adapting hydraulics to SLR not likely to require new permitting. However changes to discharge volumes or circulation may trigger additional requirements.
Permitting/Legal Rating	2
Social	Likely negligible impact
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction
Jurisdiction Rating	1

Table D-4.5. Project Concept #2A.2 – Improve or Adapt Operations of Reuse Supply Delivery to Management Units

Strategy	2. Improve Wastewater Treatment Reliability
Action	2A. Reduce Hydraulic Constraints at Treatment Plants
Project Concept Name	Project Concept #2A.2 – Improve or Adapt Operations of Reuse Supply Delivery to Management Units
Project Code	2A.2
Project Concept	Sea levels have risen in the past several decades and are projected to rise up to 2 feet by mid-century. During the wet season (November 1 through April 30), treated wastewater from Sonoma Valley wastewater treatment plant is discharged to Schell Slough, a tidally influenced waterbody downstream of Schell Creek. During the dry season, tertiary treated effluent is discharged to Wetland Management Units 1 and 3 to maintain freshwater marshlands and ponds for wetland habitat enhancement. SLR and precipitation-based flooding will increase risk of inundation at the Mulas Booster Stations (BP-B1 and BP-B2), R-4 Pump Station, and possibly R-1, R-2, and BP-J1 stations. In addition, SLR will inundate greater portions of the management units, impact tide gate operations on Schell Slough, and potentially cause levee overtopping and/or failure on private lands near the units. This project concept includes flood protection at the pump stations and an assessment of the hydraulic integration of reuse supply and management unit operations under SLR. Expansion of reuse water delivery to other areas may be necessary to adapt to the climate impacts to the reservoirs and pipelines and allowing for improvement of operations that integrate delivery to the management units under future SLR
Vulnerability #1	Sonoma Valley Reclamation
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Specific cost estimate would depend on number of pump stations needing protection. Order of magnitude cost estimate in the range of \$3 to 4 million.
Cost Rating	3
Timing	Estimated 5 years to complete.
Timing Rating	3
Environmental	Limited change in environmental impact
Environmental Rating	2

Feasibility	Feasible within small ranges of SLR. Larger SLR would mean management units may be limited.
Feasibility Rating	2
Energy	Flood protection component would require no change in energy needs, but delivery to higher final discharge location will require more pumping
Energy Rating	3
Permitting/Legal	Limited permitting or legal issues
Permitting/Legal Rating	2
Social	Could impact neighboring farmers and other landowners.
Social Rating	2
Jurisdiction	Primarily within Sonoma Water jurisdiction, but must integrate with management units and local landowners.
Jurisdiction Rating	5

Table D-4.6. Project Concept #3B.2 - Expand Opportunities for Sonoma Valley Reuse

Strategy	3. Expand Opportunities for Reuse
Action	3B. Increase Resilience of Regional Water Supply through Reuse
Project Concept Name	Project Concept #3B.2 - Expand Opportunities for Sonoma Valley Reuse
Project Code	0
Project Concept	Sonoma Valley WWTP generates more treated wastewater 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 concept includes the expansion of partnerships with wineries and other irrigators, groundwater management entities, and regional entities such as Bay Area Clean Water Agencies and Sonoma Land Trust to increase the service area for recycled water. Opportunities exist for increased delivery for seawater intrusion barrier, expanding use for irrigation by potential recycled water customers adjacent to current delivery system, and connection additional customers and storage projects such as those in the North Bay Water Reuse Program - Phase 2 projects.
Vulnerability #1	Sonoma Valley Reclamation
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Based on NBWRP Phase 2 costs of Sonoma Valley elements of approximately \$10 to 12 million.
Cost Rating	4
Timing	Estimated 5 to 7 years to complete
Timing Rating	3
Environmental	Positive impacts by increasing reuse. Some negative impacts of increasing the footprint of the reclamation system.
Environmental Rating	2
Feasibility	Technically feasible
Feasibility Rating	1
Energy	Increased energy needs due to service to more distant or higher elevation customers.
Energy Rating	3

