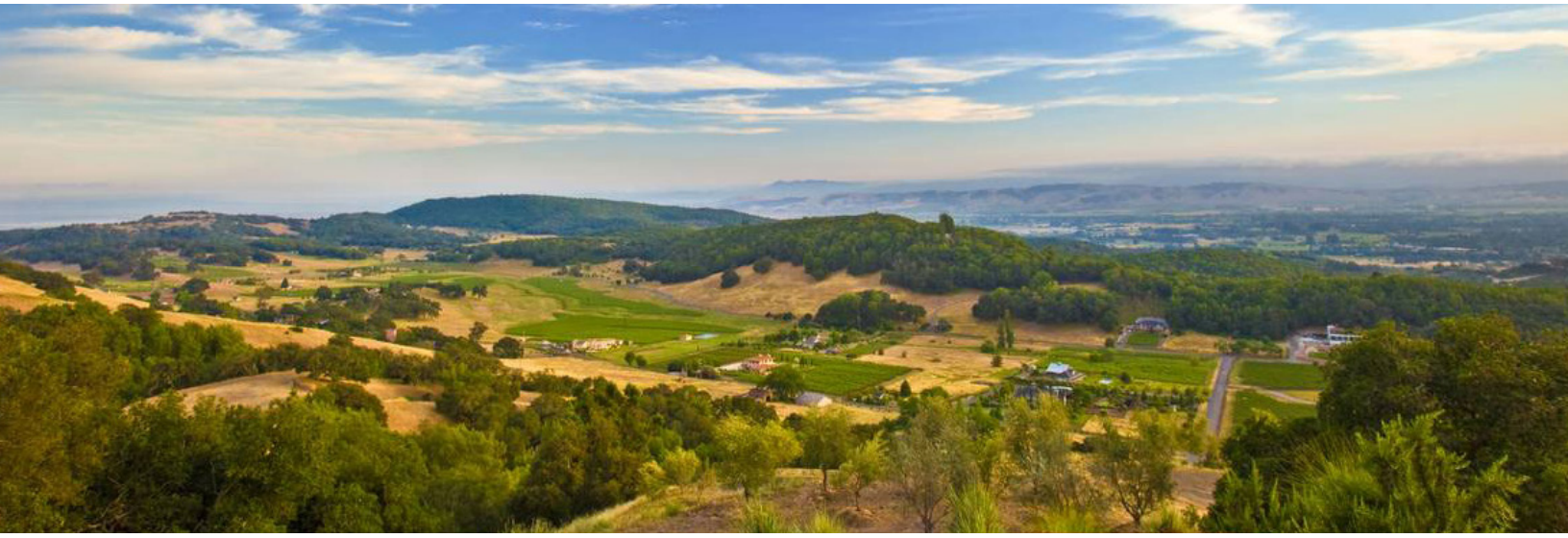
Valley of the Moon Water District

Local Hazard Mitigation Plan



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Executive Summary

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. The Valley of the Moon Water District (District) developed this Local Hazard Mitigation Plan (LHMP) update to make the District and its customers less vulnerable and more resilient to future hazard events. This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 so that the District would be eligible for the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation and Hazard Mitigation Grant programs.

The District followed a planning process prescribed by FEMA, which began with the formation of a hazard mitigation planning committee (HMPC) comprised of District representatives, and other regional stakeholders in Sonoma Valley. The HMPC conducted a risk assessment that identified and profiled hazards that pose a risk to the District, assessed the District's vulnerability to these hazards, and examined the capabilities in place to mitigate them. The District's water delivery and conveyance facilities are vulnerable to several hazards that are identified, profiled, and analyzed in this plan. Floods, wildfires, severe weather, and earthquake hazards are among the hazards that can have a significant impact on the District. The combined federal and state disaster history suggests that Sonoma County (and the District) experiences a major event worthy of a disaster declaration every 1.6 years. The County has a 63 percent chance of receiving a disaster declaration in any given year.

Based on the risk assessment review and goal setting process, the HMPC identified the following five goals, which provide the direction for reducing future hazard-related losses within the District's Planning Area:

- **Goal 1:** Increase resiliency and reliability of the District's water supply system.
- **Goal 2:** Maintain water supplies during natural, human-health, and technological hazards to provide basic public health, safety, and sanitation and fire suppression needs.
- **Goal 3:** Reduce economic impacts and asset damage from hazards and ensure the District is eligible for FEMA grant funding for mitigation projects.
- **Goal 4:** Enhance collaboration among regional agencies and organizations in regards to hazard mitigation.

To meet identified goals, the plan recommends 32 mitigation actions, which are summarized in the table that follows. This plan has been formally adopted by the District and will be updated every five years at a minimum.

Table ES.1: Mitigation Action Summary Table

Action Title	Address Existing or Future Development	Priority
Earthquake		
Conduct engineering-level study to understand seismic vulnerabilities of District critical assets	Both	High
Implementation of water pipe inspection and maintenance program	Existing	High
Earthquake hardening	Both	High
Wildfire		
Wildfire vulnerability assessment	Existing	High
Implement Pilot wildfire mitigation incentive program	Both	High
Implement fire safe standards, design review, and code enforcement inspections	Both	High
Increase water tank storage capacity	Both	Medium

Action Title	Address Existing or Future Development	Priority
Drought and Water Supply		
Emergency redundant main line connection to the City of Sonoma service area	Both	High
Water mainline replacement and retrofit project	Both	High
Alternative supplemental water supply project	Both	High
Groundwater well installation and recharge to augment water supplies	Both	Medium
Enhance coordination with regional partners to increase public awareness related to drought restrictions	Both	Medium
Collaborate with the Sustainable GSA on development of groundwater management criteria and identifying recharge projects where there is groundwater depletion in the Sonoma Valley subbasin	Both	Medium
Recycled water system project in Sonoma Valley to augment water supplies	Both	Low
Mini-rate study that compares off-peak versus peak water use cost structures to meet water demand objectives during drought events	Both	Low
Initiate a study to determine costs of purchasing off-peak water for aquifer storage and recovery	Both	Low
Flood		
Identification of water pipelines exposed to flooding and soil erosion along bridge crossing to prioritize and implement pipeline alignment upgrades	Existing	High
Boyes Boulevard water line replacement project	Existing	High
Landslide		
Donald Tank hillside stabilization	Both	High
Severe Weather		
Solar power back-up generation and battery storage at water tanks and installation of SCADA systems	Both	High
Critical water facility and infrastructure hardening and resilience projects against severe weather	Both	Medium
Dam Incidents		
Dam Incident Planning during Sonoma Development Center Specific Plan Process	Existing	Low
Public Health Hazards: Pandemic/Epidemic		
Ensure continuity of District operations through implementation of Public Health and Safety Plan	Both	High
Cyber Threats		
Implement a five-year training plan to enhance system security and exercise a recovery plan for District facilities	Both	High
Develop a Risk and Resilience Assessment (RRA) and update the Emergency Response Plan	Both	High
Leverage modern hardware and security system upgrades to improve risk management throughout District operations	Both	Medium
Multi-Hazard Actions		
Cross connection to City of Sonoma water system	Both	High
Implementation of capital improvements in Water System Master Plan	Existing	High
"Map your Neighborhood" Preparedness Program	Both	High
Scotts Dam removal at Lake Pillsbury	Both	Medium

Action Title	Address Existing or Future Development	Priority
Conduct an Intertie Feasibility Study of new main aqueduct intertie from Sonoma Valley to Petaluma Valley	Existing	Low
Conduct an Intertie Feasibility Planning Study of new main aqueduct intertie from Sonoma Valley to American Canyon	Both	Low
On-site solar power generation and battery storage project	Both	Low

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Acronyms

ACP	Asbestos Cement Pipe
ACS	U.S. Census Bureau, American Community Survey
APG	Adaptation Planning Guide
AR	Atmospheric River
ASR	Aquifer Storage and Recovery
ATSDR	Agency for Toxic Substances and Disease Registry
AWIA	America Water Infrastructure Act
BAAQMD	Bay Area Air Quality Management District
BCM	Basin Characterization Model
BFE	Base Flood Elevation
BPS	Booster Pump Station
BRIC	Building Resilient Infrastructure and Communities
CAC	Climate Action Commission
CalARP	California Accidental Release Prevention Program
Cal FIRE	California Department of Forestry and Fire Protection
Cal OES	California Office of Emergency Services
CAP	Climate Action Plan
CAS	Climate Adaptation Strategy
CBC	California Building Code
CDC	Center for Disease Control
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CIP	Capital Improvement Program
COPE	Citizens Organized to Prepare for Emergencies
CORPS	U.S. Army Corps of Engineers
CPVC	California Public Utility Commission
CRHR	California Registry of Historic Resources
CWC	California Water Code
CWD	Climate Water Deficit

CWPP	Community Wildfire Protection Plan
DAC	Disadvantaged Communities
DDoS	Direct Denial of Service
DFIRM	Digital Flood Insurance Rate Map
DHS	Department of Health Services
DIP	Ductile Iron Pipe
District	Valley of the Moon Water District
DMA	Disaster Mitigation Act
DOC	Department of Conservation
DOF	Department of Finance
DRRA	Disaster Recovery Reform Act
DSOD	Division of Safety of Dams
DWR	Department of Water Resources
EAP	Emergency Action Plan
EOP	Emergency Operations Plan
EPIC	Electric Program Investment Change
ERP	Emergency Response Plan
FEMA	Federal Emergency Management Agency
FHSZ	Fire Hazard Severity Zone
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FMAG	Fire Management Assistance Grant
FRAP	Fire and Resource Assessment Program
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
Guide	FEMA Local Mitigation Plan Review Guide
Handbook	Local Mitigation Planning Handbook
HAZUS	Multi-Hazard Loss Estimation Tool
HDPE	High Density Polyethylene
HHS	U.S. Department of Health and Human Services
HMA	Hazard Mitigation Assistance

HMBP	Hazardous Materials Business Plan
HMGP	Hazard Mitigation Grant Program
HMPC	Hazard Mitigation Planning Committee
IPCC	Intergovernmental Panel on Climate Change
ISO	Insurance Services Office
IVT	Integrated Water Vapor Transport
LAFCO	Local Agency Formation Commission
LAL	Lightning Activity Level
LHMP	Local Hazard Mitigation Plan
LOMA	Letter of Map Amendment
LOMR	Letter of Map Revision
LRA	Local Responsibility Area
MJHMP	Multi-Jurisdictional Hazard Mitigation Plan
MMI	Modified Mercalli Intensity
MSL	Mean Sea Level
NBCAI	North Bay Climate Adaptation Initiative
NCEI	National Centers for Environmental Information
NCFR	Narrow Cold Frontal Rainband
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NFHL	National Flood Hazard Layer
NID	National Inventory of Dams
NOAA	National Oceanic Atmospheric Association
NRHP	National Registry of Historic Places
NWS	National Weather Service
OES	Office of Emergency Services
OSHA	Occupational Safety and Health Administration
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
PG&E	Pacific Gas and Electric
PA	Public Assistance
PIF	Pandemic Intervals Framework
PPE	Personal Protection Equipment

PPM	Parts Per Million
PRC	Public Resources Code
PRVs	Pressure Reducing Valves
PSPS	Public Safety Power Shutoff
PVC	Polyvinyl Chloride
RCPA	Regional Climate Protection Authority
RRA	Risk and Resilience Assessment
SBA	Small Business Administration
SCADA	Supervisory Control and Data Acquisition
SDC	Sonoma Development Center
SDWA	Safe Drinking Water Act
SFHA	Special Flood Hazard Area
SGC	California Strategic Growth Council
SGMA	Sustainable Groundwater Management Agency
SHMP	State Hazard Mitigation Plan
SLR	Sea Level Rise
SOI	Sphere of Influence
SRA	State Responsibility Area
SVGSP	Sonoma Valley Groundwater Sustainability Plan
SWRCP	State Water Resources Control Board
SVI	Social Vulnerability Index
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
VOMWD	Valley of the Moon Water District
WGCEP	Working Group on California Earthquake Probabilities
WHO	World Health Organization
WMP	Water System Master Plan
WRCC	Western Regional Climate Center
WRFP	Water Recycling Funding Program
WSCP	Water Shortage Contingency Plan
WMP	Water System Master Plan

WTP	Water Treatment Plant
WUI	Wildland Urban Interface

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1 Introduction

The Valley of the Moon Water District (District) prepared this Local Hazard Mitigation Plan (LHMP) to guide planning efforts to better protect the customers and critical water supply facilities and infrastructure of the District from the effects of natural hazard events. It serves as a tool to help decision makers direct mitigation activities, to coordinate District resources, and to be eligible for State and Federal funding. This is District's first stand-alone plan. This plan also demonstrates the District's commitment to reducing risks from hazards to the Sonoma Valley community.

1.1 Background and Scope

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on hazard mitigation saves society an average of $6 in avoided future disaster costs (National Institute of Building Sciences 2018).

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are determined, prioritized, and implemented. This plan documents the District's hazard mitigation planning process and identifies relevant hazards and vulnerabilities and strategies the District will use to decrease vulnerability and increase resiliency in Sonoma Valley.

1.2 Regulatory Authority

1.2.1 Federal

This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. (Hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act or DMA of 2000.) The DMA of 2000, also commonly known as "The 2000 Stafford Act Amendments," constitutes an effort by the Federal government to reduce the rising cost of disasters. The Act stresses the importance of coordination and disaster preparedness prior to an event and emphasizes the need for mitigation planning.

Section 322 of the regulations established the requirements that LHMPs must meet in order for a local jurisdiction to be eligible for certain Federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). To facilitate implementation of the DMA of 2000 and the Stafford Act Amendments, FEMA created an Interim Final Rule (the Rule), published in the Federal Register in February of 2002 in Section 201 of 44 CFR (44 CFR §201.6). The Rule spells out the mitigation planning criteria for States and local communities.

In March 2013 FEMA released *The Local Mitigation Planning Handbook* (Handbook) as the official guide for local governments to develop, update and implement local mitigation plans. The Handbook complements and references the October 2011, *FEMA Local Mitigation Plan Review Guide* (Guide) in order to help "Federal and State officials assess Local Mitigation Plans in a fair and consistent manner." Local jurisdictions, including special districts must demonstrate that proposed mitigation actions are based upon a sound planning process that accounts for the inherent risk and capabilities of the individual communities as stated in Section 201.5 of the Rule. The Handbook and Guide were routinely reviewed during the development of the District's 2021 LHMP for the purpose of ensuring thoroughness, diligence, and compliance with the DMA of 2000 planning requirements. The District also reviewed the *2020 California Adaptation Planning Guide* (APG) among other state-focused planning guides to inform the climate vulnerability assessment and development of climate-specific adaptation goals and strategies.

This plan was also developed so the District can be eligible for certain federal disaster assistance, specifically, the FEMA Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, and the Flood Mitigation Assistance (FMA) program. Additional FEMA mitigation funds include the HMGP Post Fire funding associated with Fire Management Assistance Grant (FMAG) declarations and the Building Resilient Infrastructure and Communities (BRIC) program funding associated with the 2018 Disaster Recovery Reform Act (DRRA).

1.2.2 State and Local

During the development of the District's LHMP, District staff initiated a review of their *2019 Water System Master Plan* and *2015 Urban Water Management Plan* to ensure consistency with hazards and mutually reinforcing policies related to their water supply system needs. Information in this plan will be used to guide and coordinate mitigation activities and decisions for water facility and infrastructure planning in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to communities in Sonoma Valley and by protecting critical water supply and distribution facilities, reducing liability exposure, and minimizing overall impacts and disruptions to the District's water system assets and in turn their customers. The District's service area has been affected by hazards in the past and the District is committed to reducing future impacts from hazard events, building community resilience to future disasters, and becoming eligible for mitigation-related federal funding.

1.3 Plan Organization

The District's LHMP is organized as follows:

- Executive Summary
- Chapter 1: Introduction
- Chapter 2: District Profile
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Adoption
- Chapter 7: Plan Implementation and Maintenance
- Appendices

2 District Profile

The Valley of the Moon Water District (District) provides drinking water to approximately 23,077 people via approximately 6,993 service connections. The District's service area is located in Sonoma County, approximately 50 miles north of San Francisco, and to the northwest of the City of Sonoma. The service area encompasses approximately 11.8 square miles that span the majority of central Sonoma Valley and includes the small unincorporated spa and resort communities northwest of the City of Sonoma, including El Verano, Boyes Hot Springs, Agua Caliente, Glen Ellen, and Fetters Hot Springs, as well as the residential and commercial customers from the Trinity Oaks subdivision to the north to the Temelec subdivision to the south. Elevations in the service area range from approximately 60 feet above mean sea level (msl) to approximately 1,190 feet msl.

The Sonoma Local Agency Formation Commission (LAFCo) determines the District's Sphere of Influence (SOI) boundary, which indicates the likely eventual limits of the District's service area. The Sonoma LAFCo amended the District's SOI in 2017 to include two areas beyond the District's current service area: the territory previously served by the Sobre Vista Mutual Water Company and the territory occupied by the Sonoma Development Center (SDC). The territory occupied by the SDC included a municipal water supply, treatment, and distribution system on the campus.

The Hazard Mitigation Planning Committee (HMPC) selected the District's service area as the Planning Area for this plan. The District also depicts the SOI in the Local Hazard Mitigation Plan (LHMP) because it represents the eventual limits of the District's boundaries. The Planning Area is shown in Figure 2-1.

2.1 Location and Geography

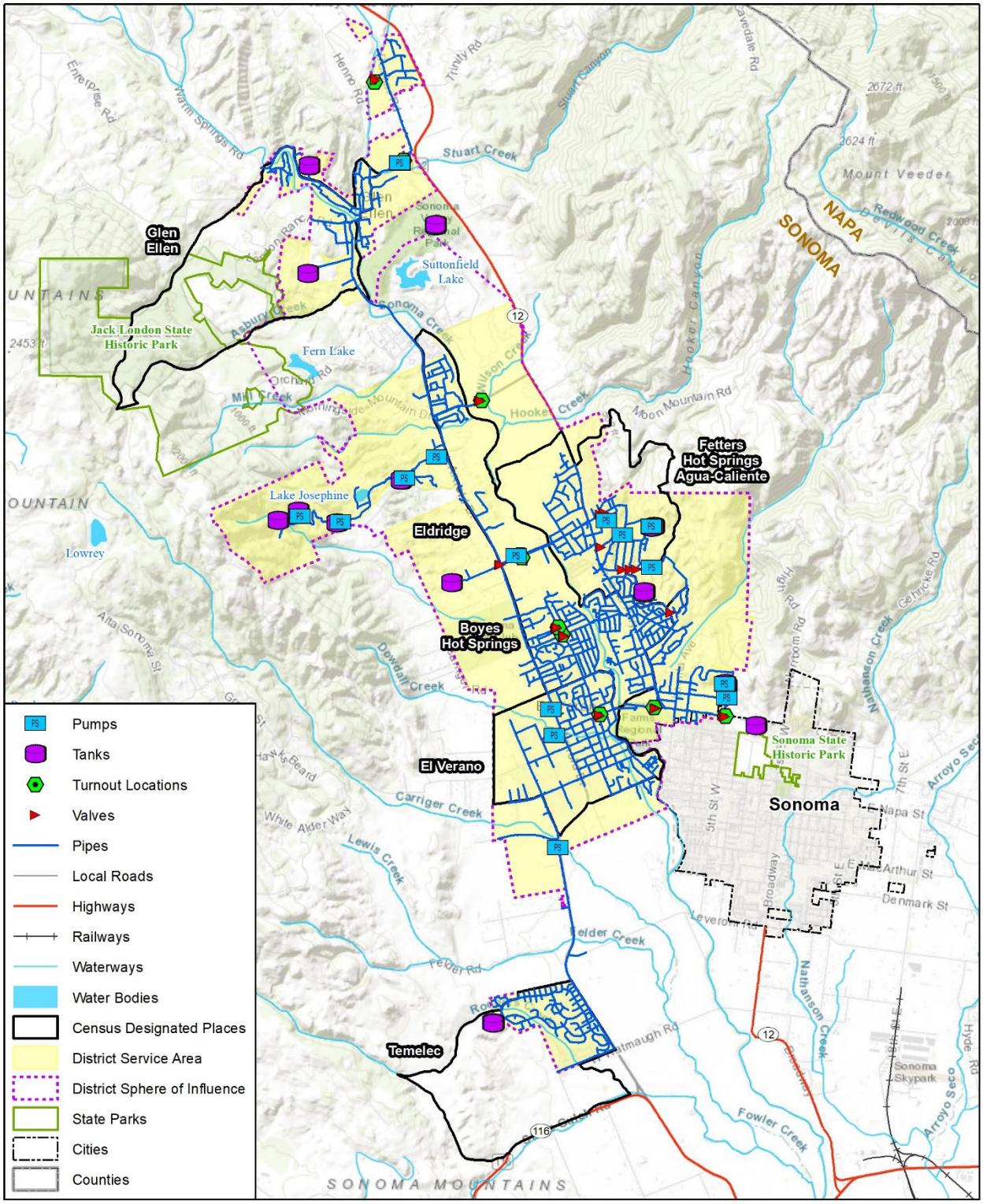
The District's service area is defined mostly by the surrounding natural landscape and topography. Sonoma Valley lies between two mountain ranges along the eastern portion of Sonoma County. The District's service area includes the central portion of Sonoma Valley between the Mayacamas Mountains and Sonoma Mountains. The entire valley stretches from Bennet Valley and Kenwood in the north to San Pablo Bay in the south. Sonoma Creek flows through the valley from the headwaters in Sugarloaf Mountain State Park to where it discharges towards the alluvial plain, estuaries, and tidal marshlands in the San Pablo Bay and the Napa Sonoma Marsh. The main tributaries of Sonoma Creek include Yulupa Creek, Graham Creek, Calabazas Creek, Bear Creek, Schell Creek, and Carriger Creek.

State Highway (SR-) 12 and Arnold Drive bisect Sonoma Valley and State Highway 116 and State Highway 121 to the south and U.S. Highway 101 to the northwest connect residents and visitors to the surrounding Bay Area region. The climate in Sonoma Valley is characterized by warm and dry summers and winters that are relatively mild with more rainfall.

2.2 Land Use Distribution

The District serves primarily residential and commercial customers in the urban portion of Sonoma Valley including the unincorporated communities of Agua Caliente, Glen Ellen, Fetter Hot Springs, El Verano, and Boyes Hot Springs. The balance of the valley's population is scattered in rural agricultural and hillside areas at very low densities, where individual on-site wells are the main source of water supply for the rural portion of the community. Agriculture, particularly vineyards, wine processing, and tourism are the main economic drivers of the Sonoma Valley community. Most of the local employment consists of the retail and service sector and many workers commute to jobs outside the Valley.

Figure 2-1 Valley of the Moon Water District Planning Area



Map compiled 5/2020;
intended for planning purposes only.
Data Source: Sonoma County, CalTrans, US Census TIGER Database, CA Open Data Portal, EKI Environment & Water, Inc., CA Parks and Rec.

Sonoma Valley's land use pattern has been defined by commercial and urban and rural residential development comprised of small and medium density residential planned communities surrounded by agricultural lands. This land use pattern translates to the number historic and current potable water service connections by customer type in the District. Single-family residential uses make up approximately 90 percent of the customers, followed by multi-family residential at 6.3 percent, commercial at 2.5 percent, and institutional and government uses at 0.5 percent (VOMWD 2019). A detailed breakdown of land use in the District by the number of potable water service connections is listed in Table 2-1. These land uses are shown in Figure 2-2.

Table 2-1: District Historical Potable Water Service Connections by Customer Type

Water Use Sector (by land use type)	Number of Potable Water Service Connection (2017)	Percentage of Total
Single Family Residential	6,239	89.8%
Multi-Family Residential	440	6.3%
Commercial	172	2.5%
Institutional/Governmental	34	0.5%
Irrigation Multi-Family	13	0.2%
Irrigation Commercial	22	0.3%
Other/Construction	24	0.4%
Total Number of Connections	**6,994**	**100%**

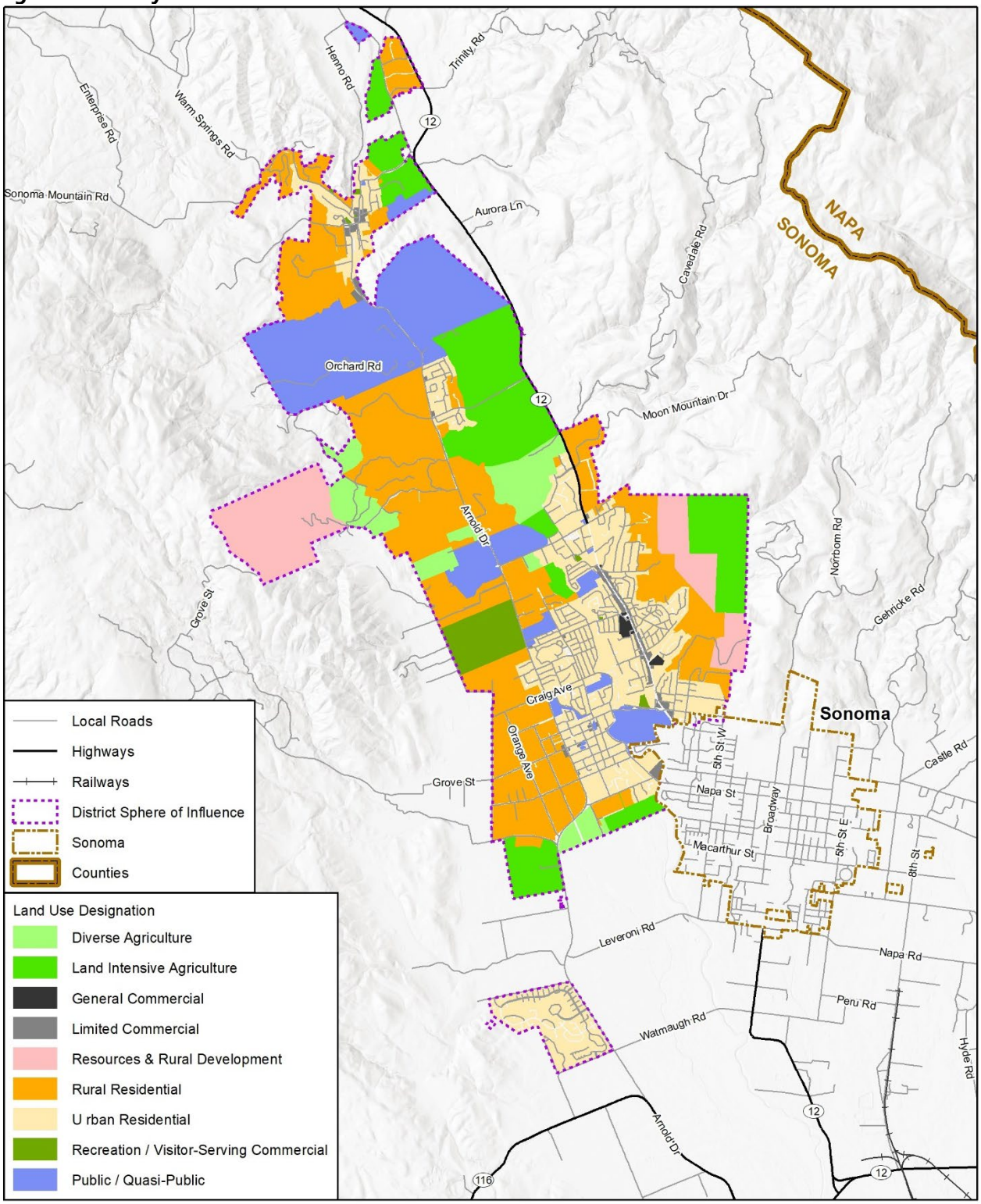
Source: VOMWD 2019

2.3 History

The District encompasses a significant portion of the area known as "The Valley of the Moon". This phrase comes from the Native American word "Sonoma". The City of Sonoma, adjacent to the District is the oldest town north of the San Francisco Bay. The City of Sonoma incorporated in 1850 and is the site of the most northerly mission of the 21 California missions. In 1834, the Mexican government sent General Mariano Vallejo to colonize the Sonoma area and in 1836, he was named Commanding General of all Mexican military forces in California and controlled the land north of the San Francisco Bay while California was under Mexican rule (VOMWD 2020). In 1846, during the Mexican-American War, Sonoma and California became officially occupied by the United States. The City of Sonoma was incorporated as a City in 1850 and then unincorporated in 1862 over various boundary disputes. The City was then reincorporated in 1883 after the boundary disputes were settled.