Permitting/Legal	Requires EIR/S for expansion of service area and facilities.
Permitting/Legal Rating	2
Social	Likely little to no change
Social Rating	1
Jurisdiction	Requires integration with county, other management entities, and private landholders.
Jurisdiction Rating	5

Table D-4.7. Project Concept #1B.1 - Penngrove Lift Station Flood Protection

Strategy	1. Improve Efficiency of Collection Systems
Action	1B. Upgrade Lift Stations for Hydraulic Efficiency
Project Concept Name	Project Concept #1B.1 - Penngrove Lift Station Flood Protection
Project Code	0
Project Concept	The Penngrove Lift Station serves the Penngrove Sanitation Zone, 475 acres and 500 Equivalent Single Family Dwellings, and pumps wastewater from the Penngrove collection system to the City of Petaluma's wastewater collection and treatment system. This lift station is currently located within the mapped FEMA 100-year floodplain and is vulnerable to flooding from heavy precipitation and will become more vulnerable in the future with increasing extreme precipitation events. In December 2014, a rain event occurred that flooded the Penngrove Lift Station. The Penngrove Lift Station was shut down to avoid electrical failure and permanent damage. Future climate projections suggest that the Penngrove location could experience flooding several feet above existing 100-year floodplain. As-of 2021, Sonoma Water is under construction implementing the Penngrove Lift Station Flood Resiliency Project to counteract the effects of possible future rain events similar to the December 2014 incident. Because of all these issues, all electrical equipment will be raised above the 500-year flood plain and situated on a platform outside the lift station to allow adequate working space. These platforms will allow Sonoma Water to meet the requirements set by the National Electrical Code for electrical systems.
Vulnerability #1	Penngrove Collection System
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Total estimate is \$1 million in CPP 2019 through 2024, but could be nearly \$10 million if relocated.
Cost Rating	3
Timing	Estimated 3 to 5 years to complete.
Timing Rating	2
Environmental	Environmental impacts would likely be low as most of the construction-related effort would be associated with the upper portion of the collector and housing.
Environmental Rating	2

Feasibility	Technically feasible. Similar projects in California have been successfully developed in recent years.
Feasibility Rating	1
Energy	No change in energy needs.
Energy Rating	1
Permitting/Legal	Unlikely to have permitting or legal challenges due to scale of project.
Permitting/Legal Rating	1
Social	No impacts on local/regional socio-economics and vulnerable communities would be low.
Social Rating	1
Jurisdiction	Primarily within Sonoma Water sole jurisdiction
Jurisdiction Rating	1

Table D-4.8. Project Concept #1A.4 - Revise Collection System Design Standards

Strategy	1. Improve Efficiency of Collection Systems
Action	1A. Reduce Collection System Infiltration and Inflow
Project Concept Name	Project Concept #1A.4 - Revise Collection System Design Standards
Project Code	0
Project Concept	Design standards for sanitation collection systems are established by Sonoma Water. The design standards were last updated over 10 years ago and are based on historical I/I estimates and did not take into consideration future climate change projections. Older systems already show high I/I flows even under moderate rainfall events. This project concept includes a review of the design standards and would recommend revisions to further reduce I/I through improved design/construction practices and consideration of higher frequency and magnitude of rainfall during storm events. This project concept would be integrated with revisions to the flood management design criteria to include projected changes in timing, frequency, and duration of extreme precipitation under future climate. Concept would include routine training of personnel on proper design methods.
Vulnerability #1	Russian River Collection
Vulnerability #2	Sonoma Valley Collection System
Vulnerability #3	Penngrove Collection System
Vulnerability #4	Airport Collection
Vulnerability #5	Occidental WWTP and Collection
Cost	Updates to design standards could be implemented and institutionalized for approximately \$500,000 to \$1 million.
Cost Rating	1
Timing	Could be completed in less than 2 years.
Timing Rating	2
Environmental	Expected improved environmental conditions
Environmental Rating	1
Feasibility	Technically feasible. Several stormwater utilities in U.S. are implementing adaptive climate flood criteria.
Feasibility Rating	2
Energy	No change in energy needs.
Energy Rating	1

Permitting/Legal	Updates to Sonoma Water and County Flood Management criteria not likely to require changes in permits.
Permitting/Legal Rating	1
Social	Likely positive impacts to landholders due to flood and erosion reduction.
Social Rating	1
Jurisdiction	Flood management criteria and guidance primarily in jurisdiction of Sonoma Water and County.
Jurisdiction Rating	2

Table D-4.9. Project Concept #2A.1 - Increase Operable Capacity at Russian River WWTP

Strategy	2. Improve Wastewater Treatment Reliability
Action	2A. Reduce Hydraulic Constraints at Treatment Plants
Project Concept Name	Project Concept #2A.1 - Increase Operable Capacity at Russian River WWTP
Project Code	0
Project Concept	The Russian River WWTP treats an average dry weather flow of approximately 0.2 mgd and the peak wet weather treatment capacity is 3.5 mgd. The climate change threats that will most severely impact the WWTP include increased river flooding and increased extreme precipitation. These changes will exacerbate the limited hydraulic capacity of the WWTP which can be exceeded during wet weather events. This project concept seeks to reduce the hydraulic limitations by increasing effluent storage, increasing the size of the ultraviolet system, and constructing a new headworks. Concept includes construction of additional 1 million gallon of emergency effluent storage to store flows that exceed the plant and current effluent storage capacity (1.8 million gallons).
Vulnerability #1	Russian River WWTP
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Order of magnitude cost for upgrades is \$10 to 15 million.
Cost Rating	4
Timing	Could be completed in 5 to 7 years
Timing Rating	3
Environmental	Improve environmental conditions due to reduced untreated wastewater discharges.
Environmental Rating	1
Feasibility	Technically feasible, but constrained site conditions will challenge additional effluent storage development.
Feasibility Rating	2
Energy	No expected changes in energy needs.
Energy Rating	1
Permitting/Legal	Would improve conditions with RWQCB due to lower untreated discharges.

Permitting/Legal Rating	1
Social	Positive impact to downstream communities.
Social Rating	1
Jurisdiction	Plant expansion would fall within Sonoma Water jurisdiction
Jurisdiction Rating	1

Table D-4.10. Project Concept #3A.1 - Purchase Additional Land at Russian River WWTP for Summer Irrigation

Strategy	3. Expand Opportunities for Reuse
Action	3A. Identify and Expand Reuse for Permit Compliance
Project Concept Name	Project Concept #3A.1 - Purchase Additional Land at Russian River WWTP for Summer Irrigation
Project Code	0
Project Concept	The Russian River WWTP treats an average dry weather flow of approximately 0.2 million gallons per day (mgd) and the peak wet weather treatment capacity is 3.5 mgd. Treated wastewater is discharged into the Russian River Oct. 1-May 1 and used for irrigation of adjacent redwoods and Northwood Golf Course May 15- Sept. 30. In some years during shoulder seasons, Summer effluent exceeds the current demand for irrigation, and effluent is discharge to the river. Future lower summertime flows could increase the relative contribution from the WWTP discharge. This project concept would acquire additional land or identify additional irrigation customers to expand the effluent irrigation during summer.
Vulnerability #1	Russian River WWTP
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimate cost for land acquisition and irrigation \$8 to 10 million.
Cost Rating	4
Timing	Could be completed in 5 to 7 years
Timing Rating	3
Environmental	Reduces effluent discharges to river.
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	Limited energy needs to expand irrigation if nearby, but distant delivery may be required.
Energy Rating	3

Permitting/Legal	Would improve conditions with RWQCB due to lower low flow discharges.
Permitting/Legal Rating	1
Social	Positive impact to downstream communities.
Social Rating	1
Jurisdiction	Requires acquisition of additional land or irrigation customers.
Jurisdiction Rating	5

Table D-4.11. Project Concept #2B.1 - Increase Flood Protection at Sonoma Valley WWTP