Since mid-1880, small unincorporated centers northwest of the City of Sonoma such as El Verano, Boyes Hot Springs, Agua Caliente and Fetters Hot Springs were established as spas and resorts around the natural mineral hot springs and promoted by the railroad companies. Today these communities are within the District's service area. Water service in the Sonoma Valley and City of Sonoma area was originally provided by private water companies and the Sonoma Water and Irrigation Company, which incorporated in 1904 and was one of the oldest water companies (VOMWD 2020). A major consolidation of water companies occurred in 1921, and the Sonoma Water and Irrigation Company purchased the Sonoma Valley Water, Light and Power Company, the Sonoma Vista Water Company, and Sonoma Water Works. Sonoma Water Works served the area within the City of Sonoma and was sold to the City of Sonoma in 1933. The Sonoma Water and Irrigation Company then purchased the Boyes Hot Springs Company and the Agua Caliente Water Works in 1927, the Boyes Springs Park Company in 1943, and the Donaghy Water Company in 1959 (VOMWD 2020).

Figure 2-2 Valley of the Moon Water District Land Use Distribution



Another major water company serving this area was established in 1921 by Mr. N. M. Petersen, Senior. He bought four smaller water companies and combined them into Mountain Avenue Water System. Acquisitions of other water systems by the Mountain Avenue Water System continued through 1935. In 1957, the Valley of the Moon Fire District was evaluated by the Pacific Fire Board, which at that time noticed the lack of a dependable water supply source. Subsequent inquiries of Fire District Board found that many wells in the area were failing due to drops in the groundwater levels in the Valley. Early attempts to have Sonoma County build an aqueduct from Santa Rosa to the Sonoma Water and Irrigation Company failed due to the inability to deposit a $25,000 cash bond with the County.

An election was scheduled for the purpose of organizing a public water district and to authorize the issuance of bonds. Proceeds of the bond issue were to be used for the acquisition of the two major private water companies operating in the area, for installation of new mains connecting the distribution systems of the two companies, and for providing a tie to the future Sonoma Aqueduct. The election was held on May 24, 1960 and the formation of the District and the issuance of bonds were approved by the voters. Acquisition of the Sonoma Water and Irrigation Company and the Mountain Avenue Water System was completed in early 1962 and the District started management and operation of the systems on June 1, 1962 (VOMWD 2020).

During this time, additional water supply sources were needed to allow for growth of the communities served in Sonoma Valley. Many other communities in Sonoma County were in a similar situation and in 1955, voters in Sonoma County Water Conservation and Flood Control District issued bonds for projects to provide water to different parts of the County. The Sonoma County Water Conservation and Flood Control District, later called the Sonoma County Water Agency (now Sonoma Water), awarded a construction contract for the first of these projects, starting with the Santa Rosa Aqueduct in 1956, followed by the construction of the Sonoma Aqueduct project in 1963. This project consisted of a booster pump in Santa Rosa, and 17 miles of 16" and 20" diameter pipeline from Santa Rosa through the center of the District's service area to the City of Sonoma.

At this time, the northern portion of the District's service area consisted of the community of Glen Ellen and where the water distribution system dates back to the 1890's. Different private parties operated water systems in this area until 1963 when the District acquired the facilities of the Glen Ellen Water Company and annexed its service area.

Until 1979, water districts in California organized under the authority of Division 12, Section 30.000 et seq. of the California Water Code (CWC). In late 1979, the State Legislature approved a change in Section 30.006 which allowed water districts organized under the CWC to drop the word "County" from their titles. The Board of Directors (Board) of the District passed a resolution to change the name to Valley of the Moon Water District on January 21, 1980. Today, the District is a public agency that provides high-quality drinking water to 23,077 people in the 11.8 square-mile area in Sonoma Valley.

2.4 Demographics

Data on the District's demographics was based on population estimates and forecasts summarized in the 2019 *Water System Master Plan* (WSMP). The demographics of the District's customers include a range of income levels, household sizes, and water demands. More affluent households are located along the foothills and are characterized by larger lots and homes with higher water demands for irrigation. There are also two disadvantaged communities (DACs) located within the District which tend to have smaller lots and lower water use. Due to the District's setting in the heart of a tourist destination, Sonoma Valley, another factor impacting water use in recent years has been the increase in the number of second homes and vacation rentals. These accounts tend to have higher water use because the sites do not have full-

time owners looking for leaks and managing irrigation water use in accordance with weather patterns (VOMWD 2019).

2.4.1 Population and Growth Projections

The District's population consisted of approximately 24,164 residents in 2018. This estimate was based on population estimates from the 2010 U.S. Census for each census block contained in the District's service area and population projections in the *Sonoma County General Plan 2020*. The aggregate population estimate was compared to the total number of service connections in 2010 (6,841) to determine the number of persons per connection (3,455). This persons-per-connection factor for 2010 was multiplied by the number of service connections in 2017 (6,994) to estimate the service area population (VOMWD 2019). Based on the *2015 Urban Water Management Plan* (UWMP), the existing and projected service area population in the District is 24,873 residents in 2020, 25,586 residents by 2030, and 26,300 residents by 2040, as shown in Table 2-2.

Table 2-2: District Population Estimates and Projections, 2020-2040

	2020	2025	2030	2035	2040
Population Estimates	24,873	25,229	25,586	25,943	26,300

Source: 2015 UWMP

2.4.2 Housing

Housing tenure for the unincorporated communities of Fetter Hot Springs, Boyes Hot Springs, El Verano, Eldridge, Glen Ellen, and Temelec were obtained through the U.S. Census Bureau American Community Survey (ACS) and shows the majority of residents live in a home they own. Table 2-3 breaks down the differences in housing tenure.

Table 2-3: Housing Tenure in the Unincorporated Communities in District Service Area, 2018

Housing Type	Fetter Hot Springs	Boyes Hot Springs	El Verano	Eldridge	Glen Ellen	Temelec
Owner Occupied	1,596	2,707	1,321	455	376	1,082
Renter Occupied	165	275	206	58	103	82
Total	**1,761**	**2,982**	**1,527**	**513**	**479**	**1,164**

Source: U.S. Census Bureau ACS, 2014-2018, www.census.gov/

2.4.3 Race and Ethnicity

Table 2-4 shows the comparative demographic estimates between 2014 and 2018 based on ACS data. The racial and ethnicity makeup of the District is slightly different than the County, where 79.8 percent of the population is White, and 26.5 percent of the population is Hispanic or Latino. In Sonoma Valley, a smaller portion of the population is White (approximately 55 percent), but the Hispanic and Latino population is similar to the County makeup (25.7 percent of the population).

Table 2-4: Race and Ethnicity in the Unincorporated Communities in District, 2014-2018

Race Ethnicity	Fetter Hot Springs	Boyes Hot Springs	El Verano	Eldridge	Glen Ellen	Temelec	Total	Percentage
White	3,407	5,647	2,982	1,035	627	1,525	15,223	55.2%
Black	0	424	47	0	0	0	471	1.7%
American Indian and Alaskan Native	0	65	86	13	81	17	262	0.95%
Asian	86	149	4	2	0	22	263	%
Native Hawaiian	9	46	18	0	0	0	73	0.26%
Other	1,272	1,977	598	301	55	0	4,203	15.2%
Hispanic	2,622	3,503	763	141	55	0	7,084	25.7%
Total	**7,396**	**11,811**	**4,498**	**1,492**	**818**	**1,564**	**27,579**	**100%**

Source: U.S. Census Bureau ACS, Comparative Demographic Estimates, 2008-2012 and 2013-2017 estimates,www.census.gov/

2.4.4 Income and Poverty

Individual households are commonly expected to use private resources and funds to prepare for, respond to and recover from disasters. This means that households living in poverty are disadvantaged when confronting natural and human-caused hazards. Households living in poverty may occupy poorly built or inadequately maintained housing. These housing types may be more susceptible to damage in earthquakes or flood events than other types of housing.

In urban and rural residential areas, such as Sonoma Valley, households living in poverty may also live in older houses and multi-family housing that is constructed of un-reinforced masonry, a building type that is susceptible to damage during earthquakes. Further, residents living below the poverty level are less likely to have insurance to compensate for the losses incurred from natural disasters. Persons under 18 years old in Sonoma County can also be disproportionately affected by poverty. According to the 2014-2018 ACS data, 12.5 percent of the County's total residents under the age of 18 were living in poverty based on the 2018 ACS data compared to 10.9 percent of the total residents within the District's service area within Sonoma Valley (see Table 2-5 below). Based on the demographics for Sonoma Valley, the median household income and per capita income is higher than the County, and the unemployment is slightly less, with the exception being the El Verano area (Census Tract 1503.05).

Table 2-5: District's Comparative Economic Characteristics, 2018

Characteristic	Sonoma County	Census Tract 1502.02	Census Tract 1503.03	Census Tract 1503.04	Census Tract 1503.05	Census Tract 1503.06	Census Tract 1505.00	District Service Area Total
Children below Poverty Level (18 years and under)	12.5%	2.5%	6.7%	18.9%	20.8%	10.1%	6.8%	10.9%
Median Household Income	$76,753	$140,167	$96,941	$106,488	$70,694	$76,944	$125,703	$102,823
Per Capita Income	$39,929	$68,116	$95,109	$40,375	$25,580	$39,869	$57,505	$54,425
Population in Labor Force	253,421	2,637	1,895	3,371	3,179	2,342	2,431	2,643
Unemployment**	5.5%	2.8%	1.8%	2.4%	1.2%	1.4%	0.6%	1.7%

Source: U.S. Census Bureau ACS, 2014-2018, obtained by California Department of Finance (DOF). Census Tract data obtained from U.S. Census Bureau ACS, 2014-2018 5-Year Estimates

*Excludes active duty armed forces

**Unemployment rate is based on October 6, 2020 DOF data.

Additional demographic data and information on income, social vulnerability, and DACs in the District's Planning Area are summarized below in Section 2.5 Social Vulnerability. Information on growth is summarized in Section 2.7 Growth and Development Trends.

2.5 Social Vulnerability

Social vulnerability considerations were included in the development of this plan to identify populations (and customers) across the District's Planning Area that might be more vulnerable to hazard impacts based on a number of factors. Hazard events can have very different impacts for different segments of a community, even if the hazard effects the entire District. The combination of socioeconomic status, household composition, physical disabilities, age, race and ethnicity, education level, primary language, housing, and transportation barriers can alter the way communities prepare for and respond to hazard events. For example, as stated in the previous section, families with lower household incomes may not be able to renovate their home to be more resilient to flooding and earthquakes, and as a result these households may be disproportionately affected by a flood or earthquake event. The elderly population may have limited mobility due to age and physical disabilities, which could lead to less accessibility during hazard events. It may also be more time-intensive for this population to receive hazard information and respond in the event of a hazard. Similarly, for those segments of the population where English is not their native language, it may take these individuals and families more time to prepare and respond during a hazard event.

The social vulnerability considerations in this plan cover household income, ethnicity, English proficiency, the senior and disabled population, and single-parent households metrics. The considerations are broad in scope and are based on best available data and mapping information from the following source:

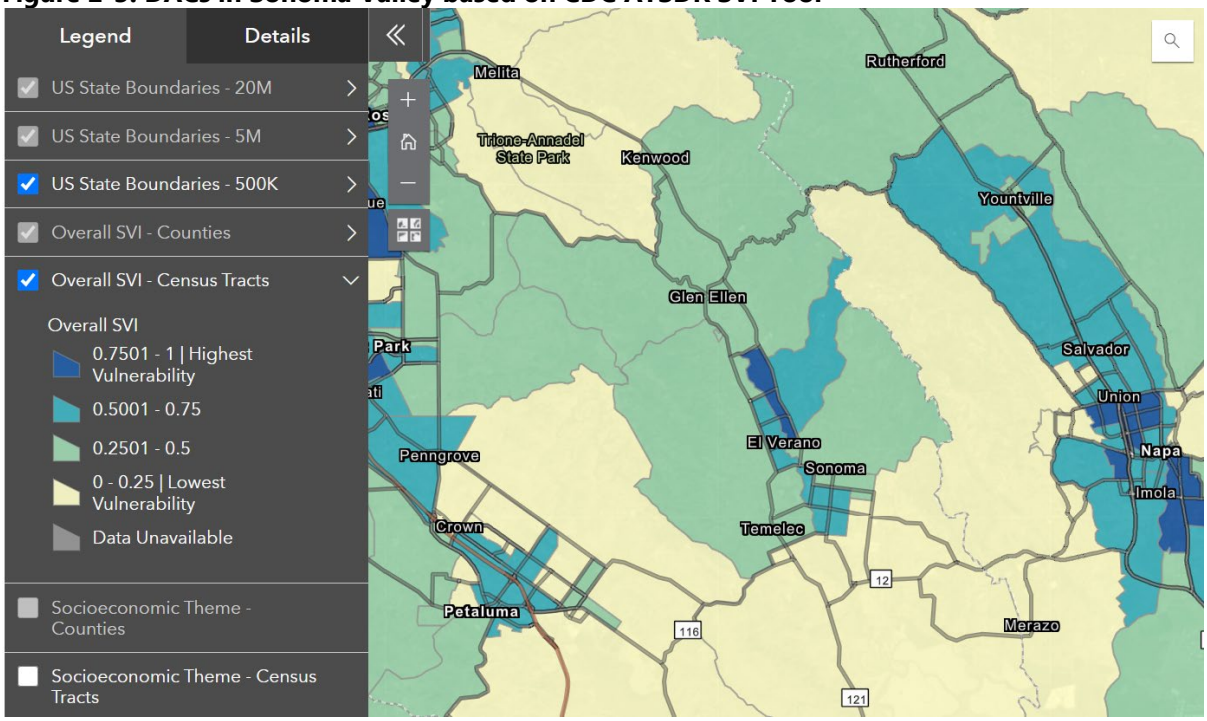
- Center for Disease Control's (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) Social Vulnerability Index (SVI).

CDC Agency for Toxic Substances and Disease Registry Social Vulnerability Index

A SVI was developed by the CDC ATSDR and their Geospatial Research, Analysis & Services Program, as a way to portray communities' capacities to prepare for and respond to natural and man-made disasters. The SVI provides information on vulnerable populations to assist emergency response planners and public health officials in the identification of communities more likely to require additional support before, during, and after a hazardous event. The CDC's SVI includes county- and state-level maps that show relative vulnerability, provide key socially and spatially relevant information on communities' populations, and the maps compare the SVI based on Census Tracts. This SVI index combines four main themes of vulnerability: socioeconomic status; household composition and disability; minority status and language; and housing and transportation. The information from the SVI data informs the vulnerability of people, as qualitatively discussed in the vulnerability assessment for each hazard in Chapter 4.

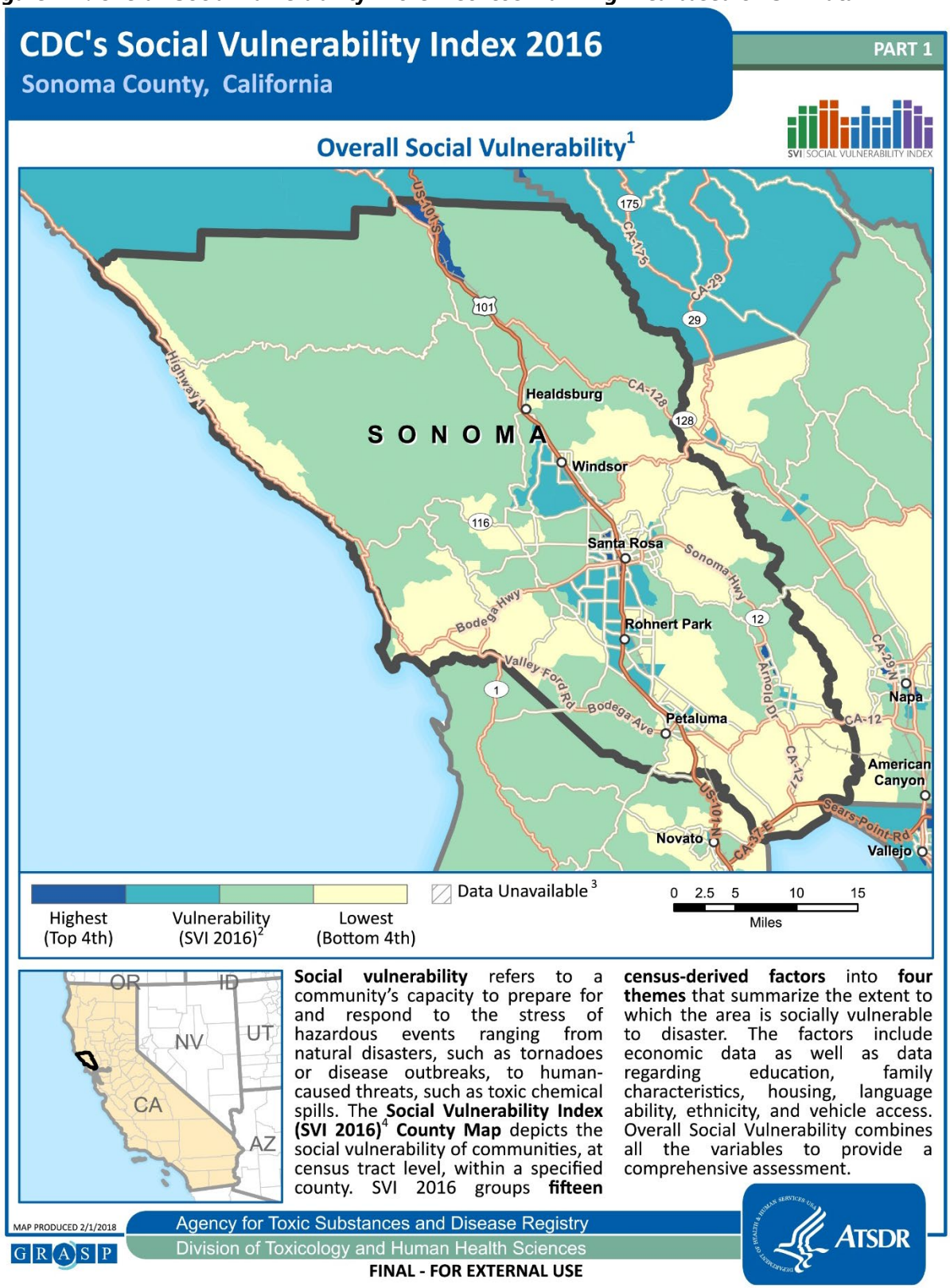
An overview of social vulnerability for the District's Planning Area is shown in Figure 2-3 based on CDC SVI data aggregated to census tracts. The SVI map depicts that within the District's Planning Area there is one census tract (Census Tract 1503.05 SVI Score = 0.7719) in the central portion of Sonoma Valley with population with a higher vulnerability to disasters (in blue) compared to Sonoma County, which overall has a low to moderate vulnerability to disasters (in pale green). The census tracts shaded in green and yellow have moderate to low vulnerability to disasters. The overall social vulnerability in the surrounding unincorporated portion of Sonoma Valley based on the SVI data is shown in Figure 2-4. Additional maps using the four main vulnerability themes of the SVI, including socioeconomic vulnerability, household composition and disability, minority status, language vulnerability, and housing and transportation are provided on the CDC's SVI online maps at https://svi.cdc.gov/.

Figure 2-3: DACs in Sonoma Valley based on CDC ATSDR SVI Tool



Source: CDC ATSDR 2020

Figure 2-4: Overall Social Vulnerability in the District's Planning Area based on SVI Data



2.6 Economy and Employment

The most comprehensive economic data available for the unincorporated communities that comprise Sonoma Valley comes from the U.S. Census ACS data and the California Department of Finance (DOF). Select estimates of economic characteristics for the District's Planning Area are summarized below.

As of 2018, El Verano, Fetter Hot Springs, and Boyes Hot Springs, three of the larger and urbanized unincorporated communities in Sonoma Valley had relatively lower unemployment rates than Sonoma County (Sonoma County 2018). The ACS 5-year estimates show an approximate 3.2 percent unemployment rate, lower than the County (5.5 percent), and statewide rates (4.2 percent); this reflects a strong economy and demand for labor in Sonoma Valley. Table 2-6 illustrates the breakdown of employment by industry in the larger unincorporated communities in the District's Planning Area and in Sonoma Valley from 2014-2018, as well as the number of people employed by each industry.

Table 2-6: District's Employment by Industry, 2013-2017

Industry	Boyes Hot Springs		Fetter Hot Springs		El Verano	
	# Employed	% Employed	# Employed	% Employed	# Employed	% Employed
Agriculture, forestry, fishing and hunting, and mining	86	2.1%	130	5.2%	13	0.7%
Construction	353	8.7%	287	11.6%	165	8.8%
Manufacturing	337	7.08.3%	237	9.6%	158	8.4%
Wholesale trade	574	2.6%	42	1.7%	92	4.9%
Retail trade	187	14.1%	214	8.6%	75	4.0%
Transportation and warehousing, and utilities	106	4.6%	56	2.3%	56	3.0%
Information	574	0.6%	34	1.4%	59	3.2%
Finance and insurance, and real estate and rental and leasing	159	3.9%	83	3.3%	73	3.9%
Professional, scientific, and management, and administrative and waste management services	426	10.9%	204	8.2%	356	19.0%
Educational services, and health care and social assistance	992	24.4%	437	17.6%	333	17.8%
Arts, entertainment, and recreation, and accommodation and food services	442	10.5%	523	21.1%	260	13.9%
Other services, except public administration	287	7.1%	189	7.6%	192	10.3%
Public administration	93	2.3%	44	1.8%	38	2.0%

Source: U.S. Census Bureau ACS, 2014/2018 www.census.gov/

2.7 Growth and Development Trends

The District experienced steady development over the past decade that resulted in some decline during the housing crisis of 2007-2012. Growth and development trends have since recovered, and the District is again experiencing steady population growth as a result of residential developments in Sonoma Valley. As the District continues to identify additional planned developments within its service area it will continually

need to reassess water demand projections to accommodate this future growth. The District anticipates providing connections and service to the following major developments in the future:

- 80-unit multi-family development on Verano Avenue across from Maxwell Farms Regional Park anticipated to be completed by 2025;
- Springs Specific Plan, bounded by Agua Caliente Road at the north and Verano Avenue at the south and bisected by the Highway 12 commercial corroder, which includes up to an additional 124 single-family dwellings units, 561 multi-family or live-work dwelling units, 167,000 square feet of commercial space, 120 hotel rooms, 82,000 square feet of office space, and 27,000 square feet of recreational area anticipated to be completed over the next 50 years;
- Approximately 200 single-family dwelling units on vacant land at the intersection of Arnold Drive and Agua Caliente Road; and
- 200 and 500 dwelling units as part of redevelopment of the SDC.

Additional information on development trends in the District's Planning Area can be found in the Future Development section of each hazard profile in Chapter 4.

2.8 Mitigation Capability Assessment

During the development of this plan the District's HMPC completed a mitigation capability assessment to understand what loss prevention mechanisms are already in place. When combined with the risk assessment and the mitigation capability assessment this results in the District's "net vulnerability" to disasters, and more accurately focuses the goals, objectives, and proposed actions of this plan. For this planning effort, a representative from each department at the District participated on the HMPC.

The HMPC used a two-step approach to conduct the capability assessment for the District. First, an inventory of common mitigation activities was made through the use of a matrix. The purpose of this effort was to identify policies and programs that were either in place, needed improvement, or could be undertaken if deemed appropriate. Second, the HMPC conducted an inventory and review of existing policies, regulations, plans, and programs to determine if they contributed to reducing hazard-related losses or if they inadvertently contributed to increasing such losses.

Similar to the HMPC's effort to describe hazards, risks, and vulnerability of the District's critical water facilities and infrastructure, this mitigation capability assessment describes the District's existing capabilities, programs, and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. It identifies select county, regional, state and federal departments/agencies that can supplement the District's mitigation capabilities. This also determines where the plan can be integrated into other planning mechanisms, such as applicable County plans and policies (e.g., *Sonoma County General Plan 2020*, *2016 Community Wildfire Protection Plan [CWPP]*) This assessment is divided into four sections: regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, and mitigation outreach and partnerships.

2.8.1 District's Regulatory Mitigation Capabilities

Table 2-7 lists planning and land management tools typically used by special districts to implement hazard mitigation activities and indicates those that are in place at the District. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

The District recognizes that there are public outreach opportunities available to support current and future community engagement with the District's customers that relates to hazard mitigation and the LHMP. As part of the development of this plan, the District also evaluated the need to continue the outreach program during the implementation phase and leading up to the next LHMP update.