Strategy	2. Improve Wastewater Treatment Reliability
Action	2B. Upgrade Treatment Plant Capacity
Project Concept Name	Project Concept #2B.1 - Increase Flood Protection at Sonoma Valley WWTP
Project Code	0
Project Concept	The Sonoma Valley WWTP is vulnerable to increased precipitation and increased creek flooding. The WWTP is located adjacent to the Schell Creek 100-year floodplain. While there is a 1 ft berm between the creek and the WWTP, creek flows have come within 1 foot of the berm in the past and minor flooding of the access road has occurred. Portions of the WWTP are within the 100-year flood zone and flood probability will increase in the future due to both increased precipitation intensities and SLR on Schell Slough. This project concept would include study of the increased flood risk at the site and increase the berm elevation. While flooding has not been a major issue historically, the importance of this plant and potential increased risk warrants review.
Vulnerability #1	Sonoma Valley WWTP
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimated cost for study and raising berm is \$1 to 2 million.
Cost Rating	2
Timing	Could be completed in 3 to 5 years
Timing Rating	2
Environmental	No expected impacts
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No changes in energy needs
Energy Rating	1
Permitting/Legal	Berm is on plant property and would not likely require permitting.
Permitting/Legal Rating	2

Social	No change
Social Rating	1
Jurisdiction	Primarily with Sonoma Water's jurisdiction
Jurisdiction Rating	1

Table D-4.12. Project Concept #5A.1 - Establish Sanitation Level Planning

Strategy	5. Establish Integrated Wastewater Planning and Policy
Action	5A. Develop an Integrated Collection System and Treatment Planning and Management Strategy
Project Concept Name	Project Concept #5A.1 - Establish Sanitation Level Planning
Project Code	0
Project Concept	Many of the sanitation systems that are currently managed by Sonoma Water were conceived and built by external entities in isolation prior to Sonoma Water's assumption of operation and management responsibilities. A regional and/or consistent systemwide assessment of sanitation needs, assets, and strategies has not been developed. No strategic planning level document such as the Water Supply Strategies Action Plan exists for the sanitation sector reflecting a consistent approach. This project concept would establish a Strategic Sanitation Systems Plan (or similar) that would compile the state of each sanitation system, outline risks and opportunities for these systems, and perhaps identify regional solutions that could reduce risks, identify consolidation opportunities (e.g. Occidental and Airport) and explore divesture (e.g. Sea Ranch). Staff perception is that a planning group for sanitation would facilitate a more equal management of water supply and sanitation.
Vulnerability #1	Russian River WWTP
Vulnerability #2	Sonoma Valley WWTP
Vulnerability #3	Airport WWTP
Vulnerability #4	Occidental WWTP and Collection
Vulnerability #5	Geyserville WWTP and Collection
Cost	Estimated cost for study is approximately \$2 to 3 million with internal and external staff to deliver
Cost Rating	2
Timing	Could be completed in 3 to 4 years
Timing Rating	3
Environmental	No expected impacts
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No changes in energy needs

Energy Rating	1
Permitting/Legal	None
Permitting/Legal Rating	1
Social	No change
Social Rating	1
Jurisdiction	Within Sonoma Water's jurisdiction
Jurisdiction Rating	1

Table D-4.13. Project Concept #4B.1 - Implement SCADA Master Plan and Automation

Strategy	4. Improve Sanitation System Operations
Action	4B. Improve Real-time Operational Control and Reliability
Project Concept Name	Project Concept #4B.1 - Implement SCADA Master Plan and Automation
Project Code	0
Project Concept	Most of Sonoma Water’s wastewater treatment plants have minimal automation and operations staff has to manually make changes on-site. Access to some of these facilities can be challenged during high flood events or fires which will be exacerbated by future climate change. Even under no natural hazards, the treatment facilities are at distance from the operators at the SCADA center. Operations staff often has to be called out to make changes that could easily be made from the SCADA center if controls were automated. This project concept builds on the Phase 1 SCADA Master Plan and implements automation pilots at Sonoma Valley and Russian River WWTPs based on the criticality of the systems and a priority list developed by operations staff.
Vulnerability #1	Russian River WWTP
Vulnerability #2	Sonoma Valley WWTP
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Estimated cost for implementing automation pilots is approximately \$3 to 4 million
Cost Rating	2
Timing	Could be completed in 3 to 5 years
Timing Rating	3
Environmental	Potential benefits due to greater operational control during critical events
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	Small increases in energy needs.
Energy Rating	2
Permitting/Legal	None
Permitting/Legal Rating	1