Table 2-7: District's Regulatory Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
General Plan	No	The *Sonoma County General Plan 2020* is the County's blueprint for land use in the unincorporated County. It provides the basis for development while maintaining the quality of life in Sonoma County. The current plan addresses the natural hazards in the following elements: Agricultural Resources, Open Space and Resource Conservation, Water Resources, Public Safety, Circulation & Transit, Air Transportation, Public Facilities & Services, and Noise. The County is in the process of beginning their county-wide, multi-year process to update their General Plan. The County's General Plan Update process was temporarily postponed during the shelter-in-place order. The County also implements the *2016 Sonoma County Operational Area Hazard Mitigation Plan* (HMP) to guide hazard mitigation planning activities. The current plan addresses the following natural hazards: seismic hazards, flooding, wildland fire, landslide hazards, and climate change. This plan is also being updated as a multi-jurisdictional hazard mitigation plan (MJHMP); hazards that will be addressed in the proposed plan include climate change, coastal erosion, earthquakes, flooding, landslide hazards, sea level rise, tsunamis, wildland fires, winter storms, and the secondary impacts of these hazards. Upon adoption of the MJHMP, the County will integrate the plan into the Public Safety Element of the *County's General Plan 2020*. Plan integration is anticipated by August 2022.
Zoning Ordinance	No	Sonoma County implements the *Sonoma County Zoning Regulations* (Chapter 26 of the Municipal Code). The Zoning Regulations promote the public health, safety, peace, comfort, convenience and general welfare in the County. It guides the orderly and beneficial land use in the County, protects the character and economic stability of agricultural, residential, commercial, and industrial uses, and protects the public safety and welfare by regulating the location and uses of structures and land.
Subdivision Ordinance	No	Chapter 25 of the *Sonoma County Municipal Code* contains the County's subdivision ordinance. Major and minor subdivisions in the County are also governed by the Subdivision Map Act (California Government Code, Section 55410, et. Seq.). Common modifications to recorded maps include relocation or removal of

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
		easements, and relocation or enlargement of building envelopes.
Growth Management Ordinance	No	Chapter 26 of the *Sonoma County Municipal Code* contain a residential growth management plan for Sonoma Valley. The growth management measures apply to properties in Planning Area No. 9 within the Sonoma Valley planning area. Restrictions include approval of no more than 60 dwelling units in that portion of Area No. 9, which lies within the "Urban Service Area" and no more than 30 dwelling units in that portion of Area No. 9, which lies outside the "Urban Service Area."
Floodplain Ordinance	No	Chapter 7 and 7B of the *Sonoma County Municipal Code* contain building regulations and flood damage preventions measures that are required before the construction and development of structures within any area of special flood hazard (e.g., elevation requirements of the lowest floor structures, elevations of structures that require floodproofing, certification that floodproofing methods meet criteria, description of extent to which water course altered due to development). Article 56 – F1 Floodway Combining District provides land use regulations for properties situated in floodways to safeguard against the effects of bank erosion, channel shifts, increased runoff or other threats to life and property and to implement the provisions of the *Sonoma County General Plan 2020* public safety element. Article 58 – F2 Floodplain Combining District of the *Sonoma County Municipal Code* provides for the protection from hazards and damage which may result from flood waters.
Other special purpose ordinance (e.g., stormwater, steep slope, wildfire)	No	The *Sonoma County Municipal Code* contains stream setbacks, scenic corridor protections, and various requirements for buildings located in any Fire Hazard Severity Zone (FHSZ) or Wildland-Urban Interface (WUI) Zone in Chapter 7 – Building Regulations. The County also implements Chapter 13 – Sonoma County Fire Safety Ordinance and Chapter 13A – Abatement of Hazardous Vegetation and Combustible Material to provide for the removal of hazardous vegetation around the exterior of improvements in the unincorporated area of the County to reduce the potential for fire. Additionally, the County implements Chapter 11A to protect stormwater quality.
Building Code	No	The County's Building Code is set forth in Chapter 7 of the *Sonoma County Municipal Code*. The building

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
		standards for work authorized by a new permit shall be governed by the codes in force at the time of a new permit application as described in Chapter 1, Division 1 of the California Building Code (CBC).
Fire department Insurance Services Office (ISO) rating	Yes	The City of Sonoma and Sonoma Valley Fire District has an Insurance Services Office (ISO) rating of Class 1.
Erosion or Sediment Control Program	No	Sonoma County implements Chapter 11A to protect stormwater quality. The District can integrate erosion and stormwater management policies into District plans to better protect water supply facilities and infrastructure.
Storm Water Management Program	No	The *Southern Sonoma County Storm Water Resources Plan* (December 2018) developed and prioritized multi-benefit projects that capture and treat stormwater in the County. The District participated in the collaborative planning process and the development of the plan as a participating entity on the Technical Advisory Committee.
Site Plan Review Requirements	No	The County requires an Administrative Design and Review Permit prior to construction. Chapter 7, Article II of *Sonoma County's Municipal Code* outlines the building regulations for the County and most construction in the County requires a building permit through either a Plan Check process for projects that require building plans, or No Plan Check process for simpler projects. Projects are also required to follow environmental and inspection requirements.
Capital Improvements Plan	Yes	The District's 2019 WSMP contains recommended capital improvements for the next 5 to 10 years. These improvements cover the District's supply and storage facilities, hydraulic capacity improvement projects, additional pipeline condition projects to replace pipelines that have reached their useful lives, and improvements identified in previous planning documents. The projects are organized by cost and organized into three levels of prioritization based on projects that should be initiated as soon as possible (next 5 years), near-term projects (next 5 to 10 years), and long-term projects (10 years or more). The location of each project is also illustrated in the plan to show its connection to the larger water supply and distribution system.
Economic Development Plan	No	The District does not have an Economic Development Plan.
Local Emergency Operations Plan (EOP)	Yes	The District has an EOP in place. The District also has an Emergency Response Plan (ERP) in place that was last prepared in 2002. The District plans to update the plan by 2021.
Other special plans	Yes	The 2019 WMP provides the District an overall plan for infrastructure improvements to ensure the District can reliably and cost-effectively serve its customers through 2050.

Regulatory Tool (ordinances, codes, plans)	Yes/No	Comments
		The 2015 UWMP describes and evaluates how the current and future water resources and demands within the District's service area will be managed to provide an adequate and reliable water supply. The Water Supply Contingency Plan (WSCP) is required under the Urban Water Management Planning Act, which states that each water supplier outline how the supplier will prepare for and respond to water shortages.
Flood Insurance Study (FIS) or other engineering study for streams	Yes	The County has participated in the National Flood Insurance Program (NFIP) since 1978 and began implementing their NFIP floodplain regulations in 1982 when they received Digital Flood Insurance Rate Maps (DFIRMs), floodway maps, and attendant certification requirements. The latest FIS applicable to the District was included in a five-volume report along with other incorporated jurisdictions and unincorporated areas studied in Sonoma County; this recent report was revised March 7, 2017. Like the FIS, the latest effective date for the DFIRMS in the County is March 7, 2017. Chapter 7B of the *Sonoma County Municipal Code* sets forth regulations to reduce flood hazards by regulations and restricting development in flood prone areas by establishing specific review requirements and performance standards in conformance with the NFIP regulations. These procedures have been in place since 1982. FEMA determined the ordinance to be NFIP-compliant in January 2004.
Elevation certificates	Yes	Sonoma County's Flood Elevation Mitigation Program implements structural elevations as an efficient and cost-effective way to mitigate against future flood losses. According to Chapter 7 of the *Sonoma County Municipal Code* all new construction must be elevated above the base flood elevation (BFE) by at least 12 inches. BFE certification must then be provided by a registered professional engineer.
Other	Yes	2015 UWMP, 2016 CWPP, WSCP

Source: HMPC Data Collection Guide

As indicated in the table above, the District has several plans and programs that guide the District's development in hazard-prone areas. Starting with the 2019 WSMP, which is the most comprehensive of the District's plans when it comes to mitigation, these relevant plans and programs are described in more detail below.

Water System Master Plan (2019)

The WMP provides the District an overall plan for infrastructure improvements to ensure the District can reliably and cost-effectively serve its customers through 2050. The plan describes the District's existing

water infrastructure, existing and future water demands, the District's main water supply sources, and assesses supply and storage capacity in the District. The WMP includes a water system hydraulic model to assess the District's existing infrastructure to evaluate capacity needs for the current and future demand conditions. Based on this assessment the plan identifies recommended improvement projects related to supply and storage deficiencies.

Urban Water Management Plan (2015)

The District's UWMP is prepared to meet the requirements of the CWC, which requires "every urban water supplier providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually to adopt and submit an UWMP every five years." The purpose of the plan is to describe and evaluate how the current and future water resources and demands within the District's service area will be managed to provide an adequate and reliable water supply. It includes several objectives designed to help the District meet their future water demands and develop performance and operational criteria. It describes the constraints on the District's water supplies and outlines their WSCP and demand management measures. It also presents the implementation measures achieved over the past five years and those planned for the future. Several of the guiding principles, objectives, and actions outlined in the plan will help the District minimize drought and water supply hazards. The District is currently preparing their 2020 UWMP.

Five-Year Capital Improvement Program

The District's five-year Capital Improvement Program (CIP) is updated annually. It covers 2020/2021 through 2024/2025. The basis for the current plan is the District's WSMP. Significant projects outlined in the CIP include the completion of the meter replacement program and Saddle Tank Rebuild in Glen Ellen, improvement of fire flow in the Glen Ellen Zone, and the replacement of undersized water mains. The CIP also includes hillside stabilization near Donald Tank.

Emergency Response Plan

The ERP is a companion plan to the District's initial vulnerability assessment and was developed to comply with the Safe Drinking Water Act as amended by the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. The purpose of the current 2002 ERP is to provide the District with a standardized response and recovery protocol to prevent, minimize, and mitigate injury and damage resulting from emergencies or disasters of man-made or natural origin. The ERPs describe how the District will respond to potential threats or terrorist scenarios identified in the vulnerability assessment, as well as additional emergency response situations. The plans identify emergency planning partnerships, mutual aid agreements, and emergency response policies, procedures, and documents. ERPs also include specific action plans that will be used to respond to events and incidents. While these plans are focused on emergency response, during the next updates proposed for 2021, the District can integrate applicable LHMP mitigation actions into the plan that should improve emergency planning incident response activities.

Water Shortage Contingency Plan

The WSCP is an integrated chapter in the 2015 UWMP. The Urban Water Management Planning Act requires that each water supplier provide a WSCP that outlines how the supplier will prepare for and respond to water shortages. The District's plan addresses the requirement by describing the staged actions it would implement in response to water shortage events that occur over a period of time, such as a drought or interruption in supply due to a catastrophic event. During the next UWMP update in 2020, the District should review the staged actions and determine if any of the LHMP mitigation actions can be integrated into the plan.

2.8.2 Federal Regulatory Mitigation Capabilities

Safe Drinking Water Act

Under the Safe Drinking Water Act (SDWA), the U.S. EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards. The District must meet all existing and proposed regulatory requirements of the SDWA.

Source Water Assessment Program

Source water protection is a national priority as a result of the 1996 amendments to the SDWA and provides a comprehensive watershed-based approach to improving and preserving water quality of the public water supply source. States have a great deal of flexibility in how they design their program. California's Source Water Assessment and Protection program allows water utilities to conduct their own assessments to improve and preserve water quality of the public water supply sources and provide information to communities that wish to develop local programs to protect their sources of drinking water. Because of the significant negative effects of wildfires on watersheds, potential wildfire mitigation measures could be linked to source water protection for District and in coordination with Sonoma Water.

2.8.3 State Regulatory Mitigation Capabilities

California State Hazard Mitigation Plan (2018)

The California State Hazard Mitigation Plan (SHMP) establishes goals and priorities for Cal OES to carry out disaster mitigation activities. The plan provides the basis for funding pre-mitigation priorities for projects and consolidates the plans of other state agencies and interagency groups into a comprehensive set of recommendations for California's long-term mitigation strategy. The District's multi-hazard mitigation planning process used the State plan for information to conduct their risk assessment, to identify mitigation goals and objectives, and to prioritize potential mitigation projects.

Strategic Fire Plan for California (2018)

The Strategic Fire Plan for California is the State's road map for reducing the risk of wildfire. The Fire Plan is a cooperative effort between the State Board of Forestry and Fire Protection and the California Department of Forestry and Fire Protection (CAL FIRE) and places the emphasis on what needs to be done before a fire starts. The current plan was finalized in 2018 and is located at https://osfm.fire.ca.gov/media/5590/2018-strategic-fire-plan-approved-08_22_18.pdf

California Water Plan Update (2018)

The California Water Plan Update provides a framework for water managers to consider options and make decisions regarding California's water future. The plan presents basic data and information on California's water resources, including water supply evaluations and assessments of agricultural, urban, and environmental water uses to quantify the gap between water supplies and uses. The plan also provides water managers with general guidance on preparing for climate change and sudden changes caused by natural disasters.

California Water Code

Sections of the CWC related to the District and hazards mitigation are summarized below:

- Water Code 350. Gives the governing body of a public water supply distributor the power to declare a water shortage emergency condition within their area when ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.
- Water Code 8000-8129. Local Flood Control. Empowers counties and local jurisdictions to appropriate and expend money from the general fund for:

  - The construction of works, improvements, levees or check dams to prevent overflow and flooding.
  - The protection and reforestation of watersheds.
  - The conservation of the flood waters.
  - The making of all surveys, maps and plats necessary to carry out any work, construction or improvement authorized by this article.
  - The carrying out of any work, construction or improvement authorized by this article outside the county if the rivers or streams affected flow in or through more than one county.
- Water Code 10910. Requires cities and counties to identify the public water system that will supply water for a new project subject to the California Environmental Quality Act (CEQA). If the city or county is not able to identify any public water system, then they must prepare a water supply assessment. The city or county must request each public water system to determine whether the projected water demand associated with a proposed project was included as part of the most recently adopted UWMP. If the projected water demand was not accounted for, or there is no urban water management plan, "the water supply assessment for the project shall include a discussion with regard to whether the public water system's total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses, including agricultural and manufacturing uses."

2.8.4 Local Regulatory Mitigation Capabilities

Sonoma County General Plan (2020)

Sonoma County's General Plan 2020 is the blueprint for land use in unincorporated Sonoma County. The purpose of the General Plan is to outline policies that will guide decisions on future growth, development, and conservation of resources through 2020 in a manner that is consistent with the goals and quality of life desired by the County's residents. The County's General Plan consists of 10 elements that cover land use, housing, agricultural resources, open space and resource conservation, water resources, public safety, circulation and transit, air transportation, public facilities and services, and noise. Several of the sections address natural hazards in the County. The water resources element addresses surface and groundwater quality, water conservation and re-use, and public water systems. The public safety element provides procedures for development projects located in areas subject to natural hazards. This element also addresses seismic and geologic hazards, flooding, hazardous materials, and susceptibility to wildland fires.

The County is in the process of beginning their county-wide, multi-year process to update the General Plan 2020. However, at this time, the development of the County's General Plan Update process is temporarily postponed during the shelter-in-place orders in California.

Sonoma County Operational Area Hazard Mitigation Plan (2016)

The *Sonoma County Operational Area Hazard Mitigation Plan* assesses the County's vulnerabilities to hazards and presents a mitigation strategy of actions intended to reduce the disruption to life, property, and economy that might result from a natural disaster. The HMP focuses on earthquake, flood, wildland fire, and landslide hazards, as they were considered to constitute the greatest risk to the County based on past disaster events, future probabilities, and vulnerability. The HMP risk assessment also addresses secondary and tertiary impacts, such as winter storms, coastal erosion, bluff failure, tsunamis, and post fire erosion.

The planning process for updating the 2016 HMP is underway and involves collaboration with several cities, fire districts, and resource conservation districts. The updated plan will be a multi-jurisdictional

effort and will integrate into the County's General Plan Public Safety Element. The plan is anticipated to be completed by August 2022.

Sonoma County Community Wildfire Protection Plan (2016)

The Sonoma County CWPP consists of three components: a collaborative effort of input from various agencies and community members, the identification of prioritized treatment areas and mitigation strategies, and the recommendation of measures to reduce ignitability of structures. The plan was developed in coordination with Fire Safe Sonoma, CAL FIRE, and Sonoma County. The Sonoma County Board of Supervisors unanimously approved the Fire Safe Sonoma's 2016 CWPP.

The County is currently in the process of updating the CWPP. The revised CWPP will reflect a collaboration between Sonoma County Fire Preparedness Division and Fire Safe Sonoma, Inc. and will focus on hardening structures and creating defensible space to reduce risk of fire damage in identified vulnerable locations in the WUI throughout the County.

2.8.5 District Administrative/Technical Mitigation Capabilities

Table 2-8 identifies personnel responsible for activities related to mitigation and loss prevention at the District.

Table 2-8: District's Administrative and Technical Mitigation Capabilities

Personnel Resources	Yes/No	Department/Position
Planner/engineer with knowledge of land development/land management practices	Yes	Water System Manager, General Manager, Consultant Support
Engineer/professional trained in construction practices related to buildings and/or infrastructure	Yes	Water System Manager, General Manager, Consultant Support
Planner/engineer/scientist with an understanding of natural hazards	Yes	Water System Manager, General Manager, Consultant Support
Personnel skilled in GIS	No	None
Full-time building official	Yes	Administrative Services/Finance
Floodplain manager	No	None
Emergency manager	Yes	Water System Manager/General Manager/Emergency Manager
Grant Writer	Yes	Handled within each department/program
GIS data—Hazard areas	No	None
GIS data—Critical facilities	No	None
GIS data—Building footprints	No	None
GIS data—Land use	No	None
GIS data—Assessor's data	No	None
Warning Systems/Service (Reverse 911, cable override, outdoor warning signals)	Yes	Flood alert system; Nixle; WEA; EAS; IPAWS; SoCo Alert

Source: HMPC Data Collection Guide

The District has emergency generation capabilities at all its critical facilities. The District can improve their administrative and technical capabilities through better coordination with Sonoma County, regular updates to their Geographic Information System (GIS) data (with support from consulting staff, if necessary), scheduling regular review meetings on plan implementation (e.g. LHMP implementation and maintenance), and providing more training opportunities for staff to ensure they are well-informed of changing regulations.

The District has started to develop several strategic emergency communication response actions internally, including a District-wide emergency call-out that messages all employees in extreme emergencies with one action.

Valley of the Moon Water District

The Board oversees all District operations by setting goals for the District's General Manager. The five-member Board adopts policies to guide the General Manager and District staff in providing efficient and effective services to present and future District customers. The District consists of the following three departments:

- **General Manager.** The General Manager is responsible for organizing, supervising, and directing activities of the District and carrying out policies set by the Board to ensure that efficient and effective services are provided through the approved policies and budget.
- **Administration.** The Administrative Department consists of an Administration and Finance Manager and one full-time employee and two part-time employees. Responsibilities of this group include customer services, accounting, office services, human resources, risk management, regulatory compliance, project administration, public information, and Board administration
- **Operations and Maintenance.** The Operations and Maintenance Department consists of a Water System Manager, eight Water Distribution/Treatment System Operators, and one Field Services Representative. The Water System Manager coordinates the operation and maintenance of a 24-hour water delivery system; plans, assigns and directs personnel involved; trains employees in operations, procedures and safety equipment; sets up and modifies the operating and preventive maintenance schedules; prepares requisitions for stock and material for operations and maintenance of plant and pipeline and in-house projects; participates in annual inventory; responds to, investigates and resolves inquiries and complaints from public about water usage.

  The primary responsibility of this department is to assure the uninterrupted delivery of water by locating and fixing leaks, flushing lines, repairing mains, operating wells, and replacing aging infrastructure. The department also monitors water quality, inspects construction projects in progress, performs preventive maintenance and repairs of all water system facilities, and performs building and ground maintenance of District facilities.

2.8.6 District's Fiscal Mitigation Capabilities

Table 2-9 identifies financial tools or resources that the District could potentially use to help fund mitigation activities. Mitigation funding opportunities are also discussed in Chapter 5 under each existing and new mitigation action. For example, there are various mitigation funding opportunities available through the Federal Emergency Management Agency (FEMA) (e.g. Hazard Mitigation Grant Program [HMGP]), Cal OES, and other state and local agencies. The District's capital improvement planning process may also identify new funding sources for CIP projects that may occur over 5-year periods.

Table 2-9: District's Fiscal Mitigation Capabilities

Financial Resources	Accessible/Eligible to Use (Yes/No)	Comments
Community Development Block Grants	No	
Capital Improvements Project funding	Yes	Grants like FEMA or Cal OES
Authority to levy taxes and assessments for specific purposes	Yes	

Financial Resources	Accessible/Eligible to Use (Yes/No)	Comments
Fees for water services	Yes	Utility, connection, and water use fees can be used for hazard mitigation of water supply and connection projects
Impact fees for new development	Yes	
Incur debt through general obligation bonds	Yes	
Incur debt through special tax bonds	Yes	
Incur debt through private activities	Yes	
Withhold spending in hazard prone areas	No	

2.8.7 Mitigation Outreach and Partnership Capabilities

Sonoma Water Local Hazard Mitigation Plan (2018)

Sonoma Water is a wholesale provider of potable water that serves nine municipal customers in Sonoma and Marin counties. The water agency maintains a water transmission system that provides naturally filtered Russian River water, builds variety of flood protection projects, manages the county sanitation zones and districts that provide wastewater collection and treatment and recycled water distribution, and produces recycled water from its wastewater treatment plants to offset surface water drawn from the Russian River.

Sonoma Water also implements the Sustainable Groundwater Management Act (SGMA) in Sonoma County and is actively working to protect the basins throughout the region. The water agency adopted a LHMP in 2018 to comprehensively assess the natural hazard risks and vulnerabilities facing the agency's infrastructure, and to articulate a plan to address the vulnerabilities. The plan includes three tailored mitigation strategies focusing on water supply and distribution, sewer and sanitation, and flood control projects.

Other Planning Capabilities (Ongoing)

The HMPC noted the following additional mitigation outreach efforts during planning sessions:

- **Sonoma County Regional Water Supply Resiliency Plan.** The District is participating in planning process and outreach efforts for a regional water supply resiliency plan.
- **District's Website.** The District's website provides public information and resources on water supply planning in Sonoma Valley. Including information on water conservation effort, hazard mitigation, and emergency water supply. The District's social media accounts (Facebook, NextDoor) are used to disseminate public information.

2.8.8 Opportunities for Enhancement

Based on the capability assessment, the District has existing mechanisms in place that help mitigate hazards. In addition to these existing capabilities, there are also opportunities for the District to expand on these policies and programs to further protect their critical water facilities, infrastructure, and customers. The District can update other plans, such as the District's Five-Year CIP to include hazard mitigation actions and climate adaptation strategies that relate to water supply and distribution infrastructure resiliency. Other future improvements may include providing hazard training for staff or hazard mitigation grant funding in partnership with Sonoma Water, the City of Sonoma, Sonoma County and Cal OES.

Other Opportunities

Additional training opportunities will help to inform District staff members on how best to integrate hazard information and mitigation projects into their departments. Continuing to train District staff on mitigation and the hazards that pose a risk to the District will lead to more informed staff members who can better communicate this information to the public.

3 Planning Process

44 U.S. Code of Federal Regulations Requirements §201.6 Local Mitigation Plans (b) and §201.6(c)(1): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and

3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

3.1 Background on Mitigation Planning in the Valley of the Moon Water District

This single-jurisdiction Local Hazard Mitigation Plan (LHMP) is the first detailed and tailored LHMP for the Valley of the Moon Water District (District). The increasing cost of disaster recovery in the nation and the State of California over the past decade, and specifically from the recent wildfires from 2017 through 2020, has prompted an interest in determining effective and holistic approaches to minimize natural hazards. Hazard mitigation planning plays an important role in building community resilience through the identification of hazards, assessment of vulnerabilities, and the development of mitigation actions.

The District recognized the importance of developing their first LHMP and is responsible for initiating its development in 2020. The goal of the LHMP is to develop practical, attainable, and cost-effective mitigation actions to reduce vulnerability to the identified hazards and reduce human, property, and economic losses from hazard events. The District contracted with Wood Environment & Infrastructure Solutions, Inc. (Wood) to facilitate and develop the plan. Wood's role was to:

- Assist in establishing the Hazard Mitigation Planning Committee (HMPC) as defined by the Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) commonly known as the 2000 Stafford Act Amendments;
- Meet the DMA requirements as established by federal regulations and follow the Federal Emergency Management Agency (FEMA) planning guidance;
- Facilitate the entire planning process based on a Community Engagement Strategy;
- Identify the data requirements for the HMPC and conduct the research and documentation necessary to augment that data;
- Perform risk assessments that identify, evaluate, and prioritize natural and human-caused hazards that could impact the District;
- Conduct a vulnerability assessment to identify the hazard's impacts on the District's critical facilities, infrastructure, property, and future development;
- Assist in facilitating the public input process;

- Integrate the risk and vulnerability assessment to help the District determine appropriate mitigation goals and objectives to minimize long-term vulnerabilities to the identified hazards;
- Produce draft and final plan documents; and
- Coordinate with California Office of Emergency Services (Cal OES) and FEMA Region IX plan reviews.

This LHMP is tailored to address the natural, human-health, and human-caused hazards in the District's Planning Area, the identified hazard impacts specific to the District's critical facilities and infrastructure, and the development of a locally attainable mitigation strategy. The LHMP will involve adopting, implementing, assigning responsibility, monitoring, and reviewing the mitigation actions over time to ensure the goals and objectives of the plan are being achieved and the plan remains relevant. The remainder of this chapter provides a narrative of the steps taken to prepare the LHMP.

3.2 Local Government Participation

The LHMP is a special-district plan that covers the District's Planning Area, which is the same boundary as the District's service area. The DMA planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC;
- Identify potential mitigation actions; and
- Formally adopt the plan.

For the District's HMPC, "participation" was defined at the outset of the planning process as the following:

- Providing facilities for meetings;
- Attending and participating in the HMPC meetings;
- Completing and returning the Wood Data Collection Guide;
- Collecting and providing other requested data (as available);
- Managing administrative details;
- Engaging stakeholders and facilitating a formal HMPC meetings;
- Making decisions on plan process and content;
- Identifying mitigation actions for the plan;
- Reviewing and providing comments on plan drafts;
- Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan;
- Advertising, coordinating, and participating in the public input process; and
- Coordinating the formal adoption of the plan by the Board of Directors (Board).

The District met all FEMA's requirements for plan participation. The District brought together a local planning team with representatives from the District and the District's Board to help collect data, identify mitigation actions and implementation strategies, and review and provide data on plan drafts. The District

engaged several federal, state, regional, and local stakeholder representatives from various agencies, municipalities, and organizations in the region to participate on the HMPC. In most cases, one or more representatives from each District department and each agency or organization attended the HMPC meetings.

The preparation of the LHMP was also intended to assist the District in reducing its risk from natural and man-made hazards by identifying resources, information, and strategies for risk reduction. For the District's HMPC, the intention of the plan is to help guide and coordinate mitigation activities throughout the District's departments, as this is their first stand-alone LHMP. As a result, the HMPC set out to develop a plan that would meet the objectives summarized below.

- The plan would meet or exceed program requirements specified under the DMA of 2000.
- The plan would not only meet Cal OES and FEMA requirements, but also the specific needs of the District.
- The plan would coordinate existing and ongoing plans and programs already established at the District so that high priority initiatives and projects to mitigate possible disaster impacts would be funded and implemented.
- The plan would create a linkage between the LHMP and established plans such as the District's *2019 Water System Master Plan* (WSMP) so that existing planning mechanisms can be integrated to help the District achieve successful mitigation.

Given plan integration is a key strategy in the success of LHMP implementation, the HMPC focused on consistency between plans and programs at the District. The HMPC also focused on ensuring District representatives consulted with their individual departments in between meetings to ensure existing capabilities were adequately documented in the LHMP and that mitigation actions were thoroughly reviewed and developed by the District. Appendix A provides additional information and documentation of the planning process.

3.3 The 9-Step Planning Process

Wood established the planning process for the District's LHMP using the DMA planning requirements and FEMA's associated guidance. This guidance is structured around a four-phase process:

1) Organize Resources
2) Assess Risks
3) Develop the Mitigation Plan
4) Implement the Plan and Monitor Progress

Into this process, Wood integrated the more detailed 9-step planning process from FEMA's *March 2013 Local Mitigation Planning Handbook* within the four-phase process. Table 3.1 summarizes the four-phase DMA process, the detailed nine handbook planning tasks from FEMA's *March 2013 Local Mitigation Planning Handbook*, and where the results are captured in the plan. The sections that follow describe each planning step in more detail, including information on the LHMP schedule and general timeframe of activities that took place to develop the plan.

Table 3-1: Mitigation Planning Processes Used to Develop the District's LHMP

FEMA 4 Phase Guidance Phases	2013 FEMA Local Mitigation Planning Handbook Steps (44 CFR Part 201)	Location in LHMP
Phase 1: Organize Resources	1: Determine the Planning Area and Resources	Chapters 1, 2, and 3
	2: Build the Planning Team 44 CFR 201.6(c)(1)	Chapter 3, Section 3.3.1
	3: Create an Outreach Strategy 44 CFR 201.6(b)(1)	Chapter 3, Section 3.3.1
	4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)	Chapter 2, Section 2.2; Chapter 3, Section 3.3.1
Phase 2: Identify Hazards and Assess Risks	5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)	Chapter 4, Sections 4.1 through 4.3
		Chapter 4, Sections 4.1 through 4.3
Phase 3: Develop a Mitigation Strategy	6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)	Chapter 5, Section 5.2
		Chapter 5, Section 5.3
		Chapter 5, Section 5.4
Phase 4: Implement the Plan and Monitor Progress	7: Review and Adopt the Plan	Chapter 6, Appendix C
	8: Keep the Plan Current	Chapter 7
	9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)	Chapter 7

3.3.1 Phase 1: Organize Resources

Planning Step 1: Organize the Planning Effort

With the District's commitment to develop the plan, Wood worked with the District's Administration and Finance and Operations departments to establish the framework and organization for the planning process. Organizational efforts were initiated with the District to inform and educate the plan participants of the purpose and need for the District, stand-alone and tailored LHMP. Wood held an initial call on January 14, 2020 to discuss the organizational aspects of this planning process with District staff. On June 12, 2020, the District circulated the HMPC invitee list and the District initiated the planning process with the HMPC on July 8, 2020. The schedule of subsequent planning activities is summarized in Table 3-2.

Table 3-2: Local Hazard Mitigation Plan Schedule of Planning Activities

Project Task	Meeting Date(s)
Project Kick-Off Meeting	May 28, 2020
Circulate Draft HMPC Invitee List	June 12, 2020
Submit HMPC Meeting #1 Agenda	July 2, 2020
HMPC Meeting #1	June 25, 2020
Submit Draft Community Engagement Strategy	July 30, 2020
District and HMPC Review of Community Engagement Strategy	August 9, 2020
Submit Final Community Engagement Strategy	August 12, 2020
HMPC Meeting #2	September 24, 2020
Prepare Hazard Identification and Risk Assessment	October 7, 2020
Public Workshop	October 20, 2020
Develop Goals and Objectives	October 27, 2020
HMPC Meeting #3	December 10, 2020
Compile Mitigation Action Worksheets	January 30, 2021
Submit 1st Administrative Draft LHMP	February 19, 2021
District and HMPC provides consolidated comments on 1st Administrative Draft LHMP	March 15, 2021
Submit 2nd Administrative Draft LHMP	March 26, 2021

Project Task	Meeting Date(s)
Complete FEMA Region IX Review Tool: Elements A through D	March 26, 2021
Circulate Public Review Draft LHMP	April 15, 2021
Public Review Ends (21-day public review)	May 6, 2021
Submit Final Draft LHMP to Cal OES for review (45-day review period)	May 21, 2021
Submit Final Draft LHMP to FEMA Region IX for review	July 4, 2021
Board Hearing*	TBD

**Board of Directors Meetings are held on the first Tuesday of each month at 6:30 p.m.*

Invitations to the kick-off meeting were extended to key District staff, federal and state agencies, Sonoma County, neighboring municipalities, and key stakeholders in Sonoma Valley. Using FEMA planning guidance, representatives from each District department established the base membership for the HMPC stakeholder committee and two Board directors participated. The HMPC also included multiple representatives from state and local agencies, and stakeholders from the local school district, community hospital, and other organizations. Key representatives from neighboring communities included staff from the Sonoma County, City of Sonoma, Sonoma Water, Sonoma Valley Groundwater Sustainability Agency (GSA), Sonoma Union School District, La Luz Center, Sierra Club – Sonoma Group, Sonoma Ecology Center, and several local businesses. The list of agencies and individuals invited to participate is included in Appendix A.

The HMPC was established as a result of this effort, as well as through interest generated through outreach conduced for this project, which is outlined in more detail in the Community Engagement Strategy. The HMPC collectively developed the plan with leadership from the District and facilitation by Wood. The HMPC meetings also had participation from other agency stakeholders with an interest in hazard mitigation, which are described in Planning Step 3. Representatives from the following District departments and other agencies participated on the HMPC:

Valley of the Moon Water District

- General Manager
- Administration and Finance Manager
- Operations Manager

Sonoma County

- Department of Emergency Management
- Board of Supervisors Representative

Other Agency and Organization Stakeholders

- City of Sonoma
  - Public Works Department
- Sonoma Unified School District
- La Luz Center
- Sonoma Ecology Center
- Sierra Club- Sonoma Group

A list of participating HMPC representatives is included in Appendix B. This list includes all HMPC members that attended one or more HMPC meetings detailed in Table 3-2. The District also utilized the support of staff in order to collect and provide requested data and to conduct timely reviews of draft documents. Note, that the core HMPC group was also supplemented by input from government and stakeholder representatives that contributed to the planning process as identified in Planning Step 3: Coordinate with Other Department and Agencies.

The planning process officially began with a kick-off meeting on January 14, 2020. The meeting covered the scope of work and an introduction to the DMA of 2000 requirements. Participants were provided with a Data Collection Guide, which included worksheets to facilitate the collection of information necessary to support development of the plan. Using FEMA guidance, Wood designed these worksheets to capture information on past hazard events, identify hazards of concern to the jurisdiction, quantify values at risk to identified hazards, inventory existing capabilities, and record possible mitigation actions. A copy of Wood's Data Collection Guide for this project is included in Appendix A. The District completed and returned the worksheets in the Data Collection Guide to Wood staff for incorporation into the plan.

During the planning process, the HMPC communicated through face-to-face meetings, email, and monthly telephone conversations, and added information to the District's LHMP Webpage. Draft documents were distributed via email to the District's project manager and then distributed to the HMPC stakeholders. The HMPC met three times during the planning period (June 25, 2020 through December 10, 2020).

The dates and purposes of these meetings are described in Table 3-3. The HMPC also met internally in between meetings to help the District's project manager track deliverables, worksheet materials, and public outreach documentation. Agendas for each of the meetings and lists of attendees are included in Appendix A. Figure 3-1 is from HMPC Meeting #2.

Table 3-3: Schedule of Planning Meetings

Meeting Type	Meeting Topic	Meeting Date(s)
HMPC Meeting #1	Kick-off meeting: introduction to DMA, the planning process, and hazard identification	June 25, 2020
HMPC Meeting #2	Risk assessment overview and work session on goal development	September 24, 2020
HMPC Meeting #3	Development of mitigation actions; selection and prioritization of mitigation recommendations	December 10, 2020

Figure 3-1: Virtual HMPC Meeting #2

At HMPC Meeting #1, the planning process scope and schedule were discussed, along with the list of hazards addressed in the plan, followed by a presentation that summarized hazard vulnerability. The group was asked what hazards presented the greatest concern and completed a poll to rank the most critical natural, human-health, and human-caused hazards in the District's Planning Area.

HMPC Meeting #2 focused on the findings from the Risk Assessment and the specific vulnerabilities to the District's critical water supply assets and infrastructure that need to be addressed in the mitigation strategy. The HMPC also developed broad goals and objectives during HMPC Meeting #2. This led to further discussion and the prioritization of mitigation actions developed at the HMPC Meeting #3.

Planning Step 2: Involve the Public

Early discussions with the District established the initial plan for public involvement. At the kick-off meeting, the HMPC discussed options for public involvement and agreed to an approach using established public information mechanisms and resources within the community. This approach was outlined in the project's Community Engagement Strategy (Appendix C). The approach was also supported and implemented by the District's project manager.

Public outreach was initiated during the plan development process with an informational press release to notify the public of the purpose of DMA of 2000 and the hazard mitigation planning process for the District. The District project manager distributed a press release to their social media platforms and circulated an online survey prior to a public workshop. Public involvement activities also included the development of the LHMP Webpage, organization of the public workshop, and circulation of social media postings and an online survey. The District compiled public comments received during the public workshop and based on the online survey. Fifteen people participated in the public workshop in October 2020 and the District received 59 responses on the online survey.

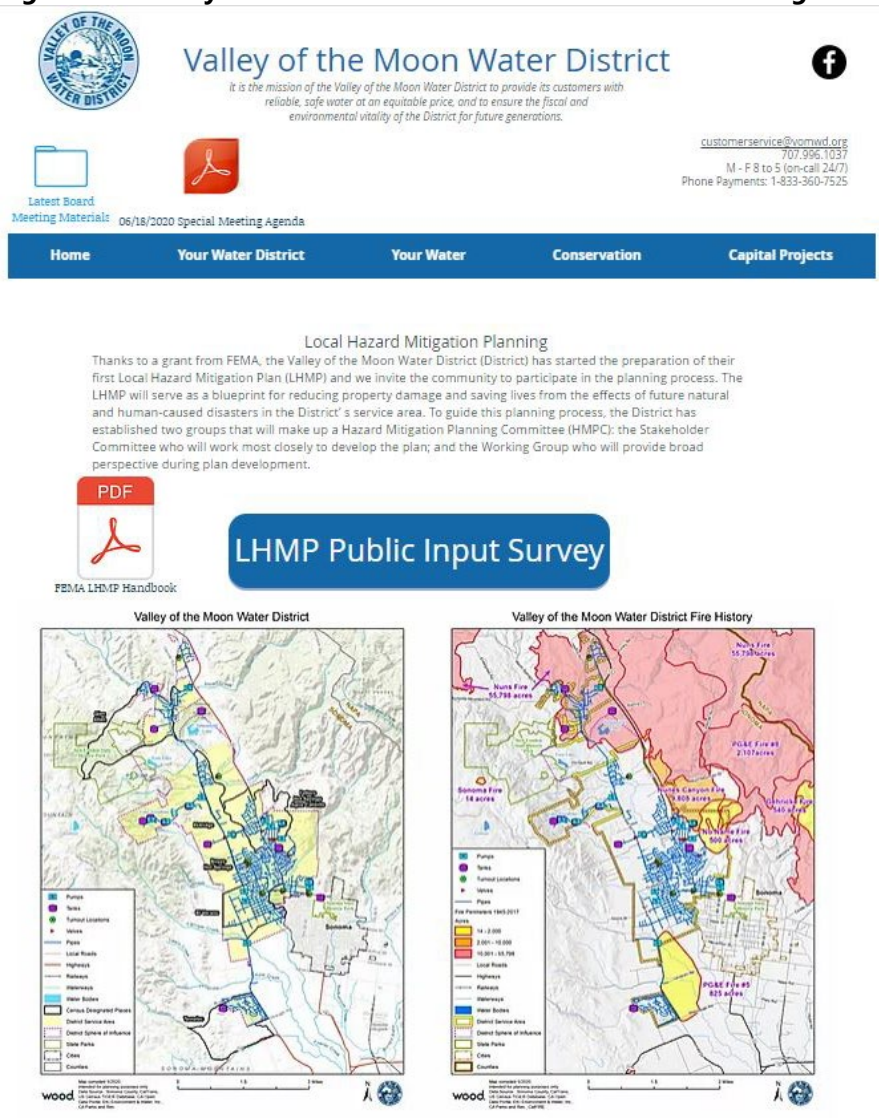
The District circulated the Draft LHMP during a 21-day public review period. The District did not receive any public comments on the plan.

Project Webpage

At the beginning of the planning process, the District created a LHMP Webpage linked to the District's main website to keep the public informed on hazard mitigation, the development of the LHMP and the

planning process, and as a place to solicit public input. The LHMP Webpage included a background section on hazard mitigation planning and the DMA of 2000. It also highlighted recent natural hazard events that have occurred in the District's Planning Area and the Sonoma Valley portion of unincorporated Sonoma County. The LHMP Webpage publicized on all media releases, mailings, newsletters, public workshop advertisements, and the online survey. It has a sidebar with the meeting agenda's, minutes, sign-in sheets, and presentations from the various HMPC meetings and the public workshop. The District also intends to keep the LHMP Webpage active after the plan is completed to keep the public informed about the status of the mitigation actions. Figure 3-2 shows the District LHMP Webpage. The District made the Public Review Draft LHMP available on the LHMP Webpage in April 2021 here: https://www.vomwd.org/local-hazard-mitigation.

Figure 3-2: Valley of the Moon Water District Local Hazard Mitigation Plan Webpage



Public Workshop

A virtual public workshop was held on October 27, 2020. Where appropriate, stakeholder and public comments were incorporated into the plan, including the sections that address mitigation goals and strategies. The public workshop scheduled and organized by the District is detailed in Table 3-4.

Table 3-4: Public Workshop

Meeting Topic	Meeting Dates	Meeting Locations
Public Workshop	October 20, 2020	Livestream Virtual Workshop

The Public Workshop was held to solicit public and stakeholder input during draft development of the plan. Public outreach included an email distribution with a notice of the public meeting to the HMPC with direction to share with other associations, boards and committees and postings around the workplace. The meeting notice was also posted on the District's LHMP Webpage. Fifteen people participated in the public workshop. The public workshop was recorded; workshop materials are included in Appendix A.

Comments submitted during the public workshop addressed specific natural hazards in Sonoma Valley, human-caused hazards related to residual fire retardant in the soil from recent wildfires (e.g. contaminants), grey water system options to capture rainfall, drought conditions, energy-saving tools and rebates, and water demand hardening (e.g. toilet upgrades). Where appropriate, stakeholder and public comments and recommendations were incorporated into the final plan, including the risk assessment and sections that address mitigation goals and strategies. If there were comments submitted during public review they would be summarized in this chapter; however, no public comments were submitted during public review. A summary of the public workshop was also shared with the HMPC and is included in Appendix A.

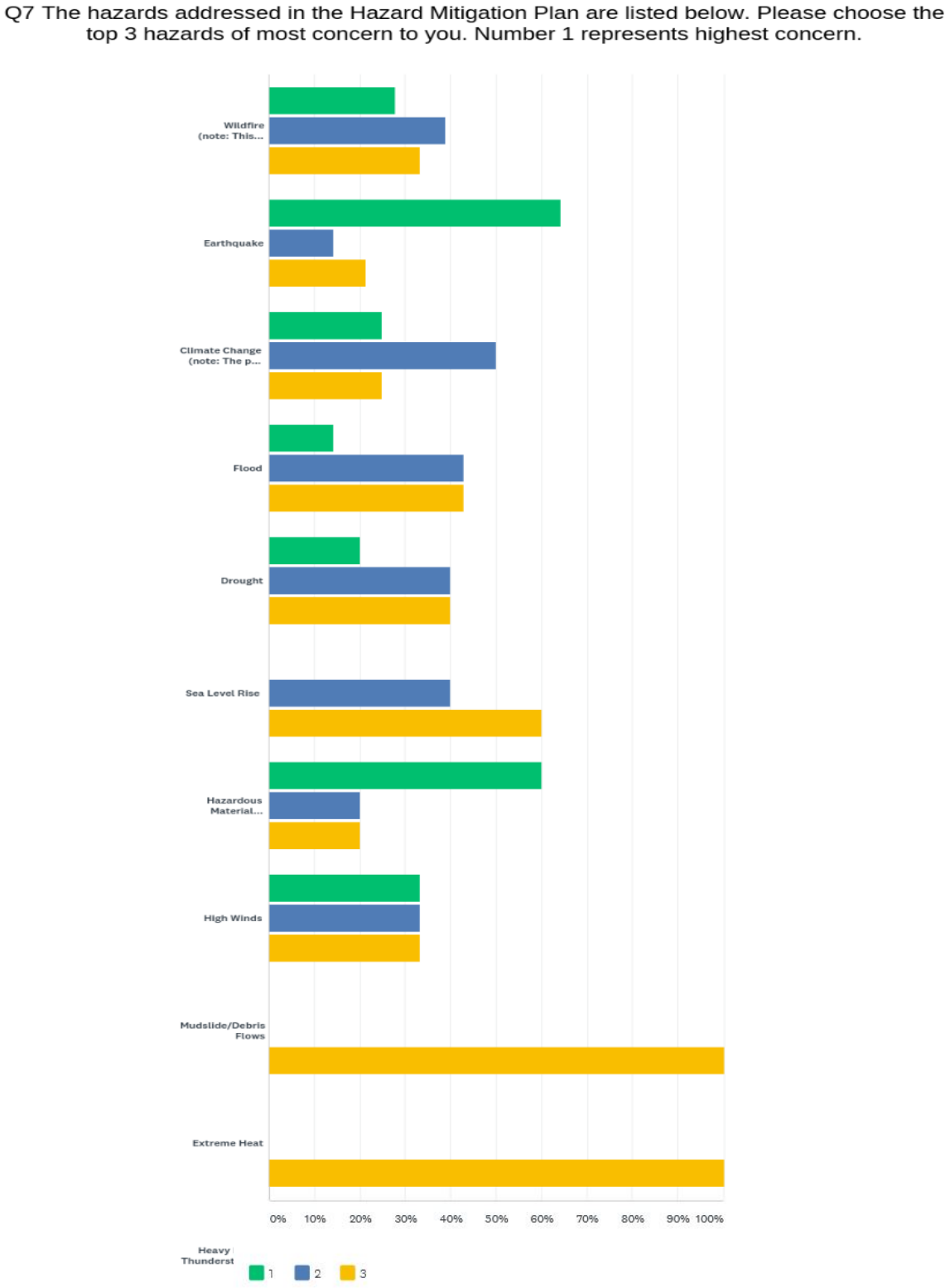
Prior to finalization of the plan, the draft was circulated and made available on the District's LHMP Webpage for a 21-day public comment period from April 16, 2021 through May 6, 2021. The public was able to provide written and emailed comments at customerservice@vomwd.org. Verbal comments and questions were directed to Matt Fullner, the District's Interim General Manager at (707) 996-1037.

Online Survey

During the planning process and drafting stage, an online survey was developed as a tool to gather public input. The online survey was for the public to provide feedback to the HMPC on topics related to hazard concerns and reducing hazard impacts. The online survey provided an opportunity for public input during the planning process and prior to finalization of the plan. It gathered public feedback on concerns about wildfires, floods, earthquakes, climate change, and other hazards and solicited input on strategies to reduce their impacts. The survey was released on September 1, 2020 and closed on October 31, 2020 (2-month comment period). The HMPC provided links to the online survey by distributing it using social media, email, posting the link on the District LHMP Webpage, and making the survey link available on information flyers included in customers bills. 59 responses were received on the survey. This information was shared with the HMPC to inform the process.

The survey included a total of 10 questions. There was a short section of questions on demographics, specifically on whether participants were customers within the District's Planning Area. The next section included questions on ranking hazard significance. The results generally track with the significance levels noted in Chapter 4 of this plan, with earthquake, drought and water supply, flooding, and wildfire being considered the most significant. Drought, high wind events, and public safety power shutoffs (PSPS) also ranked highly in significance based on the public input. The last section of the survey focused on questions related to mitigation actions that the District should consider in the plan. The results indicated that public education/awareness, critical facilities protection, forest health/watershed protection, stormwater drainage improvements, and wildland fuels treatment projects were popular topics to the public. These results were shared with the HMPC and considered during the planning process. Figure 3-3 shows an example of one of the public survey responses from the survey. The full results of the survey are included in Appendix A.

Figure 3-3: Valley of the Moon Water District Public Survey Response



Social Media

The District used the following social media platforms to circulate information on the LHMP:

- Valley of the Moon Water District Facebook (160+ followers);

An announcement posted on the social media platform highlighted the kick-off of the LHMP planning process, advertised the District's LHMP Webpage and other events, included a link to the online survey, notified the public about meetings and workshop, and announced the availability of the plan for public input and comment. Figure 3-4 is a notice of the community workshop on Facebook. Figure 3-5 is a notice of the community workshop on Nextdoor.

Figure 3-4: Social Media Announcement for Community Workshop on District's Facebook Page

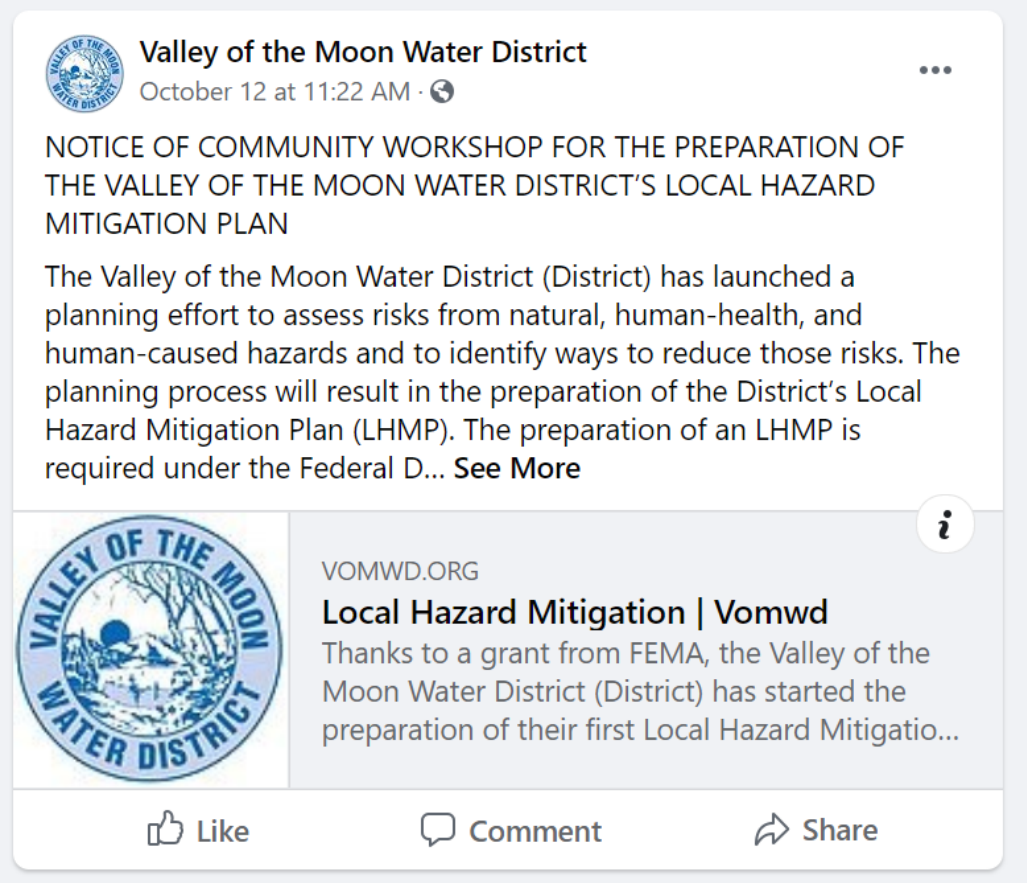
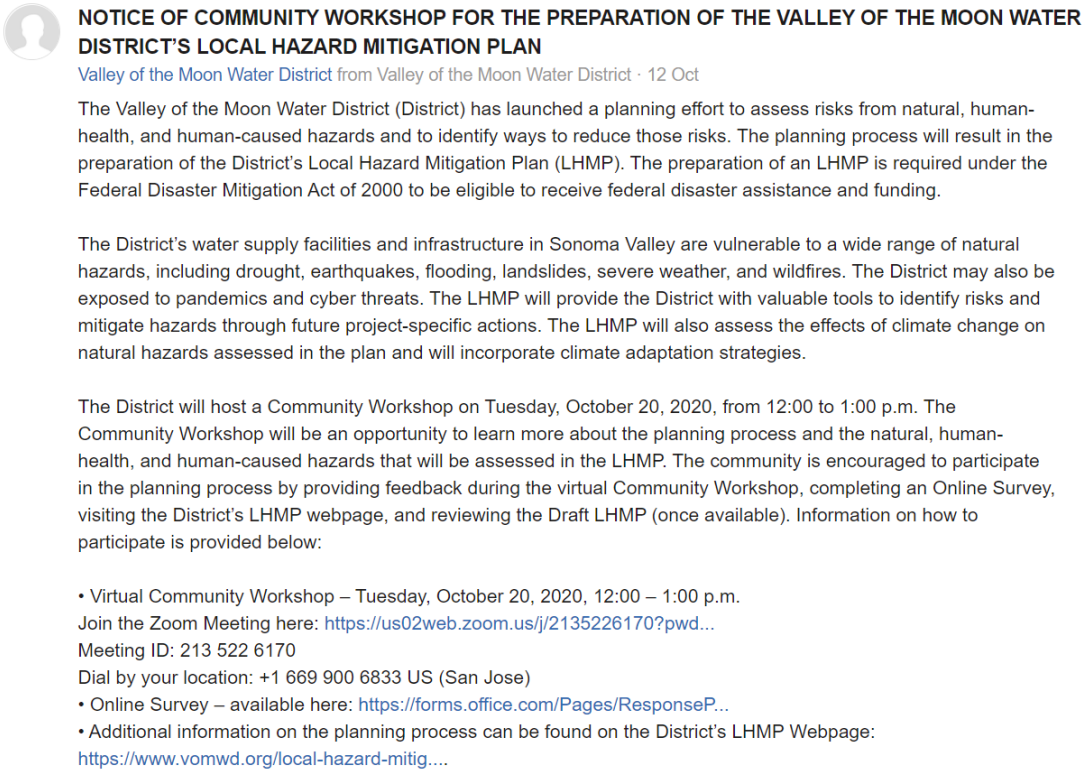


Figure 3-5: Notice of Public Workshop on District's Nextdoor Page



NOTICE OF COMMUNITY WORKSHOP FOR THE PREPARATION OF THE VALLEY OF THE MOON WATER DISTRICT'S LOCAL HAZARD MITIGATION PLAN

Valley of the Moon Water District from Valley of the Moon Water District · 12 Oct

The Valley of the Moon Water District (District) has launched a planning effort to assess risks from natural, human-health, and human-caused hazards and to identify ways to reduce those risks. The planning process will result in the preparation of the District's Local Hazard Mitigation Plan (LHMP). The preparation of an LHMP is required under the Federal Disaster Mitigation Act of 2000 to be eligible to receive federal disaster assistance and funding.