Social	No change
Social Rating	1
Jurisdiction	Within Sonoma Water's jurisdiction
Jurisdiction Rating	1

Table D-4.14. Project Concept #3B.2 - Long-Term Solution for Occidental County Sanitation District

Strategy	3. Expand Opportunities for Reuse
Action	3A. Identify and Expand Reuse for Permit Compliance
Project Concept Name	Project Concept #3B.2 - Long-Term Solution for Occidental County Sanitation District
Project Code	0
Project Concept	The Occidental County Sanitation District collection system is gravity fed and includes one lift station that historically pumped wastewater to the Occidental WWTP. The WWTP was decommissioned in 2018, but currently can be used as equalization. The collection system collects an average dry weather flow of up to 0.05 mgd. Occidental County Sanitation District now transports by septic holding trucks wastewater to the Airport SZ WWTP for treatment. In addition to the regulatory risks, the WWTP is moderately vulnerable due to climate change hazards such as wildfires and increased influent due to wet weather events. Truck access may be restricted during fires. This project concept will develop a plan for a long-term solution to close Occidental WWTP, convey wastewater to the Airport WWTP in the interim, and possibly ultimately pump to the Graton Sanitation Zone treatment plant for treatment, reuse, and disposal.
Vulnerability #1	Occidental WWTP and Collection
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost for study of long-term conveyance solutions estimated in range of \$250k.
Cost Rating	1
Timing	Could be completed in 1 year.
Timing Rating	1
Environmental	Study has no impact, but solution would be positive greenhouse gas and transportation impacts due to reduced trucking
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No change

Energy Rating	1
Permitting/Legal	None
Permitting/Legal Rating	1
Social	No change
Social Rating	1
Jurisdiction	Within Sonoma Water's jurisdiction
Jurisdiction Rating	1

Table D-4.15. Project Concept #5C.1 - Establish Property Partnerships and Ordinances to Reduce Overflows

Strategy	5. Establish Integrated Wastewater Planning and Policy
Action	5C. Develop Consistent Guidelines and Policy for Sanitation Systems
Project Concept Name	Project Concept #5C.1 - Establish Property Partnerships and Ordinances to Reduce Overflows
Project Code	0
Project Concept	One significant contribution to Sonoma Water's various collection systems inflow/infiltration is leaking private sewer laterals. Without any changes to these laterals, climate change is expected to increase I/I due to increased frequency of storm events causing infiltration. This project concept would include two main elements: partnerships and outreach to realtors and homeowners (associations) and implementing and enforcing the sewer lateral ordinance mandating repairs of leaking laterals.
Vulnerability #1	Russian River Collection
Vulnerability #2	Sonoma Valley Collection System
Vulnerability #3	Penngrove Collection System
Vulnerability #4	Airport Collection
Vulnerability #5	Occidental WWTP and Collection
Cost	Outreach and ordinance development/enforcement estimated at \$500,000.
Cost Rating	1
Timing	Could be completed in 1 year.
Timing Rating	1
Environmental	Positive impact of reducing I/I
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	Small reduction in energy due to lower peak flows
Energy Rating	1
Permitting/Legal	None expected
Permitting/Legal Rating	1
Social	Improve water quality
Social Rating	1
Jurisdiction	Within Sonoma Water's jurisdiction, but requires ordinance and enforcement.
Jurisdiction Rating	5

Table D-4.16. Project Concept #2A.3 - Develop In-Line or Off-Line Collection System Storage