The District's water supply facilities and infrastructure in Sonoma Valley are vulnerable to a wide range of natural hazards, including drought, earthquakes, flooding, landslides, severe weather, and wildfires. The District may also be exposed to pandemics and cyber threats. The LHMP will provide the District with valuable tools to identify risks and mitigate hazards through future project-specific actions. The LHMP will also assess the effects of climate change on natural hazards assessed in the plan and will incorporate climate adaptation strategies.

The District will host a Community Workshop on Tuesday, October 20, 2020, from 12:00 to 1:00 p.m. The Community Workshop will be an opportunity to learn more about the planning process and the natural, human-health, and human-caused hazards that will be assessed in the LHMP. The community is encouraged to participate in the planning process by providing feedback during the virtual Community Workshop, completing an Online Survey, visiting the District's LHMP webpage, and reviewing the Draft LHMP (once available). Information on how to participate is provided below:

• Virtual Community Workshop – Tuesday, October 20, 2020, 12:00 – 1:00 p.m.
Join the Zoom Meeting here: https://us02web.zoom.us/j/2135226170?pwd...
Meeting ID: 213 522 6170
Dial by your location: +1 669 900 6833 US (San Jose)
• Online Survey – available here: https://forms.office.com/Pages/ResponseP...
• Additional information on the planning process can be found on the District's LHMP Webpage:
https://www.vomwd.org/local-hazard-mitig....

Newspapers

The following regional and local print newspapers were used to circulate and advertise information on the LHMP, specifically the availability of the District's LHMP:

- Kenwood Press
- Sonoma County Gazette
- Sonoma Index-Tribune
- Sonoma West Times & News; and
- Press Democrat.

Figure 3-6 is a newspaper article written about the District's LHMP that was published in the Kenwood Press. The article was circulated prior to public review.

Figure 3-6: Newspaper Article Advertising the District's LHMP

(https://www.kenwoodpress.com/kenwoodpress/news/)

KENWOOD PRESS

Serving the Communities of Kenwood, Glen Ellen and Oakmont

(https://www.kenwoodpress.com/kenwoodpress/news/)

▸ HOME (HTTPS://WWW.KENWOODPRESS.COM/KENWOODPRESS/NEWS)
> NEWS (HTTPS://WWW.KENWOODPRESS.COM/CATEGORY/NEWS/)

NEWS (HTTPS://WWW.KENWOODPRESS.COM/CATEGORY/NEWS/)

Posted on April 1, 2021

VOM Water District Hazard Mitigation Plan draft up for public input

By Jay Gamel

Beginning March 31, customers of the Valley of the Moon Water District (VOMWD) will have 30 days to comment on the first draft of a very detailed hazard mitigation plan designed to alleviate the impacts of major disasters like wildfires, earthquakes, and floods.

The district provides drinking water to about 23,750 customers from Glen Ellen to Schellville, with about 80 percent of its daily needs delivered from the Russian River over a 30-mile long aqueduct considered vulnerable to earthquakes, fires and floods. The loss of potential potable water reserves from the now-shuttered, state-owned Sonoma Developmental Center, massive wildfires in 2017 and 2020, and two grand jury findings that the delivery system could be severely stressed if earthquakes sever the pipeline, particularly where it crosses Sonoma Creek, played a part in getting this year-long planning effort underway. Federal funding has been available since 1988 to help local jurisdictions cope with overwhelming disasters. The scope of federal aid was widened with the Disaster Mitigation Act of 2000, aimed at reducing the severe financial impact of coping with increasing and immense disaster costs on rapidly expanding habitation throughout the country. Mitigation plans are intended to reduce risk to existing and future development to make communities safer and more disaster resilient.

Having an approved hazard mitigation plan is a requirement for receiving FEMA and other disaster grants, public and private.

International environmental consultants Wood Environment & Infrastructure Solutions, Inc., was chosen to develop a Local Hazard Mitigation Plan (LHMP) for an initial cost of $40,000.

Hazard mitigation plans are complex, taking into consideration "all possible hazards affecting the planning area." Sonoma Valley has a good share of both possible and probable future disasters: earthquakes, landslides, sea level rise, dam and levee incidents, wildfire, agricultural pests and diseases, aquatic invasive species, drought and water shortages, and power shutoffs are identified as the district's major hazards. The plan looks at buildings and structures, water treatment plants, pipelines, people impacted, development trends and constraints, historical and cultural resources, and attempts to estimate potential losses.

Each mitigation proposal must be evaluated for effectiveness, cost, and whether the district even has the technical or political ability to effect proposed measures. Mitigation alternatives need to be examined.

After the 30-day comment period closes on April 29, the LHP will go to California Office of Emergency Services for a 45-day review. It will be sent to FEMA on June 16 for another 45-day review. If both those agencies approve, it will go before the district's directors on Sept. 14.

Press Releases

The District was encouraged to distribute and circulate press releases over the course of the LHMP development. The District's project manager and Wood staff also encouraged HMPC participants and stakeholders to distribute press releases during the project. Press releases were distributed as informational flyers, advertisements, and public notices. These communication platforms were used to spread the news about the LHMP and invite the public to participate in the process.

Advertisements and press releases announced the kick-off of the LHMP planning process, advertised the District's LHMP Webpage and other events, included links to the online survey, notified the public about meetings and workshops, and announced the availability of the plan for public input and comment. Press releases were distributed to multiple print news agencies.

Figure 3-7 is an example of a press release used to announce the community workshop and to notify the public about the LHMP update.

Figure 3-7: Press Release for the Valley of the Moon Water District LHMP Public Workshop

FOR IMMEDIATE RELEASE
October 12, 2020
Contact: Matt Fullner, Interim General Manager (707) 996-1037

NOTICE OF COMMUNITY WORKSHOP FOR THE PREPARATION OF THE VALLEY OF THE MOON WATER DISTRICT'S LOCAL HAZARD MITIGATION PLAN

The Valley of the Moon Water District (District) has launched a planning effort to assess risks from natural, human-health, and human-caused hazards and to identify ways to reduce those risks. The planning process will result in the preparation of the District's Local Hazard Mitigation Plan (LHMP). The preparation of an LHMP is required under the Federal Disaster Mitigation Act of 2000 to be eligible to receive federal disaster assistance and funding.

The District's water supply facilities and infrastructure in Sonoma Valley are vulnerable to a wide range of natural hazards, including drought, earthquakes, flooding, landslides, severe weather, and wildfires. The District may also be exposed to pandemics and cyber threats. The LHMP will provide the District with valuable tools to identify risks and mitigate hazards through future project-specific actions. The LHMP will also assess the effects of climate change on natural hazards assessed in the plan and will incorporate climate adaptation strategies.

The District will host a Community Workshop on **Tuesday, October 20, 2020, from 12:00 to 1:00 p.m.** The Community Workshop will be an opportunity to learn more about the planning process and the natural, human-health, and human-caused hazards that will be assessed in the LHMP. The community is encouraged to participate in the planning process by providing feedback during the virtual Community Workshop, completing an Online Survey, visiting the District's LHMP webpage, and reviewing the Draft LHMP (once available). Information on how to participate is provided below:

- Virtual Community Workshop – Tuesday, October 20, 2020, 12:00 – 1:00 p.m.
  Join the Zoom Meeting here:
  https://us02web.zoom.us/j/21352261707pwd=R1Ira2FZWWVWNmdrVk16ZTFwelFsUT09
  Meeting ID: 213 522 6170
  Dial by your location: +1 669 900 6833 US (San Jose)
- Online Survey – available here:
  https://forms.office.com/Pages/ResponsePage.aspx?id=7KxDCD79vkm9VBjGBIo_0NsElmYufTdBqeHx9-Gb9ZdUMVdXSzlRUDNSQVJYWkJHUkJENE5BTFAxNS4u
- Additional information on the planning process can be found on the District's LHMP Webpage:
  https://www.vomwd.org/local-hazard-mitigation.

Questions may be directed to Matt Fullner, Interim General Manager by calling (707) 996-1037 or by email at mfullner@vomwd.org.

Public Review and Comments on the Draft LHMP

The District circulated the Public Review Draft LHMP for 21 days to solicit public input; it was posted on the District's LHMP Webpage and circulated from April 15, 2021 through May 6, 2021. If comments had been submitted during public review they would have been summarized in this chapter and incorporated in the revised version of the Draft LHMP submitted to Cal OES and FEMA Region IX, however, no comments were submitted on the plan.

Planning Step 3: Coordinate with Other Departments and Agencies

Early in the planning process, the HMPC determined that data collection, mitigation strategy development, and plan approval would be greatly enhanced by inviting state and federal agencies and organizations to participate in the process. Based on their involvement in hazard mitigation planning, their landowner status in the County, and/or their interest as a neighboring jurisdiction, representatives from the following agencies were invited to participate on the HMPC:

- U.S. Geological Survey (USGS) Pacific and Coastal Marine Center
- Sonoma County Department of Emergency Management
- City of Sonoma
- Sonoma Valley Unified School District
- Sonoma Ecology Center
- California Department of Fire and Forestry (CAL FIRE)
- Sonoma Valley Fire District (formerly Sonoma Valley Fire & Rescue Authority)
- Sonoma Water
- La Luz Center
- Hotel Fairmont Sonoma Mission Inn & Spa

Wood in coordination with the District and the HMPC also used technical data, reports, and studies from the following agencies and groups:

- American Red Cross
- California Department of Finance
- California Department of Fish and Game
- CAL FIRE
- California Department of Parks and Recreation Office of Historic Preservation
- California Department of Public Health
- California Department of Water Resources
- California Emergency Management Agency
- California Geological Survey
- Sonoma County Department of Health Services Environmental Health and Safety Division
- U.S. Army Corps of Engineers
- U.S. Center for Disease Protection
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service
- U.S. Forestry Service
- USGS
- U.S. Census Bureau
- Federal Emergency Management Agency
- National Weather Service
- National Oceanic and Atmospheric Administration, National Climatic Data Center
- National Resource Conservation Service

Several opportunities were provided for the above groups to participate in the planning process. At the beginning of the planning process, invitations were extended to the first group to actively participate on

the HMPC and as a stakeholder representative to support the DMA planning process. Specific participants from these groups are detailed in Appendix C.

City of Sonoma staff worked closely with the District and HMPC. The District also provided various opportunities for Sonoma County to participate in the development of the District's LHMP. Others assisted in the process by providing data directly as requested in the Data Collection Guide or through data contained on their websites or as maintained by their offices. These groups were also invited to participate through the public outreach process, which included a public workshop as previously described. As part of the HMPC and public outreach processes, all groups were invited to review and comment on the plan during public review and prior to submittal to Cal OES and FEMA.

Other Community Planning Efforts and Hazard Mitigation Activities

Coordination with other community planning efforts is paramount to the success of this plan. Hazard mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards.

As a water supply provider and special district, the District uses a variety of comprehensive water supply forecast and planning mechanisms, such an Urban Water Management Plans (UWMP) to guide growth and development. Integrating existing planning efforts and mitigation policies and action strategies into this plan establishes a credible and comprehensive plan that ties into and supports other community programs. The development of this plan incorporated information from the following existing plans, studies, reports, and initiatives listed in Table 3-5. Other related planning efforts were inventoried in the capability assessment in Chapter 2.

Table 3-5: Incorporated Planning Mechanisms

District Plans	How Plan is Incorporated in LHMP
Water System Master Plan (2019)	• Reviewed the District's water supply and distribution system facilities and infrastructure assessed in the Water System Master Plan (WMP). • The LHMP incorporated information on the District's existing infrastructure and the capacity needs for future demand, and cross references the recommended capital improvement projects related to water supply and shortage deficiencies in the LHMP. • The LHMP references the capital improvement projects included in the WMP and emphasized the three levels of prioritization in the CIP section during HMPC Meeting #3 and in the LHMP mitigation strategy. This process ensures the mitigation actions are consistent and complement the same or similar actions in the WMP.
Urban Water Management Plan (2015)	• The UWMP evaluates the required potable water supplies and transmission and storage facilities required to serve the District's customers in 2020. • Integrates availability and reliability information on the District's existing and future water supplies into the LHMP. • Cross references goals and projects outlined in the UWMP, specifically those related to new groundwater water facilities. Similar mitigation actions were prioritized by the HMPC during HMPC Meeting #3 and incorporated into to District's mitigation strategy. • Integrates water conservation principles and strategies developed in the plan related to the District's capital improvement program, Water Supply Contingency Plan (WSCP), demand management measures, and plans for potable and groundwater system facilities.

District Plans	How Plan is Incorporated in LHMP
Five-Year Capital Improvement Program (2020/2021 – 2024/2024)	• The basis for this plan is the District's WSMP and significant projects outlined in the WSMP are included in the District's 5-year CIP. • The plan is also included in the District's annual budget plan. • The LHMP integrated the top priorities from the CIP into the planning process and mitigation alternative development associated with HMPC Meeting #3 and the District's LHMP mitigation strategy. • Significant projects reviewed included the Saddle Tank Rebuild Project in Glen Ellen, fire flow improvement in the Glen Ellen Zone, replacement of undersized water mains, and hillside stabilization near Donald Tank.
Other Plans	
California State Hazard Mitigation Plan (2018)	• Reviewed goals and objectives in the State Hazard Mitigation Plan (SHMP) and noted the new and revised hazards related to community resilience. • Reviewed the hazards profiled in the SHMP and compared those with the hazards summarized in the 2016 Sonoma County Operational Area HMP. • Integrated disaster declaration information and other key findings on major hazards from the SHMP into the District's LHMP Update. • Under 44 CFR Section 201.6, LHMPs must be consistent with the SHMP. In updating this plan, HMPC and consultant staff reviewed California's SHMP to identify key relevant state plan elements. • Climate change is expected to intensify existing hazards in the District's Planning area. Consistent with the organization of the 2018 California SHMP, the District and HMPC integrated a discussion of climate change hazards and considerations throughout the hazard profiles in the Risk Assessment.
California State Drought Contingency Plan (2016)	• Reviewed the state's strategies and actions to prepare for and respond to future droughts and other water shortage events. • The District reviewed the plans goals related to adequate water supply, species protection, and water management.
California Water Plan Update (2018)	• Reviewed 5-year update to plan to integrate information on water supply trends in California that also occur in Sonoma County. • Reviewed general integrated water management toolbox strategies to reduce water demand, increase water supply, improve water quality, practice resource stewardship, and improve flood management. • The District considered the recommended actions in the Water Plan Update in support of the Governor's Water Resilience Portfolio initiative during HMPC Meeting #3.

District Plans	How Plan is Incorporated in LHMP
Sonoma County Operational Area Hazard Mitigation Plan (2016)	• Hazard profile information from the 2016 Sonoma County Operational Area HMP was incorporated throughout the LHMP, where appropriate; this included information on earthquakes, flooding, landslides, wildfire hazards the main four hazards profiled in the County HMP. • HMPC reviewed the Sonoma County Operational Area HMP goals during the development of the District's LHMP goals and objectives. • There are comparative tables on the hazards profiled in the state and county plan to those considered in the District's LHMP. This information was helpful for the HMPC to compare which hazards to address and which to prioritize for the District's Planning Area. Two Sonoma County stakeholders from the Board of Supervisors and the Department of Emergency Management were invited to participate in the HMPC meetings. Only staff from the County Department of Emergency Management attended meetings. • Sonoma County is currently updating their 2016 HMP through a multi-jurisdictional planning effort anticipated to be completed by August 2022; this provides the District with another opportunity to participate with hazard mitigation planning efforts in the region.
Sonoma County Community Wildfire Protection Plan (2016)	• The District staff reviewed the County's Community Wildfire Protection Plan (CWPP) and discussed the prioritized treatment areas and mitigation strategies during HMPC Meeting #3. • The District invited a stakeholder from the Sonoma Valley Fire District to participate on the HMPC. The Sonoma Valley Fire District participated in all meetings and shared information regarding the update to the Sonoma County CWPP during the meetings.
Sonoma County Operational Area Emergency Operations Plan Annex: Pandemic Response (2020)	• The District reviewed the Annex's outlines of policies and procedures in place to guide local government and special districts during the outbreak of pandemic diseases. This plan serves as an update to the Sonoma County Department of Health's 2007 Pandemic Flu Plan. It explains risk levels and major impacts to the community. • The District's HMPC prioritized public health hazards in the LHMP; this Annex was reviewed, and key actions related to the District's authority as a special district were integrated into the mitigation strategy.
Sonoma County Operational Area Emergency Operations Plan (2014)	• The Sonoma County Operations Emergency Operations Plan (EOP) addresses the planned response to extraordinary situations associated with large-scale disasters affecting the County. It establishes emergency management organization, operational concepts, and a platform for planning and response to all hazard emergencies. • The EOP facilitates multi-jurisdictional coordination between County, local governments, and special districts. • Strong emphasis on mitigation phase and post-disaster mitigation during recovery is discussed in plan. • The District reviewed planning methods for mitigation, such as amending ordinances, initiating structural retrofits, assessing tax abatements, assessing land use patterns, and emphasizing public education. • The EOP discusses drought threats and the various water agencies that supply water to the urbanized areas in the County. These threats were reviewed in the development of the District's risk assessment to ensure the key findings were consistent in the District's LHMP.
Sonoma County Emergency Action Plan	• The County's Emergency Action Plan (EAP) identifies immediate responses to an emergency or disaster in context of the environment. The County's plan adheres to the California Occupational Safety and Health Administration (OSHA) standards.

District Plans	How Plan is Incorporated in LHMP
	• The District implements a water district-specific EAP; this plan was recently updated to integrate emergency measures that address employee health and safety in the workplace to prevent the spread of human-health hazards, such as COVID-19 pandemic.
Sonoma Valley Groundwater Sustainability Agency Draft Groundwater Sustainability Plan (2020)	• The 20-year Groundwater Sustainability Plan (GSP) ensures the sustainable use of groundwater within the Sonoma Valley Groundwater Basin. • The GSP establishes standard groundwater management tools and incorporates best available scientific and technical information by building on the technical foundation already established for the Sonoma Valley Basin. • The plan integrates the interests of many users and uses of groundwater resources within the Sonoma Valley Basin through public and community engagement. • The District invited one stakeholder from the Sonoma Valley GSA to participate on the HMPC; this stakeholder has participated in all meetings and provided key input during the development of drought and water supply mitigation actions. • The District and several members of the HMPC familiar with the Draft GSP discussed key hazards and mitigation actions addressed in the draft plan during HMPC meetings, and incorporated specific information related to drought mitigation actions into the LHMP.
Sonoma County Flood Insurance Study (2017)	• Sonoma County has participated in the National Flood Insurance Program (NFIP) since 1978 and implemented their floodplain regulations in 1982. • The District reviewed the latest 2017 Flood Insurance Study (FIS) and Digital Flood Insurance Rate Maps (DFIRMs); these DFIRMs were used for the LHMP risk assessment. • The District also reviewed DFIRMs and base flood elevations (BFE) to determine whether critical water assets were identified within flood hazard zones.

Other documents were reviewed and considered, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, vulnerability assessment, and capability assessment. Appendix B identifies additional documents and community planning efforts utilized in the development of this plan, such as FEMA mitigation planning guides and other federal and state technical sources. Specific references relied on in the development of this plan are also sourced throughout the document as appropriate.

3.3.2 Phase 2: Assess Risks

Planning Steps 4 and 5: Identify the Hazards and Assess the Risks

Wood led the HMPC in a comprehensive research effort to identify and document all the hazards that have, or could, impact the District's Planning Area. Data collection worksheets were developed and used in this effort to aid in determining hazards and vulnerabilities and where risk varies across the Planning Area. Geographic Information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. The HMPC also conducted a capability assessment to review and document the Planning Area's current capabilities to mitigate risk and vulnerability from hazards. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the HMPC could assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified.

Using this information, Wood developed the risk assessment portion of the plan, which contained the hazard identification, the vulnerability assessment, and the capability assessment.

- **Vulnerability Assessment**—The District assessed their critical water supply and distribution facilities at risk to natural hazards. These assets included critical water facilities and infrastructure, such as pump stations, water tanks, and main water conveyance lines; and natural, historic, and cultural assets. The HMPC also analyzed development trends in hazard areas within Sonoma Valley.
- **Capability Assessment**— The HMPC conducted a capability assessment update to review and document the current capabilities in the Planning Area to mitigate risk and vulnerability from natural hazards. By collecting information about existing state and local government programs, policies, regulations, ordinances, and emergency plans, the HMPC can assess those activities and measures already in place that contribute to mitigating some of the risks and vulnerabilities identified. This addressed FEMA planning task 4: Review community capabilities - 44 CFR 201.6 (b)(2) & (3).

Wood completed the risk assessment in September 2020 and the information was presented at the HMPC Meeting #2 on September 24, 2020. A more detailed description of the risk assessment process and the results are included in Chapter 4 Risk Assessment.

3.3.3 Phase 3: Develop the Mitigation Plan

Planning Steps 6 and 7: Set Goals and Review Possible Activities

Wood facilitated brainstorming and discussion sessions with the HMPC on September 24, 2020, including a description of the purpose and process of developing planning goals, as well as discussion of a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. Additional details of the process to develop goals and actions is included in Chapter 5 Mitigation Strategy. Documentation on the process the HMPC used to develop the goals and strategy is in Appendix C.

Planning Step 8: Draft an Action Plan

Based on input from the HMPC during the September 24, 2020 and from subsequent review of the draft risk assessment and the goals and activities identified in Planning Steps 6 and 7, Wood produced a complete first draft of the plan. This complete draft was internally circulated for HMPC review and comment via email in February 2021. HMPC and agency comments were integrated into the second draft in March 2021.

Public Review Draft LHMP

The Public Review Draft LHMP was advertised and circulated for public input for 21 days from April 15, 2021 through May 6, 2021. If comments were received during time, Wood and District staff would have integrated the comments and issues from the public and stakeholders, as appropriate, along with additional agency and other stakeholder internal review comments. However, the District did not receive any comments during public review period.

Wood produced a final draft LHMP in May 2021 for Cal OES and FEMA Region IX staff to review and pre-approve. Once Cal OES and FEMA Region IX provide pre-approval of the LHMP, the District Board of Directors can consider the plan for final adoption. Final FEMA Region IX approval is contingent upon final adoption by the District Board of Directors.

3.3.4 Phase 4: Implement the Plan and Monitor Progress

Planning Step 9: Adopt the Plan

In order to secure buy-in and officially implement the plan, the plan will be reviewed by the HMPC and adopted by the Board on the dates included in the corresponding resolution in Appendix D: Adoption Resolution.

Planning Step 10: Implement, Evaluate, and Revise the Plan

The true worth of any mitigation plan is in the effectiveness of its implementation. In the previous steps of the planning process the HMPC's efforts have been directed at researching data, gathering information for the plan, and developing appropriate mitigation actions. Each recommended action includes key descriptors, such as a lead entity and possible funding sources, to help initiate implementation. An overall implementation strategy for the District's LHMP is described in Chapter 7 Plan Implementation and Maintenance.

Finally, there are numerous organizations within the District's Planning Area whose goals and interests' interface with hazard mitigation. Coordination with these other planning efforts, as addressed in Planning Step 3, is key to the ongoing success of this plan and mitigation in the District and is addressed further in Chapter 7. A plan update and maintenance schedule and a strategy for continued public involvement are also included in Chapter 7.

4 Risk Assessment

44 U.S. Code of Federal Regulations Requirement §201.6 Local Mitigation Plans (c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

As defined by the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

A key step in preventing disaster losses in the Valley of the Moon Water District's (District) service area is developing a comprehensive understanding of the District's hazards, vulnerabilities, and risks. The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards, as well as the vulnerabilities of a community. The process allows for a better understanding of a jurisdiction's potential risk to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events. Environmental and social impacts are taken into consideration wherever possible. The following terms are used throughout the Plan.

- **Hazard:** Event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, other types of harm or loss.
- **Vulnerability:** Degree of susceptibility to physical injury, harm, damage, or economic loss; depends on an asset's construction, contents, and economic value of its functions.
- **Risk:** The potential for damage, loss, or other impacts created by the interaction of hazards with vulnerabilities.

The relationship between hazards, vulnerabilities, and risk is depicted in Figure 4-1. This risk assessment covers critical water transmission and distribution facilities within the District's service area, or Sphere of Influence (SOI) boundary, herein referred to as the District's Planning Area. In sections of this chapter, critical facilities outside the District's service area that could provide back-up water supply are addressed.