Strategy	2. Improve Wastewater Treatment Reliability
Action	2A. Reduce Hydraulic Constraints at Treatment Plants
Project Concept Name	Project Concept #2A.3 - Develop In-Line or Off-Line Collection System Storage
Project Code	0
Project Concept	Many of the Sanitation Zone collection systems, but most acutely the Sonoma Valley and Russian River collection systems, suffer from high I/I during storm events. SSOs are fairly common in the Sonoma Valley system. The relatively poor understanding of these flows and the likelihood that future climate change will increase I/I in these systems requires focused effort. This project concept seeks to address the hydraulic capacity limitations at the WWTP by managing peak flow within the collection system. Either in-line or off-line storage within the collection system would be installed to attenuate the peak flows arriving at the WWTPs. Siting and sizing of these wet weather storage facilities would be dependent on a more detailed review of collection system flow monitoring. Assumed that two 5-million gallon storage facilities would be installed in both the Sonoma Valley and Russian River systems.
Vulnerability #1	Sonoma Valley Collection System
Vulnerability #2	Russian River Collection
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost of approximately \$2.5 million per 5-million gallon storage facility. Additional cost for pumping, controls, and land acquisition. Total estimated at \$10 to 15 million.
Cost Rating	4
Timing	Estimated 2 to 3 years to complete.
Timing Rating	4
Environmental	Positive impact on environment due to reduced SSOs
Environmental Rating	3
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No change to energy use. Gravity system.

Energy Rating	1
Permitting/Legal	Positive impact of reducing SSOs and fines from RWQCB. Would lessen permitting/legal issues.
Permitting/Legal Rating	1
Social	Positive impact on communities due to reduced SSOs, but potential negative impacts with tanks in neighborhoods
Social Rating	3
Jurisdiction	Primarily within Sonoma Water jurisdiction, but may require land acquisition.
Jurisdiction Rating	3

Table D-4.17. Project Concept #2A.3 - Improve SOP Development and Training

Strategy	2. Improve Wastewater Treatment Reliability
Action	2A. Reduce Hydraulic Constraints at Treatment Plants
Project Concept Name	Project Concept #2A.3 - Improve SOP Development and Training
Project Code	0
Project Concept	With projections of future climate change to increase the frequency and magnitude of extreme precipitation events, collection system I/I is expected to increase. This project concept seeks to reduce these flows through improved SOP development, training, and application. SOPs outline the procedures for on-going operations, maintenance, and testing (e.g. lateral inspection and smoke testing) of the collection systems to reduce the potential for SSOs. SOPs would be revised and training initiated for all sanitation operations staff.
Vulnerability #1	Sonoma Valley Collection System
Vulnerability #2	Russian River Collection
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Approximately \$500,000 for SOP updates and training.
Cost Rating	1
Timing	Could be completed in 1 to 2 years.
Timing Rating	2
Environmental	Positive impact on environment due to reduced SSOs
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No change to energy use.
Energy Rating	1
Permitting/Legal	Positive impact of reducing SSOs and fines from RWQCB. Would lessen permitting/legal issues.
Permitting/Legal Rating	1
Social	Positive impact on communities due to reduced SSOs
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction.
Jurisdiction Rating	1

Table D-4.18. Project Concept #1B.2 - Address Localized Flooding at Airport WWTP

Strategy	1. Improve Efficiency of Collection Systems
Action	1B. Upgrade Lift Stations for Hydraulic Efficiency
Project Concept Name	Project Concept #1B.2 - Address Localized Flooding at Airport WWTP
Project Code	0
Project Concept	The Airport WWTP currently provides tertiary treatment for an average dry weather flow of approximately 0.75 mgd. All treated effluent is disposed of through irrigation. Climate change threats are associated with increased extreme precipitation and creek flooding that inundates the road to North Pond, limiting access to the pond and to several valves. However, access to the plant is not limited. This project concept includes creek maintenance measures to help reduce flooding of the road to North Pond and protecting or relocating the vulnerable valves to ensure access during flood events.
Vulnerability #1	Airport WWTP
Vulnerability #2	0
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Assuming two valves relocated at \$350k each (2019 CPP). Approximately \$700k for valve replacement plus \$100k for stream maintenance, total of \$800k.
Cost Rating	1
Timing	Could be completed in 1 year.
Timing Rating	1
Environmental	No appreciable impact expected
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No change to energy use.
Energy Rating	1
Permitting/Legal	No change
Permitting/Legal Rating	1
Social	no change
Social Rating	1
Jurisdiction	Primarily within Sonoma Water jurisdiction.
Jurisdiction Rating	1

Table D-4.19. Project Concept #5A.3 - Evaluate Post-Fire Impacts on Collection Systems

Strategy	5. Establish Integrated Wastewater Planning and Policy
Action	5A. Develop an Integrated Collection System and Treatment Planning and Management Strategy
Project Concept Name	Project Concept #5A.3 - Evaluate Post-Fire Impacts on Collection Systems
Project Code	0
Project Concept	The two most recent fires have shown property and sanitation systems were not sheltered from the effects. The Sonoma Complex Fires, a series of fires that swept through Sonoma County in October 2017, caused widespread damage. In the Airport Larkfield-Wikiup Sanitation Zone entire neighborhoods, including Larkfield Estates, were destroyed by the Tubbs Fire. Many homes in the Larkfield area were connected to septic systems. This project concept would expand on the project that constructed sewer collection systems in Larkfield Estates and in Dover and Ramsgate Courts, and map other similar areas with both vulnerable sanitation systems and high fire risk. The results from the 2017 fires can be utilized to make proactive improvements to the vulnerable systems. This project concept assumes another similar area as Larkfield Estates is identified.
Vulnerability #1	Airport Collection
Vulnerability #2	Penngrove Collection System
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Using costs from 2019 CPP, estimate of \$8 million for new system.
Cost Rating	3
Timing	Requires 2 to 3 years to complete
Timing Rating	2
Environmental	Improved sanitation system leads to fewer SSOs
Environmental Rating	1
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No change to energy use.
Energy Rating	1

Permitting/Legal	Would require EIR or Negative Declaration due to construction impacts.
Permitting/Legal Rating	2
Social	Improved sanitation system leads to fewer SSOs
Social Rating	1
Jurisdiction	Requires engagement with cities and property owners.
Jurisdiction Rating	5

Table D-4.20. Project Concept #4B.1 - Improve WWTP Road Access and Emergency Staffing

Strategy	4. Improve Sanitation System Operations
Action	4B. Improve Real-time Operational Control and Reliability
Project Concept Name	Project Concept #4B.1 - Improve WWTP Road Access and Emergency Staffing
Project Code	0
Project Concept	Recent events of flooding and wildfires have exposed access challenges at some facilities. Future climate change is expected to increase both of these risks. This project concept would improve alternate road access to the Russian River, Geyserville, and Occidental treatment plants and lift stations, which can be blocked when extreme river flooding occurs or when wildfires in the wildland urban interface (WUI) occur. The ability to access the plants and operate during peak flows is critical. Additional accommodation should be considered to house staff for a period of days at the Russian River WWTP due to its potential inaccessibility.
Vulnerability #1	Russian River WWTP
Vulnerability #2	Geyserville WWTP and Collection
Vulnerability #3	0
Vulnerability #4	0
Vulnerability #5	0
Cost	Cost expected less than \$500,000 for access road maintenance and staff accommodation changes.
Cost Rating	1
Timing	Could be completed in 1 year
Timing Rating	1
Environmental	Continuity of operations
Environmental Rating	3
Feasibility	Technically feasible
Feasibility Rating	1
Energy	No change to energy use.
Energy Rating	1
Permitting/Legal	None
Permitting/Legal Rating	1
Social	Continuity of operations
Social Rating	2
Jurisdiction	Primarily within Sonoma Water jurisdiction.
Jurisdiction Rating	1

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