Figure 4-1 Risk Graphic

This risk assessment followed the methodology described in the FEMA *Local Mitigation Planning Handbook* (FEMA 2013), which breaks the assessment into a four-step process:

1. Describe hazards
2. Identify community assets
3. Analyze risks
4. Summarize vulnerability

In other words, this risk assessment evaluates potential loss from hazards by assessing the vulnerability of the District's water utility services, critical facilities, buildings and infrastructure, and customers. Data collected through this process has been incorporated into the following sections of this chapter:

- **Section 4.1 Hazard Identification** profiles the natural hazards that threaten the District's Planning Area and describes why some hazards have been omitted from further consideration.
- **Section 4.2 Asset Summary** describes the methodology for determining vulnerability of the Planning Area to the identified hazards.
- **Section 4.3 Hazard Profiles and Risk Assessment** discusses the threat to the Planning Area and describes previous occurrences of hazard events and the likelihood of future occurrences. All the hazards identified in Section 4.1 are profiled and assessed individually in this section. Research and information from the District's Hazard Mitigation Planning Committee (HMPC) are integrated into this section. This section also includes the identified vulnerability to each of the priority hazards, describing the impact that each hazard would have on the District. The vulnerability assessment quantifies (to the extent possible) using best available information, assets at risk to hazards and estimates potential losses.
- **Section 4.4 Human-Health Hazards** identifies the hazards that threaten the Planning Area resulting from public health hazards.
- **Section 4.5 Hazards Summary** summarizes the results of the hazard identification and hazard profiles for the Planning Area based on the hazard identification data and input from the HMPC.

If any location information of the District's water supply infrastructure is considered sensitive, this spatial information was excluded from this assessment. Sensitive information may include portions of the District's potable water supply and distribution system (e.g. water pipelines, etc.). For these instances, the vulnerability of the potable water supply facilities is addressed more broadly and qualitatively compared to the level of detail considered for other water facilities. Additional information on the District's Planning Area as it pertains to this plan is provided in Chapter 2, Community Profile.

4.1 Hazard Identification: Natural and Human-Health Hazards

44 U.S. Code of Federal Regulations Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

The first step in developing a risk assessment is identifying the natural hazards. The HMPC conducted a hazard identification poll during the first planning meeting to determine the hazards that threaten the Planning Area. The identification of public health hazards is summarized in Section 4.4.

4.1.1 Methodology and Results

Using existing natural hazards data and input gained through planning meetings, the HMPC agreed upon a list of natural and public hazards that could affect the District. Hazards data was examined to identify and assess the significance of these hazards to the Planning Area and to prioritize which hazards to address in detail in the risk assessment. The sources of data included information from the California Office of Emergency Services (Cal OES), FEMA, the National Oceanic and Atmospheric Administration

(NOAA), Sonoma County Department of Emergency Management, and other sources as referenced in this assessment. The assessment relied on relevant District planning documents, such as the *2019 Water System Master Plan*, *2015 Urban Water Management Plan* (UWMP), and adopted hazard mitigation plans in the region (i.e., *Sonoma County Operational Area Hazard Mitigation Plan* (HMP). The assessment also references the *2020 Sonoma Valley Groundwater Sustainability Plan for the Sonoma Valley Groundwater Subbasin* (SVGSP) (Working Draft), *2019-2020 Sonoma County Civil Grand Jury Investigation*, and three subsequent companion reports to the investigation: *Will There Be Water After an Earthquake?, Emergency Water Shortages in Sonoma* Valley, and *Sonoma Valley Regional Water Resources*.

Table 4-1 below provides a crosswalk of the hazards identified in the *2016 Sonoma County Operational Area HMP*, *2018 Sonoma County Water Agency LHMP (*herein referred to as the Sonoma Water LHMP), and *2018 California State Hazard Mitigation Plan* (SHMP). Numerous hazards were identified in the state and county plan, including five natural hazards identified in the *2016 Sonoma County Operational Area HMP*. Natural hazards discussed in the Sonoma Water LHMP included flooding, earthquake and other seismic-related hazards (e.g. surface rupture, ground shaking, ground failure, liquefaction, slope instability), wildfire, and climate change. The crosswalk was used to develop a list of preliminary hazards for the HMPC to evaluate which were most relevant to the District's Planning Area.

The significance of each hazard was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths, injuries, and property and economic damage. The natural and human-caused hazards evaluated as part of this plan include those that occurred in the past or have the potential to cause significant human and/or monetary losses in the future.

Table 4-1: Crosswalk with Other Hazard Mitigation Plans

Hazard	City of Sonoma General Plan Safety Element (2011)	Sonoma County Operational Area HMP (2016)	Sonoma County Water Agency LHMP (2018)	California SHMP (2018)
Natural, Human-Health, and Climate and Weather-Influenced Hazards				
Agricultural and Silvicultural Pests and Diseases				√
Air Pollution	√			√
Aquatic Invasive Species				√
Avalanches				√
Dam Incidents	√		√	
Drought and Water Shortage	√		√	√
Climate Change		√	√	√
Earthquake and Geologic Hazards (liquefaction, subsidence, landslides)	√	√	√	√
Energy Shortage and Energy Resiliency				√
Epidemic/Pandemic/Vector-Borne Disease				√
Flood: 100-, 200-, 500-Year Events	√	√	√	√
Sea Level Rise				√
Severe Weather: Extreme Heat	√			√
Severe Weather: Heavy Rain/Thunderstorm/Lightning/Hail/Fog	√			√

Hazard	City of Sonoma General Plan Safety Element (2011)	Sonoma County Operational Area HMP (2016)	Sonoma County Water Agency LHMP (2018)	California SHMP (2018)
Severe Weather: Wind	√			√
Tree Mortality				√
Tsunami				
Volcano				√
Wildfire	√	√	√	√
Technological Hazards				
Hazardous Materials Release	√			√
Oil Spills	√			√
Natural Gas Pipeline Hazards				√
Radiological Accidents				√
Transportation Accidents				√
Threat and Disturbance Hazards				
Terrorism				√
Cyber Threats				√
Civil Disorder				√

1. Hazards listed is based on the natural, technological, and human-caused hazards in the California SHMP.

In alphabetical order, the natural hazards identified and investigated for the District's LHMP include:

- Dam Incidents
- Drought and Water Shortage
- Earthquake
  - Surface Rupture
  - Ground Shaking
  - Liquefaction
  - Lateral Spread
  - Subsidence
- Flood: 100/500-Year Flood
- Landslides
- Severe Weather: Heavy Rain/Thunderstorm/Hail/Lightning/Dense Fog
- Severe Weather: Extreme Heat
- Severe Weather: High Winds
- Wildfire

The human-health hazards identified and investigated for the District's 2020 LHMP include:

- Public Health Hazards (Disease/Epidemic/Pandemic)

Based on discussions at the early planning analyses, the following natural and human-health hazards were eliminated from further consideration in this risk assessment because of a lack of past occurrences in the District at the time or based on minimal potential impacts. Certain hazards were also eliminated based on separate State and Sonoma County regulatory programs and planning documentation that thoroughly addresses the hazard profile.

- Agricultural Hazards
- Air Pollution
- Aquatic Invasive Species
- Avalanches
- Energy Shortage and Energy Resiliency (integrated in the Extreme Weather: Winds vulnerability assessment)
- Hazardous Materials: Hazard Material Releases, Chemical Facilities, Gas Pipelines
- Sea Level Rise
- Tree Mortality (integrated in the Drought and Water Shortage vulnerability assessment)
- Tsunami
- Volcano

The District's Planning Area is largely surrounded by rural land uses in the unincorporated portion of Sonoma County that consist of single-family residences, agriculture, and open space. Land uses include farms, dairies, livestock ranches, and vineyards, and the larger properties and adjacent open spaces function as a separation between the more urbanized areas near the City of Sonoma. Agricultural uses are also common in Sonoma Valley, thereby minimizing the perception that agricultural operations are nuisances. Land use compatibility is also sufficiently addressed by Sonoma County's General Plan 2020.

Air quality and emissions within the Bay Area are generated by a variety of sources, including stationary sources, such as fireplaces and heating systems to mobile sources, such as vehicles and truck traffic. The Bay Area Air Quality Management District (BAAQMD) is the regional agency with the authority to develop and enforce regulations for the control of air pollution throughout the Bay Area. The Clean Air Plan is the BAAQMD's triennial plan for reducing air pollutant emissions in the Bay Area. The Bay Area is considered in "attainment" for all of the national standards of carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and particulate matter, with the exception of ozone. Given there are federal, state, and local laws and regulations in place for controlling air pollution, in addition to air quality management plans administered by the California Air Resources Board and BAAQMD, air pollution hazards and programs are not addressed in this plan.

Aquatic invasive species are non-indigenous species transported to new environments through human activities. The introduction of non-indigenous species into Sonoma Valley's marine, estuarine, and freshwater environment can cause economic, human health, and ecological impacts. Known past occurrences related to aquatic invasive species in the District's Planning were not emphasized during the initial HMPC meetings given this hazard is currently addressed by the District's main water supplier, Sonoma Water. Aquatic invasive species are also addressed by the Sonoma County Department of Health Services (DHS), Environmental Health and Safety Public Health Division. The Division regularly tests water bodies in the County for aquatic invasive species, and specifically algae blooms at various beach and river park locations throughout the County. Given County monitoring programs are in place, this hazard was not addressed in this plan.

Avalanches and volcano hazards were not addressed in this plan. Sonoma Valley does not receive snowfall to have avalanche hazards. According to the 2018 California SHMP, only ten volcanic eruptions have occurred in California in the last 1,000 years and the likelihood of another eruption in the state is low (Cal

OES 2018). Of the 20 volcanoes in the state, only a few are active and pose a threat (Cal OES 2018). Of these, the Clear Lake Volcano is the closest volcano to Sonoma Valley, and while it has been known for substantial geothermal activity, there are no past occurrences associated with the volcano. Given this volcanic field is approximately 80 miles to the north, volcano hazards were not addressed in this plan.

Energy shortage hazards can include energy disruptions related to electricity, renewable energy, natural gas, and gasoline and diesel fuels. Based on the energy types, electrical power outages, both planned and unscheduled disruptions can result in cascading hazards related to traffic, economic losses, other utility disruptions, and extreme heat and public health hazards. Climate change is also expected to bring more frequent and intense natural disasters, which could result in planned or unscheduled power outages or energy shortages. Given Pacific Gas & Electric's (PG&E) recent Public Safety Power Shutoff (PSPS) that began in October 2019 and again in August 2020, energy shortage hazards are a major concern for the region and Sonoma Valley. Energy shortages are discussed as a secondary hazard impact in the Wildfire section, and in the vulnerability assessment in the Severe Weather: High Winds section of this chapter.

Drought conditions can cause increased tree mortality associated with lack of moisture, pest infestations, and other drought-related issues. Tree mortality is discussed in more detail as a subsection of the Drought and Water Shortage section and as a secondary hazard.

The District's Planning Area is situated approximately 10 miles upstream of the tidally influenced portion of Sonoma Creek and the Napa-Sonoma Marshes Wildlife Area near the San Pablo Bay. Based on the U.S. Geological Survey (USGS) Tsunami Inundation Map for Emergency Planning (Cal EMSA, CGS, and USC 2009) the District's Planning Area lies approximately nine miles upstream from the northern extent of the tsunami inundation area near Sears Point. Based on this information, tsunami and coastal erosion hazards were not further analyzed in this plan. Sea level rise was also not addressed in this chapter given most projections for sea level rise along the tidally-influenced rivers in the San Pablo Bay do not project inundation areas within or near the District's Planning Area (OCOF 2020).

The District acknowledged natural gas pipeline hazards, oil spills, radiological incidents, as well as transportation accidents associated with these hazards. Gas pipeline hazards are addressed as a secondary hazard associated with earthquakes in the vulnerability assessment. Oil spill and radiological accidents were not further evaluated in this plan, as there are few oil pipelines or oil wells in the District's Planning Area, and few areas at risk to radiological accidents according to the HMPC. Other human-caused hazards, such as terrorism, and civil unrest or disturbances were considered and discussed during HMPC meetings, but these issues will be thoroughly addressed in a separate Vulnerability Assessment prepared by the District to comply with the American Water Infrastructure Act (AWIA) and were therefore not discussed in detail in this plan.

4.1.2 Overall Hazard Significance Summary

Overall hazard significance was based on a combination of geographic extent, probability of future occurrences, and potential magnitude/severity. Climate change considerations are discussed qualitatively in each hazard profile, specifically on whether it is anticipated to have a low, medium, or high influence on future impacts. The individual ratings shown inTable 4-2 are based on or interpolated from the analysis of the hazards in the sections that follow.

Table 4-2: Valley of the Moon Water District Hazard Significance Summary

Hazard	Geographic Extent	Probability of Future Occurrences	Magnitude/Severity	Overall Significance
Earthquake	Extensive	Likely	Catastrophic	High
Wildfire	Extensive	Highly Likely	Catastrophic	High

Hazard	Geographic Extent	Probability of Future Occurrences	Magnitude/Severity	Overall Significance
Drought and Water Supply	Extensive	Highly Likely	Critical	High
Flood	Limited	Likely	Limited	Medium
Severe Weather: Extreme Heat	Extensive	Likely	Limited	Low
Severe Weather: Heavy Rain/Thunderstorms/Hail/Lighting /Dense Fog	Significant	Likely	Limited	Medium
Severe Weather: High Winds	Significant	Likely	Limited	Medium
Landslides	Limited	Likely	Negligible	Low
Dam Incidents	Limited	Unlikely	Limited	Low
Cyber Threats	Extensive	Likely	Critical	High
Public Health Hazards	Extensive	Occasional	Critical	High

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Probability of Future Occurrences
Highly Likely: Near 100% chance of occurrence in next year or happens every year.
Likely: Between 10 and 100% chance of occurrence in next year, or a recurrence interval of 10 years or less.
Occasional: Between 1 and 10% chance of occurrence in the next year or has a recurrence interval of 11 to 100 years.
Unlikely: Less than 1% chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.

Magnitude/Severity
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths
Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability
Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Overall Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Severe weather hazards addressed in this plan include extreme heat, heavy rain, thunderstorms, hail, lighting, dense fog, and high winds. Of these hazards, heavy rain, thunderstorms, hail, lighting, and high winds were rated medium priority hazards. Extreme heat and dense fog hazards have fewer direct effects on water utility infrastructure in the District's planning area. For this reason, the District's HMPC included a mitigation action for extreme heat, but the District did not include a dense fog mitigation action in this plan.

FEMA's Hazus 4.0 Loss Estimation Tool

Hazus Multi-Hazard Loss Estimation tool (Hazus-MH) is FEMA's standardized method for modeling and estimating potential losses from earthquakes, floods, strong wind-caused events, and hurricanes. For the purposes of this plan, Hazus Version 4.0 was used with Geographic Information System (GIS) software to estimate economic and social impacts from the occurrence (or potential occurrence) of natural hazards, including earthquakes (FEMA 2018a).

Hazus-MH provides tabular outputs as well as graphic and illustrative results of identified high-risk areas due to the profiled hazards of interest, with reports summarizing losses or damages from structures and critical facilities, populations affected or at risk, and debris generated from an event. Hazus 4.0 is a key component of the pre-disaster planning process and is used for mitigation and recovery, given its ability

to estimate potential losses and damages on a special district, city, county, and multi-regional context. For this LHMP, Hazus-MH was used to estimate effects from a probabilistic 2,500-year earthquake scenario and the software is referenced in the dam incidents and earthquake sections to point out methodologies applied to the vulnerability assessments as indicated in Hazus-MH loss calculation procedures (FEMA 2018b). For more information on the earthquake scenario processed with Hazus 4.0, refer to the Section 4.3.1 Earthquakes.

4.1.3 Disaster Declaration History

One method the HMPC used to identify hazards was researching past events that triggered federal and state emergency or disaster declarations in the Planning Area. Federal and state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded, a federal presidential emergency or disaster declaration may be issued allowing for the provision of federal assistance to help disaster victims, business, and public agencies.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), or the Small Business Administration (SBA). FEMA also issues emergency declarations which are more limited in scope and without the long-term federal recovery programs of major disaster declarations (Farm Service Agency 2018). The quantity and types of damage are the determining factors in the type of declaration issued. This section focuses on state and federal disaster and emergency declarations.

Sonoma Valley and the District's water customers within their Planning Area are among many water districts with communities in California and several smaller water districts in Sonoma Valley (e.g. City of Sonoma, Kenwood Village Water Company) that are susceptible to disaster. Details on federal and state disaster declarations were obtained by the HMPC, FEMA, and Cal OES and compiled in chronological order in Table 4-3.

Table 4-3: Sonoma County State and Federal Disaster Declarations, 1950-2020

Event/ Hazard	Year	Disaster #	Declaration Type
Heavy Rains and Flooding	1964	183	Major Disaster Declaration
Severe Storms and Flooding	1969	253	Major Disaster Declaration
Drought	1977	3023	Emergency Declaration
Flood	1982	651	Major Disaster Declaration
Coastal Storm	1983	677	Major Disaster Declaration
Flood	1986	758	Major Disaster Declaration
Freeze	1991	894	Major Disaster Declaration
Flood	1993	979	Major Disaster Declaration
El Niño - Fishing Losses	1994	1038	Major Disaster Declaration
Severe Storm(s)	1995	1044	Major Disaster Declaration
Severe Storm(s)	1995	1046	Major Disaster Declaration
Cavedale Fire	1996	--	Local Emergency
Severe Storm(s)	1997	1155	Major Disaster Declaration
Severe Storm(s)	1998	1203	Major Disaster Declaration
Severe Storm(s)	1999	--	Local Emergency
Severe Storm(s)	2002	--	Local Emergency
Geysers Fire	2004	2554	Fire Management

Event/ Hazard	Year	Disaster #	Declaration Type
Flood	2005	--	State and Federal Disaster Declaration
Severe Storm(s)	2006	1646	Major Disaster Declaration
SF Oil Spill	2007	--	Gubernatorial Declaration
H1N1 Influenza Pandemic	2009	--	Local Emergency
Great Tohoku Tsunami	2011	--	Gubernatorial Declaration
Drought	2014-2016	--	Gubernatorial Declaration
South Napa Earthquake	2014	4193	Major Disaster Declaration
Severe Storm(s)	2014	--	Local Emergency
Valley Fire	2015	4240	Major Disaster Declaration
Severe Storm(s)	2017	4301	Major Disaster Declaration
Flood	2017	4308	Major Disaster Declaration
Wildfires	2017	4344	Major Disaster Declaration
Severe Winter Storms, Flooding, and Mudslides	2017	4308	Major Disaster Declaration
Severe Winter Storms, Flooding, and Mudslides	2017	4301	Major Disaster Declaration
Severe Winter Storms, Flooding, Landslides, and Mudslides	2019	4434	Major Disaster Declaration
California COVID-19 Pandemic	2020	4482	Major Disaster Declaration
California Wildfires	2020	4558	Major Disaster Declaration

Sources: 2018 California State Hazard Mitigation Plan, FEMA, 2016 Sonoma County Hazard Mitigation Plan

Most disaster declarations are issued on a county-wide basis. In some limited instances a city or area within a county is specifically designated. Sonoma County has received 34 declarations between 1964 and September 2020, 23 of which received federal disaster declarations, 4 received a Gubernatorial Declaration, 6 were local emergency declarations and 1 for fire management assistance. Of the 34 disaster declarations, 15 were associated with severe storms and heavy rain (also includes the 1 coastal storm event), 8 associated with flooding, 6 declarations related to wildfires; 2 declarations from pandemics and freeze and earthquake received 1 declaration. The County also received 1 declaration related to fishing losses, 1 related to the Cosco Busan oil spill in San Francisco Bay, and 1 related to the 2011 Japan Tsunami.

Since 2012, there have been 14 drought declarations issued by the Secretary of Agriculture for Sonoma County, 10 of which were "Fast Track Secretarial Disaster" designations; refer to Section 4.3.3 on drought and water shortage hazards for more details on previous occurrences of drought events. According to the Secretary of Agriculture, a Fast Track designation is for a severe drought and provides an automatic designation when any portion of the county meets the severe drought intensity value for eight consecutive weeks during the growing season.

This combined federal and state disaster history suggests that Sonoma County (and the District) experiences a major event worthy of a disaster declaration every 1.6 years. The County has a 63 percent chance of receiving a disaster declaration in any given year. Further, a review of these events helps the District identify risk reduction targets and ways to improve their capabilities to avoid large-scale hazard events in the future.

4.1.4 Climate Change Considerations Summary

Climate change is an increasingly important factor now affecting all phases of the disaster management cycle. Sonoma County acknowledges that climate change is occurring and began to plan for it when they initiated climate change efforts in 2009 by the establishment of a North Bay Climate Adaptation Initiative (NBCAI) and the Regional Climate Protection Authority (RCPA). The NBCAI is a coalition of natural resource managers, policy makers, and scientists working together to create climate adaption solutions for the ecosystems and watersheds in Sonoma County. Likewise, the RCPA was formed through locally sponsored state legislation to coordinate countywide climate protection efforts among Sonoma County's nine cities and multiple county agencies. The RCPA focuses on efficient buildings, clean energy, alternative transportation, and conservation and adaptation. In 2014, the RCPA prepared a climate hazard and vulnerability assessment, known as *Climate Ready Sonoma County: Climate Hazards and Vulnerabilities*. In 2016, the RCPA prepared Sonoma County's *Regional Climate Action Plan: Climate Action 2020 and Beyond* (referred to as the County's CAP). Although not formally adopted by the County, climate change projections summarized in the CAP are based on the Basin Characterization Model (BCM) prepared by scientists from the USGS and the University of California, Davis Center for Environment. The projections were developed by applying scaled-down models that identify watershed-level climate change impacts specific to Sonoma County; the projections represent the best available climate data for the County (RCPA 2016). The BCM projections and recent studies indicate that climate change could affect Sonoma County (and the District's Planning Area) in the following ways:

What is Climate Change?

Climate change refers to distinct changes in weather conditions that result from increased atmospheric greenhouse gas (GHG) emissions. Monthly mean carbon dioxide (CO_2) levels now exceed 410 parts per million (ppm) for the first time in recorded history. This GHG increase has trapped heat in the atmosphere and is linked to an increase in average global temperature and the global temperature and GHG increases are resulting in a series of changes to the global climate. These changes include shifts in seasonal temperature patterns; altered precipitation timing, amount, and location; sea level rise due to melting glaciers and ice caps; ocean acidification due to increased CO_2 absorption; and altered wind and storm event frequency and severity, including more frequent and intense storms, droughts, and heat waves. Climate change is not a discrete event, but a long-term hazard that already affects communities in California.
Sources: NOAA 2021; IPCC 2018; SHMP 2018

- **Higher Average Temperature and More Extreme Heat Events:** Sonoma County is expected to experience more very hot days and overall higher temperatures over a longer warm season. Most climate change models project that temperatures will continue to rise, and under both high and mitigated carbon emission trends. For scenarios with mitigated emissions, summer high temperatures are expected to rise by 1 to 2°F; scenarios with unmitigated emissions project average summer high temperatures will increase by up to 9 to 11°F by 2100.
- **More Frequent and Intense Droughts:** Whether Sonoma County experiences more or less rainfall overall, the land will likely be drier because warmer temperatures increase evapotranspiration even under wetter scenarios. Three of the four climate scenarios examined indicate a rising climate water deficit (CWD), a numeric measure of drought stress, over this century, producing 10 to 20 percent drier soil conditions in the summer months. The greatest increases in soil dryness are projected to occur in the south and southeastern portions of the County (including the District's Planning Area).
- **More Frequent and Intense Wildfire:** Wildfire risk will continue to rise due to increased dryness of vegetation compounded by the productivity of plants in the spring, as this creates more fuel for dry season wildfires). By the end of the century, the chances of one or more fires during a 30-year period are projected to increase from 15 to 20 percent to 25 to 33 percent in the mountainous areas of the County. It should be noted that this finding on more frequent and intense wildfire risk was made before the Sonoma County firestorms in 2017, 2018, and 2020. Taken into consideration the wildfire activity that occurred in the past five years in the County, the frequency and severity of wildfires has

increased and this projection from the County's CAP was a conservative forecast of future fire probability.

- **Fewer Winter Nights that Freeze.** Projected winter low temperatures are expected to rise in the future. Generally, the coast, ridges, and mountain peaks will experience the most significant warming whereas valley bottoms are projected to warm less dramatically. For scenarios with mitigated emissions, winter low temperatures are expected to rise by 1 to 2°F. In the two scenarios with unmitigated emissions, average winter low temperatures are projected to increase by up to 7 to 9°F by 2100. These increases have potential implications for controlling disease vectors, agricultural pests, and agricultural practices that may impact the land management practices surrounding the District's Planning Area.
- **More Variable Rain:** Future rainfall models vary across global climate models, and some models project less annual rainfall in Sonoma County, while others predict more rainfall. However, all climate scenarios project more variation in the timing and amount of precipitation from individual rain events. All of the scenarios indicate that Sonoma County will continue to have years with precipitation similar to historic averages interspersed with more extreme conditions. For 2040 through 2069, the wettest scenario projects a 25 percent increase in average annual rainfall compared to historical conditions, whereas the driest scenario projects a 19 percent decrease. While the County may experience more or less total rainfall, the land will be drier because warmer temperatures increase evapotranspiration from soil and plants.
- **Increased Risk of Extreme Floods:** Climate scenarios project increased seasonal variability of precipitation, runoff, and stream flows for Sonoma County, along with increased likelihood of "extreme" precipitation and drought events. There may be more years with more frequent storm events and occasional events that are much stronger than historical ones and the length of season over which storm events occur is predicted to increase. These changes to the patterns of storm events may result in more frequent and more severe floods in Sonoma County and the District's Planning Area.
- **More Frequent Coastal Flooding, Increased Erosion, and Saltwater Intrusion:** Sea levels are projected to rise between 16.5 and 65.8 inches by 2100. Rising sea levels combined with increased storm surge will lead to more frequent inundation of the low-lying areas, and flooding of homes, infrastructure, agricultural land, and natural areas on the shores of San Pablo Bay located to the south of the District's Planning Area. The greatest impacts are anticipated during winter storms.

The important consideration for hazard mitigation is that climate change is exacerbating the hazards which are already identified and profiled in this plan. The District and California are also already experiencing the impacts of climate change including prolonged drought, increased flooding, increased average temperatures, shifts in the water cycle, and changes to precipitation patterns and the intensity of extreme events resulting from hazards, such as wildfires. Climate change not only results in progressive changes, such as shifting weather patterns, but also affects the frequency and severity of hazard events (SHMP 2018). Climate change also results in an increase in the variance of climate patterns and this increased variance creates challenges for hazards planning, which previously used historic recurrence rates to predict future events, and now must incorporate changes to the frequency, severity, and location of natural hazards due to climate change.

Risk assessment for hazards is built upon the frequency of past events and the assumption that historic occurrence rates are a good predictor of future event probability. With climate change; however, history is not an adequate predictor of the probability of future occurrences (SHMP 2018). Planning for climate change (and understanding the probability of future occurrences [see Section 4.3 below]) is therefore now based on understanding and integrating evolving climate change science and modeled projections that

account for shifts in historic conditions due to climate change into hazard mitigation planning (SHMP 2018).

Additional specifics associated with the hazards are discussed in the Climate Change Considerations subsection of each hazard profile. This section also summarizes whether climate change is anticipated to have a low, medium, or high influence on future hazards.

4.2 Asset Summary

The HMPC assessed the District Planning Area's vulnerability to identified hazards by developing an inventory of the District's critical water facilities and infrastructure that could be impacted during a hazard event. If a catastrophic disaster were to occur in the Planning Area, this section describes significant assets exposed or at risk. Data used in this baseline assessment included:

- Critical water facilities and infrastructure assets at risk;
- Customers at risk;
- Cultural, historical, and natural resources; and
- Future development trends.

Critical Water Facilities and Infrastructure Assets at Risk

A spatial inventory containing the District's water supply transmission and distribution facilities and infrastructure assets, such as aboveground water storage tanks, pump stations, and underground water pipelines, pressure reducing valves (PRVs), and flow meters was provided by the District. This spatial inventory dataset included replacement value information for all the District's assets and provided the baseline for an inventory of the total exposure of developed assets owned and operated by the District. This dataset ensures that the LHMP can be updated over time to reflect changes in water supply facilities and infrastructure development.

The total values of the District's critical water supply transmission and distribution infrastructure at risk was then assessed and organized by aboveground assets, including water storage tanks, pump stations; and underground assets, including below ground pipelines, PRVs, and flow meters comprising the water distribution system. The data was provided by the District and EKI Environment & Water (EKI) and represents the best available data for their service area. The data also provides information on which District water assets are potentially at risk and vulnerable to the damaging effects of natural hazards. Other data, such as jurisdictional boundaries, roads, and natural resource features were obtained from Sonoma County GIS and Sonoma County Local Agency Formation Commission (LAFCo) to support the mapping and analysis of assets at risk.

The District's aboveground assets are categorized as water storage tanks, pump stations, and other supporting facilities that comprise the water supply system and include 89 assets. The underground assets are categorized as water pipelines totaling 486,604 linear feet, or 92 miles. The critical water assets include:

- Water supply Transmission and Infrastructure Assets – water storage tanks, pump stations, and hydrants
- Water Distribution and Infrastructure Assets – water pipelines, PRVs, isolation valves, and flow meters

Table 4-4 lists the total values of the District's aboveground water assets by facility type. Land values have been purposely excluded because the land remains following disasters, and subsequent market devaluations are frequently short term and difficult to quantify. Additionally, federal and state disaster assistance programs generally do not address loss of land or its associated value.

Table 4-4: Valley of the Moon Water District Asset Values by Type

Asset Type	Count	Replacement Value
Pump	20	$25,200,000
Wells	6	$10,000,000
Tank	18*	$40,500,000
Turnout Location	10	$2,500,000
Valve	41**	$1,110,000
Total	**89**	**$79,310,000**

Source: VOMWD 2020

*This number includes the tanks owned by Sonoma Water (Eldridge and Sonoma water tanks) that do not below to the District. The District owns 13 storage tanks and 2 hydro-pneumatic tanks for a total of 15 water storage tanks.

**The number of valves includes automatic valves (e.g., PRVs, PSVs, Rate-of-Flow and Altitude valves), not system valves.

The District's water distribution network consists of approximately 92 miles of pipe ranging from 3/4 inches to 14 inches in diameter. Pipe materials are primarily asbestos cement pipe (ACP) and polyvinyl chloride (PVC) pipe, but there are also sections of cast-iron pipe (CIP), ductile iron pipe (DIP), steel pipe, and high-density polyethylene (HDPE) pipe. Table 4-5 lists the total values of the District's underground water assets by pipeline size and type.

Table 4-5: Valley of the Moon Water District Asset Values by Type – Water Pipeline

Pipeline Diameter (inches)	Length (feet)						
	ACP	CIP	DIP	HDPE	PVC	Steel	Length (miles)
<2	89	--	--	759	1,691	6,738	1.76
3	--	--	--	--	--	249	0.05
4	30,069	81	615	6,610	3,880	2,520	8.29
5	160,838	--	10,549	3,586	53,899	274	43.40
6	91,005	--	4,291	--	58,357	1,107	29.31
8	19,621	--	742	--	6,019	--	5.00
10	7,497	--	1,457	73	11,305	--	3.85
14	2,684	--	--	--	--	--	0.51
Total	**311,804**	**81**	**17,654**	**11,028**	**135,151**	**10,889**	**92.16**

Source: VOMWD 2020

NOTES

1. Pipeline lengths, diameters, and materials include all active potable water transmission and distribution pipelines present in the GIS dataset and in the 2019 WMP provided by the District and EKI.

While this is the best available data, the vulnerability assessment should be used an initial guide to the overall values associated with the District assets. In the event of a disaster, structures and other infrastructure improvements are at the greatest risk of damage. Depending on the type of hazard and resulting damages, the land itself may not result in impacts or damages. For this reason, the values of structures and other infrastructure improvements are the greatest concern for the District.

Detailed Asset Inventory

The District currently provides a critical lifeline utility and water supply to via 6,993 service connections and approximately 27,077 people in Sonoma Valley based on multiplying the District's number of service connections by a factor of 3.3 (VOMWD 2021). All other estimates to the District's service connections and customer base in the plan that differ reference the estimates and projections from the 2015 UWMP and the 2019 WSP. All facilities owned by the District are considered critical water facilities. There are 89

facilities owned by the District, as shown in Table 4-6. The District's water facilities include 14 booster pump stations (BPSs), 6 groundwater wells, 18 water storage tanks, 10 turnouts, 10 valves, 11 flow meters, and 20 PRVs. These facilities are shown in Figure 4-2. This list does not include the District's office building located in El Verano.

Table 4-6: Detailed Facilities in the Valley of the Moon Water District Planning Area

Asset	Type	Facility Name	Replacement Value ($)
Pump	BPS	Agua Caliente Pump Station	$1,700,000
	BPS	Arnold Drive Pump Station	$1,700,000
	BPS	Chestnut Pump Station	$2,400,000
	BPS	Chestnut Pump Station	$2,400,000
	BPS	Donald Pump Station	$1,700,000
	BPS	Donald Pump Station	$1,700,000
	BPS	Donald Pump Station	$1,700,000
	BPS	Glen Ellen Pump Station	$1,700,000
	BPS	Glen Ellen Pump Station	$1,700,000
	BPS	Hanna Pump Station	$1,700,000
	BPS	Lower Sobre Vista Pump Station	$1,700,000
	BPS	Sonoma Mountain – Lower Pump Station	$1,700,000
	BPS	Sonoma Mountain – Upper Pump Station	$1,700,000
	BPS	Upper Sobre Vista Pump Station	$1,700,000
SUBTOTAL	***14***		***$25,200,000***
Well	Pump and Well	Agua Caliente Well	$1,500,000
	Pump and Well	Donald Well	$1,500,000
	Pump and Well	Labre Well	$1,500,000
	Pump and Well	Mountain Well	$1,500,000
	Pump and Well	Park Well	$1,500,000
	Pump and Well	Verano Well	$2,500,000
SUBTOTAL	***6***		***$10,000,000***
Tank		Bolli 1 Tank	$2,000,000
		Bolli 2 Tank	$2,000,000
		Chestnut Hydropnuematic Tank	$2,000,000
		Chestnut Tank	$2,000,000
		Donald Hydropnuematic Tank	$2,000,000
		Donald Tank	$2,000,000
		Eldridge 1 Tank*	$2,000,000
		Eldridge 2 Tank*	$2,000,000
		Glen Ellen Tank	$2,000,000
		Hanna Tank	$4,000,000
		Lower Sobre Vista Tank	$2,000,000
		Saddle Tank	$1,500,000
		Sonoma Mountain – Lower Tank*	$1,000,000
		Sonoma Mountain – Upper Tank*	$1,000,000

Asset	Type	Facility Name	Replacement Value ($)
		Sonoma Tanks	$4,000,000
		Temelec 1 Tank	$4,000,000
		Temelec 2 Tank	$4,000,000
		Upper Sobre Vista Tank	$1,000,000
SUBTOTAL	***18***		***$40,500,000***
Turnout Location		Agua Caliente Turnout	$250,000
		Altimarato Turnout	$250,000
		Boyes Turnout	$250,000
		Glen Ellen Turnout	$250,000
		Hanna Turnout	$250,000
		Madrone Turnout	$250,000
		Trinity Turnout	$250,000
		Verano Turnout	$250,000
		Verano & Fifth Turnout	$250,000
		Verano Main Turnout	$250,000
SUBTOTAL	***10***		***$2,500,000***
Valve	Closed Isolation Valve	GV10	$50,000
	Closed Isolation Valve	GV11	$50,000
	Closed Isolation Valve	GV12	$50,000
	Closed Isolation Valve	GV2	$50,000
	Closed Isolation Valve	GV3	$50,000
	Closed Isolation Valve	GV4	$50,000
	Closed Isolation Valve	GV5	$50,000
	Closed Isolation Valve	GV6	$50,000
	Closed Isolation Valve	GV8	$50,000
	Closed Isolation Valve	GV9	$50,000
SUBTOTAL	***10***		***$500,000***
Flow Meter Valve	Flow Meter	Agua Caliente Meter	$10,000
	Flow Meter	Altimira Meter	$10,000
	Flow Meter	Boyes Meter	$10,000
	Flow Meter	Glen Ellen 4 Meter	$10,000
	Flow Meter	Glen Ellen 6 Meter	$10,000
	Flow Meter	Hanna Turnout Meter	$10,000
	Flow Meter	Madrone Meter	$10,000
	Flow Meter	Trinity Meter	$10,000
	Flow Meter	Verano & Main Meter	$10,000
	Flow Meter	Verano Fifth Meter	$10,000
	Flow Meter	Verano Meter	$10,000
SUBTOTAL	***11***		***$110,000***
Pressure Reducing Valves	PRV	Agua Caliente Turnout Pressure Reducing Valve 1	$25,000
	PRV	Agua Caliente Turnout Pressure Reducing Valve 2	$25,000

Asset	Type	Facility Name	Replacement Value ($)
	PRV	Altimira Turnout Pressure Reducing Valve	$25,000
	PRV	Altimira Turnout Pressure Reducing Valve 2	$25,000
	PRV	Boyes Boulevard Turnout Pressure Reducing Valve	$25,000
	PRV	Boyes Boulevard Turnout Pressure Reducing Valve 2	$25,000
	PRV	Glen Ellen Pressure Reducing Valve	$25,000
	PRV	Glen Ellen Pressure Reducing Valve	$25,000
	PRV	Hanna Lower Pressure Reducing Valve	$25,000
	PRV	Hanna Turnout Pressure Reducing Valve	$25,000
	PRV	Hanna Turnout Pressure Reducing Valve 2	$25,000
	PRV	Madrone Turnout Pressure Reducing Valve 2	$25,000
	PRV	Madrone Turnout Pressure Reducing Valve	$25,000
	PRV	Trinity Turnout Pressure Reducing Valve 2	$25,000
	PRV	Verano & Fifth Pressure Reducing Valve	$25,000
	PRV	Verano & Fifth Pressure Reducing Valve 2	$25,000
	PRV	Verano & Main Pressure Reducing Valve	$25,000
	PRV	Verano & Main Pressure Reducing Valve 2	$25,000
	PRV	Verano Pressure Reducing Valve	$25,000
	PRV	Verano Pressure Reducing Valve 2	$25,000
SUBTOTAL	***20***		***$500,000***
TOTAL	**89**		**$79,310,000**

Source: VOMWD 2020

*The Eldridge and Sonoma Mountain water tanks (four total tanks) are owned and operated by Sonoma Water, not the District.

Critical and City Facility Inventory

A critical facility is defined (within the context of this plan) as a facility that is essential in providing utilities or support either during the response to an emergency or during a recovery operation. The following four categories were used to differentiate critical assets and facilities in the District's Planning Area based on FEMA's Hazus-MH program and other FEMA guidelines:

- **Emergency Services –** Facilities or centers aimed at providing for the health and welfare of the whole population (e.g., hospitals, police, fire stations, emergency operations centers, evacuation shelters, schools).
- **Lifeline Utility Systems –** Facilities and structures such as potable water, wastewater, oil, natural gas, electric power and communications systems.
- **Transportation Systems –** These may include railways, highways, waterways, airways and city streets to enable effective movement of services, goods and people. Particular examples for Petaluma include airports, historic drawbridges, and train or other transportation stations.
- **High Potential Loss Facilities –** These include nuclear power plants, dams, and levees.

Lifeline utility systems for potable water supply are critical facilities, so on this basis, all the District's facilities are critical. In addition, while HMPC identified their own critical facilities – those that are essential

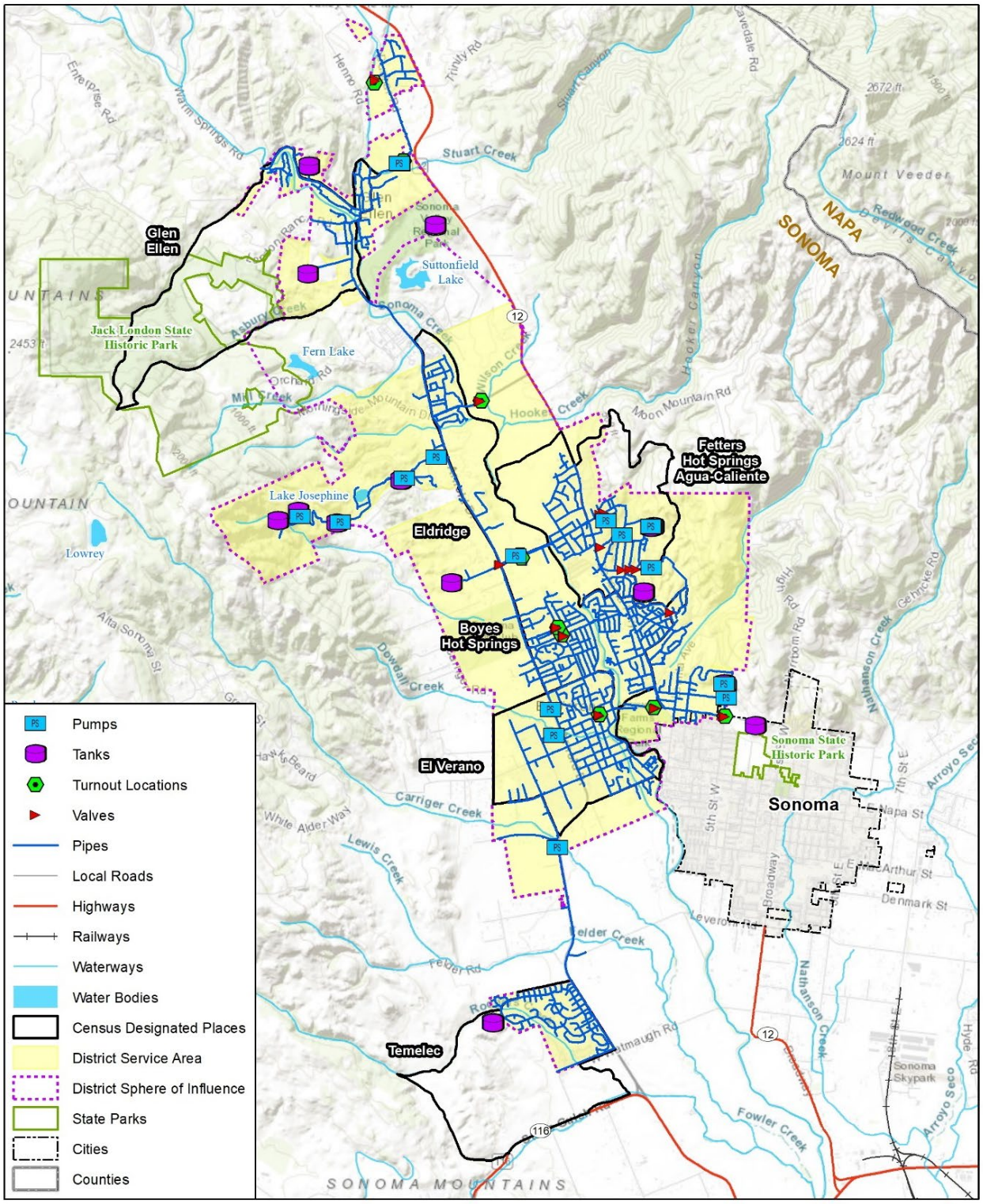
to maintaining their operations, they also identified other major water suppliers in Sonoma Valley, such as the Sonoma Water.

Sonoma Water is another special water district and the major water supplier in Sonoma County. It operates the Sonoma Aqueduct that delivers water from the Russian River to more than 600,000 residents in portions of Sonoma County and northern Marin counties. The agency is a water wholesaler, selling potable water primarily to nine cities and special districts (also referred to as contractors), which these jurisdictions and water districts then sell to their customers. The District and the City of Sonoma are two agencies in Sonoma Valley that currently purchase water from Sonoma Water.

The District also historically relied on water for domestic, agricultural, and fire suppression purposes from the Sonoma Development Center (SDC) campus that occupies property owned by the State of California located south of Glen Ellen. Until the end of 2018, the SDC was a residential facility for people with physical and development disabilities. Domestic and fire suppression water at the SDC primarily came from surface water on the campus property stored in two reservoirs (Suttonfield Lake and Fern Lake), which was treated on site in a facility with a capacity of up to 1.8 million gallons a day. As the population at the SDC declined, the WTP handled less and less water until it closed completely in September 2019. The ultimate use and potential redevelopment of the campus (and the water uses associated with it) will be determined with the completion of the *Sonoma Development Center Specific Plan*. The SDC Campus is currently outside the District's service area, but within the District's SOI boundary.

Standby power is also necessary for critical facilities in the event of a power outage (planned or unplanned), which can be the result of many natural hazard events, such as severe weather, high winds, earthquake, or wildfire. The District has emergency generation capabilities at all its critical facilities.

Figure 4-2 Critical Water Facilities in District by Type



Cultural, Historical, and Natural Resources

Assessing the District's vulnerability to disaster also involves inventorying the natural, historical, and cultural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- In the event of a disaster, an accurate inventory of natural, historical and cultural resources allows for more prudent care in the disaster's immediate aftermath when the potential for additional impacts is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, for example, wetlands and riparian habitat which help absorb and attenuate floodwaters and thus support overall mitigation objectives.

Cultural Resources

Historical resources are buildings, structures, objects, places, and areas that are eligible for listing in the National Register of Historic Places (NRHP), the California Register of Historic Resources (CRHR), or the City's List of Historic Resources, have an association with important persons, events in history, or cultural heritage, or have distinctive design or construction method.

For purpose of federal actions, a qualified historic resource is defined as a property listed in or formally determined eligible for listing in the NRHP before a disaster occurs. The NRHP is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the U.S. Department of the Interior National Park Service. Local and state agencies may consider a broader definition of qualified historic properties in the review, evaluation, and treatment of properties damaged during a disaster.

The State of California Office of Historic Preservation can provide technical rehabilitation and preservation services for historic properties affected by a natural disaster. Depending on the hazard, protection could range from emergency preparedness, developing a fire safe zone around sites susceptible to wildfires, or seismically strengthening or structurally reinforcing structures.

State and local registers of historic resources provide designated Historical Landmarks, Points of Historical Interest, and Historic Buildings. These resources include, but are not limited to:

- The California Register of Historical Resources (CRHR)
- The California Historical Landmarks
- The California Inventory of Historical Resources
- The California Points of Historical Interest
- Sonoma County Historic Landmarks

Historical resources designated the National Register of Historic Places and by Sonoma County are provided in Table 4-7. Some of these historic and cultural places are duplicative in both the County and National databases.

Table 4-7: Sonoma Valley Historical Resources

Historical Resource Name	Listed Date	Location	Community	Other Names or Description
National Register of Historic Places				
Sonoma State Home – Main Building	10/6/2000	15000 Arnold Drive	Eldridge	Sonoma State Hospital; Sonoma Development Center
Glen Oaks Ranch	10/21/1994	13255 Sonoma Highway	Glen Ellen	Glen Ellen Vineyard; Cochran, Roswell and Camille M. Ranch
Hotel Chauvet	2/25/1990	13756 Arnold Drive	Glen Ellen	Chauvet Hotel
Jack London Ranch	10/15/1966	0.4 miles west of Glen Ellen in Jack London Historical State Park	Glen Ellen	Jack London Home and Ranch
Sonoma County Historical Landmarks (1st District Sites)				
Arnold Drive Bridge #20C-213	1998	Arnold Drive	Glen Ellen	Arnold Bridge
Calabezas Creek Bridge #20C-324	1981	O'Donnell Lane	Glen Ellen	O'Donnell Lane Bridge
Chateau Saint Jean	1981	843 Saint Jean Court	Kenwood	Goff Residence
Chauvet Building	1981	13740 Arnold Drive	Glen Ellen	Chauvet Building
Freestone House/Clemente Inn	1989	17341 Highway 12	Agua Caliente	Clementi Inn Fetters Hot Springs
Gaige House	1980	13540 Arnold Drive	Glen Ellen	Gaige House
General Joseph Hooker's Ranch	1981	16601 Meadow Oaks Drive	Aqua Caliente	Hooker Ranch, Hooker Oaks Watriss Ranch, Serres Ranch
Glen Oaks	1981	13255 Highway 12	Glen Ellen	Glen Oaks Vineyards
Hotel Chauvet	1981	13756 Arnold Drive, #1B	Glen Ellen	Glen Ellen Hotel Four Nations Restaurant
Jack London Barn	1998	1467 Hill Road	Glen Ellen	Jack London Barn
Jack London Village: Stone Winery Building	1981	14301 Arnold Drive	Glen Ellen	Jack London Village; Stone Winery Building
Joshua Chauvet House	1980	13760 Arnold Drive	Glen Ellen	Joshua Chauvet House
Kenwood Community Church	1981	9655 Channing Row	Kenwood	First Congregational Church of Los Guillicos
Kenwood Depot	1980	314 Warm Springs Road	Kenwood	Kenwood Railroad Depot South Guillicos Station
Kenwood Winery	1981	9592 Highway 12	Kenwood	Pagani Winery & Home
Mervyn Hotel Site	1990	13751 Arnold Drive	Glen Ellen	Mervyn Hotel Site
Monroe Ranch/Coops House	1998	8790 Highway 12	Kenwood	Monroe Ranch/Coops House
Partis Residence	1981	98 Shaw Avenue	Kenwood	Partis Residence
Fetter's Hot Springs Depot	1975	215 Depot Road	Fetter's Hot Springs	Northwestern Pacific Railroad Depot
Agua Caliente Springs Hotel	1975	17250 Vailetti Drive	Agua Caliente	Agua Caliente Villa
Sonoma Mission Inn	1986	18140 Highway 12	Boyes Hot Springs	Sonoma Mission Inn

Historical Resource Name	Listed Date	Location	Community	Other Names or Description
Superintendent's House, Sonoma State Hospital	1981	15000 Arnold Drive	Glen Ellen	California Home for the Care and Training of Feeble-Minded Children
Ten Oaks Ranch	1981	12783 Dunbar Road	Glen Ellen	Kate Warfield Ranch Decker House Cool Ranch
Thompson Ranch and Cemetery	1979	7301 Enterprise Road	Glen Ellen	Redwood Farm
Triniti School	NA	11790 Dunbar Road	Glen Ellen	Triniti School
Valley of the Moon Winery	1997	751 Madrone Road	Glen Ellen	Valley of the Moon Winery
Wake Robin Lodge	1981	4100 Wake Robin Drive	Glen Ellen	Wake Robin Lodge
Wegenerville Resort	1979	1883 London Ranch Road	Glen Ellen	Wegenerville Resort
Wildwood Vineyards	1981	11011 Highway 12	Kenwood	James Shaw Ranch
Zane House	NA	3443 Warm Springs Road	Glen Ellen	Zane House

Source: National Register of Historic Places, 2019; Sonoma County 2020

Lists of designated historical resources change periodically, and they may not include those currently in the nomination process and not yet listed. Additionally, as defined by the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for listing on the National Register. Thus, in the event that the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

Cultural resources defined in California Environmental Quality Act (CEQA) Section 15064.5 include prehistoric and historic archaeological resources; historic-period resources (buildings, structures, area, place, or objects). Archaeological resources reflect past human activity extending from Native American prehistoric cultures throughout the early 20th century. The artifacts left by previous occupants may be encountered in small to large residential sites, or special use areas.

Many cultural and historical resources in the District's Planning Area are vulnerable to several hazards due to location and the nature of their construction. Some of these risks include earthquakes, wildfires, or adverse weather.

Tribal Cultural Resources

Tribal cultural resources are defined in Public Resources Code (PRC) Section 21074.1 as a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe. A Native American tribe is defined as "a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the Native American Heritage Commission". Traditional tribal cultural places are defined in PRC Sections 5097.9 and 5097.993 to include sanctified cemeteries, places of worship, religious or ceremonial sites, or sacred shrines, or any historic, cultural, or sacred site that is listed on or eligible for the CRHR including any historic or prehistoric ruins, burial grounds, or archaeological site. Cultural and tribal resources are governed primarily by federal, state, and local laws that regulate potential impacts to such resources. State regulations that were established to encourage the preservation and protection of traditional tribal cultural resources include:

- **Assembly Bill 52** (PRC Section 21080.3.1) mandates early tribal consultation prior to and during CEQA review to consider tribal cultural values in determination of project impacts and mitigation.

- **Senate Bill 18** (Government Code 655352.3) requires cities and counties to consult with Native American tribes early during broad land use planning efforts on both public and private lands, prior to site- and project-specific land use decisions. Consultation is intended to encourage preservation and protection of traditional tribal cultural places by developing treatment and management plans that might include incorporating the cultural places into designated open spaces.
- **State Executive Order B-10-11 (2011)** established the Governor's Tribal Advisor position and established Administration Policy to encourage State Agencies to communicate and consult with Californian tribes regarding tribal cultural resources.

Natural Resources

The District's Planning Area in Sonoma Valley contains diverse in natural resources, exemplified by the creeks and rivers and salt marshes within the Sonoma Creek watershed that drain inland mountains to the confluence of the Sonoma Creek and San Pablo Bay.

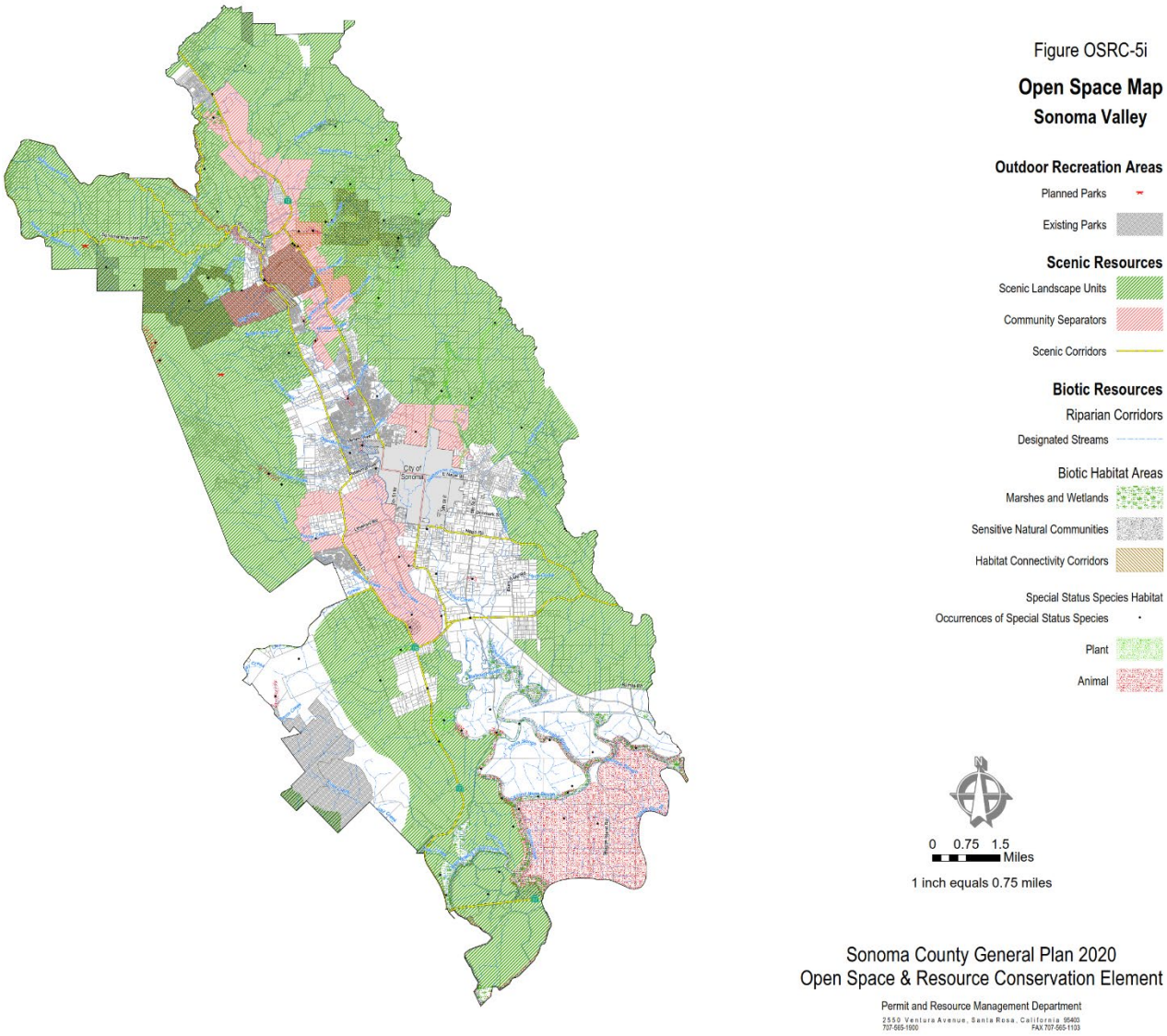
Natural resources are important to include in benefit/cost analyses for future projects and may be used to leverage additional funding for mitigation projects that also contribute to community goals for protecting sensitive natural resources. Inventory and awareness of natural resource assets is vital to meeting conservation objectives. For example, protecting wetland areas provides sensitive habitat protection as well as floodwater conveyance and storage, which further enhances public safety.

Natural resources also exhibit varied levels of resiliency to anthropogenic impacts, climate change, and natural hazards such as flooding, drought, coastal storms or wildfire. Climate change is one of the most substantial threats to conserving the biodiversity and ecological habitat of the County (OPR 2019). Habitat resiliency is exemplified in coastal habitat migration to inland areas as a result to sea level rise, and recovery of burn areas following a wildfire. Figure 4-3 illustrates the biotic resources and habitat areas in Sonoma Valley and the Sonoma Creek watershed.

Special Status Species

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (endangered and threatened species) potentially located in the District's Planning Area. The US Fish and Wildlife Service (USFWS) maintains a list of federally-listed threatened and endangered species for the country, which can be queried at the state and county levels. The California Department of Fish and Wildlife (CDFW) also maintains species lists and accounts for threatened and endangered species. State and federal laws protect the habitat of these species through the environmental review process. Species of special concern may additionally include species that meet the State definition of threatened or endangered but has not been formally listed, experiences serious population declines or habitat decline, or has naturally small populations exhibiting high susceptibility to population decline (CDFW 2019). Table 4-8 summarizes those special status animal species as indicated in the USFWS database that are located in Sonoma County and likely the areas surrounding the District's Planning Area within Sonoma Valley.

Figure 4-3 Biotic Resources in Sonoma Valley



Source: Sonoma County 2003

Table 4-8: Threatened and Endangered Species in Sonoma Valley and greater Sonoma County

Common Name	Scientific Name	Group	Status
California red-legged frog	*Rana draytonii*	Amphibians	Threatened
California least tern	*Sterna antillarum browni*	Birds	Endangered
California clapper rail	*Rallus longirostris obsoletus*	Birds	Endangered
Yellow-billed Cuckoo	*Coccyzus americanus*	Birds	Threatened
Western snowy plover	*Charadrius nivosus*	Birds	Threatened
Northern spotted owl	*Strix occidentalis caurina*	Birds	Threatened
California freshwater shrimp	*Syncaris pacifica*	Crustaceans	Endangered
Delta smelt	*Hypomesus transpacificus*	Fishes	Threatened
Tidewater Goby	*Eucyclogobius newberryi*	Fishes	Endangered
Burke's Goldfields	*Lasthenia burkei*	Flowering Plants	Endangered
Kenwood Marsh Checker-mallow	*Sidalcea oregana ssp. Valida*	Flowering Plants	Endangered
Sonoma alopecurus	*Alopecurus aequalis var. sonomensis*	Flowering Plants	Endangered
Yellow larkspur	*Delphinium luteum*	Flowering Plants	Endangered
Contra Costa goldfields	*Lasthenia conjugens*	Flowering Plants	Endangered
Sonoma sunshine	*Blennosperma bakeri*	Flowering Plants	Endangered
Sonoma spineflower	*Chorizanthe valida*	Flowering Plants	Endangered
Soft Bird's-beak	*Cordylanthus mollis ssp. Mollis*	Flowering Plants	Endangered
Marin dwarf-flax	*Hesperolinon congestum*	Flowering Plants	Threatened
Sebastopol meadowfoam	*Limnanthes vinculans*	Flowering Plants	Endangered
Showy Indian clover	*Trifolium amoenum*	Flowering Plants	Endangered
Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*	Insects	Endangered
San Bruno elfin butterfly	*Callophrys mossii bayensis*	Insects	Endangered
Salt marsh harvest mouse	*Reithrodontomys raviventris*	Mammals	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Reptiles	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Reptiles	Endangered

Source: USFWS – Environmental Conservation Online System, 2020

Population, Growth, and Development Trends

The District's customer base was 24,164 in 2018 and are currently 23,077 as of April 2021 (VOMWD 2019). Population projections for the District summarized in the 2015 UWMP indicate an increase to 24,873 customers by 2020 and 26,300 customers by 2040, or an increase of about 8 percent over the next two decades (UWMP 2016). According to the 2015 UWMP and 2020 SVGSP, Sonoma Valley has experienced significant growth and land use changes over the last 30 years, especially with regard to irrigated agriculture, such as vineyards. While water demand decreased slightly during the recession, the District estimates that future water demand will plateau and remain relatively stable, despite additional population and economic growth (VOMWD 2016). This projection reflects anticipated sustained decreased in per capita water use as a result of continued investment in water efficiency improvements by the District and customers.

Contrary to these water supply and demand projections, cities and water districts in Sonoma Valley, such as the District and City of Sonoma are working together to minimize the risk of disruptions to the water supply from Sonoma Water during emergencies, such as an earthquake. As a result, while current surface water and groundwater supplies may be adequate to support the District's customers; in the event of an emergency that takes the water delivery from the Sonoma Aqueduct offline, the District could have little back-up drinking water supply.

The demographics of the District's customers include a range of income, household size, and water demands. The more affluent households located along the foothills are characterized by larger lots and homes with higher water demands for irrigation. There are also three disadvantaged communities located with the District's Planning Area, including Temelec, El Verano, and Boyes Hot Springs (three census block groups where the median income is approximately $50,000 and lower income households are estimated to comprise approximately 33 percent of the total households) that have smaller lots and lower water use.

Also, as a tourist destination, Sonoma Valley also has a high concentration of second homes and vacation rentals. These customers have a higher water use because the sites do not have full-time owners looking for leaks and managing irrigation water use in accordance with weather patterns (VOMWD 2019).

The District's SOI, a boundary determined by the LAFCo indicating the eventual limits of the District's service area, was amended in October 2017 to include two near areas beyond the District's current service area. These two areas included a territory served by the Sobre Vista Mutual Water Company and a territory occupied by the SDC campus. Since 2016, the District identified additional planned developments within its service area that were not incorporated into the 2015 population or water demand projections. As a result, the District now provides new service connections to the following major recent developments:

- 80-unit multi-family development on Verano Avenue across from Maxwell Farms Regional Park anticipated to be completed by 2025; and
- The Springs Specific Plan, bounded by Agua Caliente Road at the north and Verano Avenue at the south and bisected by the Highway 12 commercial corroder, which included up to an additional 124 single-family dwellings units, 561 multi-family or live-work dwelling units, 167,000 square feet of commercial space, 120 hotel rooms, 82,000 square feet of office space, and 27,000 square feet of recreational area anticipated to be completed over the next 50 years.

Two additional developments are anticipated within the District's Planning Area in the future including an approximately 200 single-family dwelling units on vacant land at the intersection of Arnold Drive and Agua Caliente Road; and between 200 and 500 dwelling units as part of redevelopment of the SDC campus pursuant to the *Sonoma Development Center Specific Plan* (under development). There are no tentative timelines for these future developments given the SDC Specific Plan is still under preparation by the County. Additional information on population and growth and development trends are in Section 2.4 and Section 2.8 in Chapter 2.

4.3 Hazard Profiles and Risk Assessment

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

The hazards identified in Section 4.1 Hazard Identification: Natural Hazards are profiled individually in this section. In general, information provided by HMPC is integrated into this section with information from

other data sources. These profiles set the stage for the vulnerability assessment for each natural hazard that follow the detailed hazard profiles.

Each hazard is profiled in the following format:

- **Hazard Description** - This section gives a description of the hazard and associated issues followed by details on the hazard specific to the District's Planning Area.
- **Geographic Location** – This section provides a spatial description of the potential locations or geographic areas and extents in the District's Planning Area of where the hazard is expected to impact.
- **Magnitude/Severity** - This section gives a description of the potential strength or magnitude of the hazard as it pertains to the District. Different hazards may have different measures of severity.
- **Previous Occurrences** - This section contains information on historical incidents, including impacts where known. The extent or location of the hazard within or near the Planning Area is also included in this subsection. Historical incident worksheets and other data sources were used to capture information on past occurrences.
- **Probability of Future Occurrence** - The frequency of past events is used in this section to gauge the likelihood of future occurrences. Where possible, frequency was calculated based on existing data. Frequency was determined by dividing the number of events observed by the number of years on record and multiplying by 100. This gives the percent chance of an event happening in any given year (e.g., three droughts over a 30-year period equates to a 10 percent chance of a drought in any given year). The likelihood of future occurrences is categorized into one of the following classifications:
  - **Highly Likely** - Nearly 100 percent chance of occurrence in next year or happens every year.
  - **Likely** - Between 10 and 99 percent chance of occurrence in next year or has a recurrence interval of 10 years or less.
  - **Occasional** - Between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years.
  - **Unlikely** - Less than 1 percent chance of occurrence in next 100 years or has a recurrence interval of every 100 years or greater.

The risk assessment for most hazards is built upon the frequency of past events and the assumption that historic occurrence rates are a good predictor of future event probability.

With climate change; however, and as previously discussed history is not an adequate predictor of the probability of future occurrences (SHMP 2018). Planning for climate change is based on understanding and integrating evolving climate change science and modeled projections that account for shifts in historic conditions due to climate change into hazard mitigation planning (SHMP 2018). For these reasons, the likelihood of future occurrences for climate change is categorized into one of the three classifications, but this classification is based on climate change science and modeled projections.

- **Climate Change Considerations** – Climate change refers to a long-term change in the earth's temperature, precipitation, humidity, and seasons. This section addresses the probable effects of climate change qualitatively and as a secondary impact for each identified hazard. It describes the potential for climate change to affect the frequency and severity of natural hazards. Impacts can include water supply shortages, changes in the frequency, intensity, and extent of drought and extreme heat events, more precipitation and flooding risks, and increasing temperatures. This section concludes whether climate change is anticipated to have a low, medium, or high influence on future hazard impacts.

The discussion relies on information from the Fifth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) *Climate Change 2013: The Physical Science Basis Contribution of Working Group*

I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2018). It also relies on numerous California publications on climate change and climate adaptation including:

- *California's Fourth Climate Assessment* (California Natural Resources Agency 2018a);
- *Safeguarding California Plan: 2018 Update – California's Climate Adaptation Strategy* (Cal-Adapt 2018);
- *2014 Safeguarding California: Reducing Climate Risk* (California Natural Resources Agency 2014); and
- *2009 California Climate Adaptation Strategy* (CAS) (California Natural Resources Agency 2009).

The discussion integrates climate information from Cal-Adapt, a website that gathers data on how climate change might affect California at the local level based on the state's scientific and research community (CEC 2018). Cal-Adapt projections are incorporated into the drought and water supply, extreme heat, and severe weather sections. The climate change considerations subsections also summarize climate change modelling and findings from the following two RCPA-prepared documents:

- *2014 Climate Ready Sonoma County: Climate Hazards and Vulnerabilities;* and
- 2016 Sonoma County's Regional Climate Action Plan: Climate Action 2020 and Beyond.

Climate change projections summarized in Sonoma County's CAP are based on BCM projections, which as previously mentioned were developed by applying scaled-down models that identify watershed-level climate change impacts specific to Sonoma County (RCPA 2016). Climate change is addressed in the plan as a secondary impact for each hazard.

Vulnerability Assessment – The vulnerability of the Planning Area to a specific natural hazard is assessed through the study of potential impacts to specific sectors:

- Customers
- Critical Water Facilities and Infrastructure
- Historic, Cultural, and Natural Resources
- Future Development

An estimate of the vulnerability of the District to the priority hazards, in addition to the estimate of risk of future occurrence, is provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **Low**—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High**—Very widespread with catastrophic impact.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of water assets subject to the identified hazard can be counted and their values tabulated. Other information can be collected regarding the hazard area, such as the location District water facilities, historic structures, and valued natural resources

(e.g., an identified wetland or endangered species habitat). Together, this information conveys the impact, or vulnerability, of that area to that hazard.

The HMPC identified four hazards in the planning area for which specific spatial hazard areas have been defined and for which sufficient data exists to support a quantifiable vulnerability analysis. These four hazards are dam incidents, earthquakes, flood, and wildfire. The vulnerability and potential impacts from priority hazards that do not have specific mapped areas nor the data to support additional vulnerability analysis are discussed qualitatively, or in more general terms.

Information in the assessment is based on conclusions and key findings from the *Sonoma Water LHMP, Sonoma County Operational Area LHMP,* and *Sonoma County Grand Jury Investigation,* including the companion reports. Given the unique and complex interconnectedness of the District's system and the region's water supply system, the assessment is organized by a discussion on the District's water assets, and followed by a discussion on Sonoma Aqueduct, and the Russian River system, where applicable.

Risk Summary – This is a summary of key findings and risk based on threat, vulnerability and consequences to the Planning Area from the specific hazard. The significance of each hazard was determined based on the hazard profile, focusing on key criteria such as frequency and resulting damage, including deaths/injuries, and property and economic damage. This assessment was used by the HMPC to prioritize those hazards of greatest significance to the Planning Area thereby allowing the District to focus resources where they are most needed. The following sections provide profiles of the natural hazards, listed by priority based on HMPC input. Human-health hazards are addressed in Section 4.4.

4.3.1 Earthquakes

Hazard Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface (see discussion in the Extent section). Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Seismic Hazards

Earthquakes can cause structural losses, injury, and possibly death, as well as damage to infrastructure such as water, power, gas, communication, and transportation networks and systems. The degree of damage depends on many interrelated factors. Among these are the magnitude, focal depth, distance from the causative fault, source mechanism, duration of shaking, high rock accelerations, type of surface deposits or bedrock, degree of consolidation of surface deposits, presence of high groundwater, topography, and the design, type, and quality of building construction.

Primary hazards associated with seismic activity include surface rupture along faults, ground shaking, and associated building failure. Secondary hazards result from the interaction of ground shaking with existing ground instabilities or facilities and include liquefaction, settlement, debris flows, landslides, and the potential for flooding or wildfires from broken pipelines, gas, or electrical infrastructure.

Surface Fault Rupture

Large magnitude earthquakes that occur along a fault have the potential to extend to ground surface rupture visible on the earth's surface. Fault rupture zones are identified as areas subject to excessive

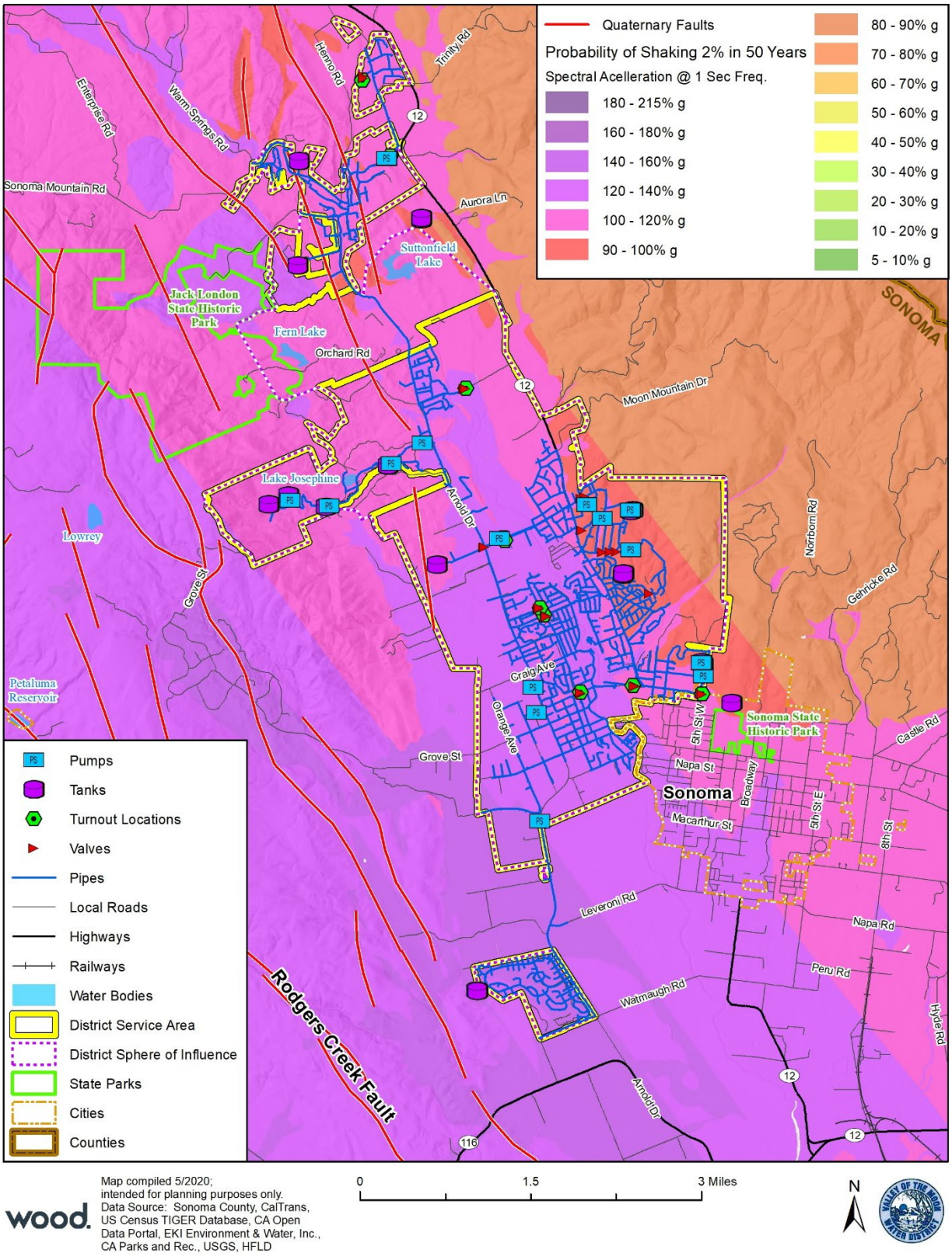
ground deformations and structures located within these areas are vulnerable to damage. The 1906 San Francisco earthquake resulted in 15 feet of horizontal displacement along the San Andreas Fault in Sonoma County (Sonoma County 2018). Faults located in County such as Healdsburg, Rodgers Creek, and Maacama faults have shown evidence on surface displacement in the past 11,000 years. A Magnitude 7.0 earthquake on the Rodgers Creek fault will likely cause an average offset of 3 feet, according the California Division of Mines and Geology Special Publication 112, prepared by the California Geological Survey. The Rodgers Creek fault was identified in the Sonoma County Water Agency's LHMP as posing the greatest risk to the Agency's facilities which could also lead to impacts on the District's supply and transmission. According to the Sonoma County Water Agency's LHMP a recent United States Geological Survey (USGS) study shows the previously unidentified Spring Valley Fault, a fault segment that is part of the Bennett Valley Fault, may lead to fault slip between the Rodgers Creek fault and the Maacama fault. The Spring Valley Fault is thought to have a high slip rate, which corresponds with a high potential for surface fault rupture. Mapping from the Sonoma County Water Agency's LHMP shows that the fault crosses the Agency's Sonoma aqueduct, the main method water is conveyed to the District.

Ground Shaking

When movement occurs along a fault, the energy generated is released as waves, which cause ground shaking. Ground shaking intensity varies with the magnitude of the earthquake, the distance from the epicenter, and the type of rock or sediment through which the seismic waves move. The geological characteristics of an area can be a greater hazard than the area's distance to the earthquake epicenter.

The intensity of ground shaking at a particular location is measured in terms of ground acceleration that generally decreases with distance from the earthquake source unless modified by local subsurface conditions. The maximum acceleration recorded at a location is referred to as the peak ground acceleration (PGA) and is reported as a fraction of earth's gravitational acceleration (g). The total force experienced by a structure can be related directly to the level of acceleration it experiences. Given the proximity to the San Andreas fault and the Rodger Creek fault, all parts of Sonoma County including the District's Planning Area are exposed to long duration peak ground accelerations greater than 0.15g (SCWA 2018). A high-magnitude earthquake on one of these faults could cause moderate to high ground shaking within the District's Planning Area and may impact the District's water supply infrastructure. Figure 4-4 below is an earthquake shaking map for the District that is based on the two percent probability of occurrence in 50 years according to the USGS analyses of nearby faults. The probabilistic PGA values are those estimated by the USGS for a 2 percent probability of exceedance in 50 years, also known as a 2,500 year event. These probability levels are typically used in seismic design of structures and form the basis of the seismic design codes such as the International Building Code and the California Building Code. The 2 percent probability of exceedance in 50 years level is considered as an acceptable upper bound for design against collapse. As such, the probability of occurrence map represents a worst-case shaking scenario and shows that the majority of the District's Planning Area would experience strong ground shaking and 100 to 140 percent g spectral acceleration at a one second frequency. Ground shaking at this frequency has the potential to be damaging. According to the Sonoma County Water Agency's LHMP, the same 2 percent probability of exceedance in 50 years estimates for the Agency's water supply facilities range from 60 to 70 percent g (SCWA 2018).

Figure 4-4 Potential Ground Shaking Probability in the Valley of the Moon Water District



Map compiled 5/2020;
intended for planning purposes only.
Data Source: Sonoma County, CalTrans, US Census TIGER Database, CA Open Data Portal, EKI Environment & Water, Inc., CA Parks and Rec., USGS, HFLD

Liquefaction Susceptibility

Liquefaction can be defined as the loss of soil strength or stiffness due to a buildup of pore-water pressure during a seismic event, and is associated primarily with relatively loose, saturated fine to medium-grained unconsolidated soils with shallow groundwater. Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. If this layer is at the surface, its effect is much like that of quicksand for any structure located on it. If the liquefied layer is in the subsurface, the material above it may slide laterally depending on the confinement of the unstable mass. Liquefaction is caused by a sudden temporary increase in pore-water pressure due to seismic densification or other displacement of submerged granular soils. Liquefiable soil conditions are most common in alluvial deposits in floodplains and coastal areas where the groundwater level is shallow (i.e. 50 feet or less below the surface). Bedrock units, due to their dense nature, are unlikely to present a liquefaction hazard.

According to the USGS Earthquake Hazards Program data for liquefaction susceptibility, there are several areas of liquefaction susceptibility in the District's Planning Area (see Figure 4-5). The majority of the District's Planning Area is in the medium to low liquefaction susceptibility zone, but there are some areas of high susceptibility (along Carriger Creek near Grove Street and east of Arnold Drive) within more severe liquefaction susceptibility zones. The District depends on water conveyance from the Sonoma Aqueduct, which traverses areas of moderate to high liquefaction susceptibility zones (SCWA 2018).

Earthquakes can also lead to secondary hazards including flooding, building structure failure, debris flows, and fire (among others). The District is at risk of flooding from dam failure from the Suttonfield Dam to the north as well as risk of broken pipelines and critical infrastructure, such as the turnout locations in the eastern portion of the District's Planning Area boundary.

Faults

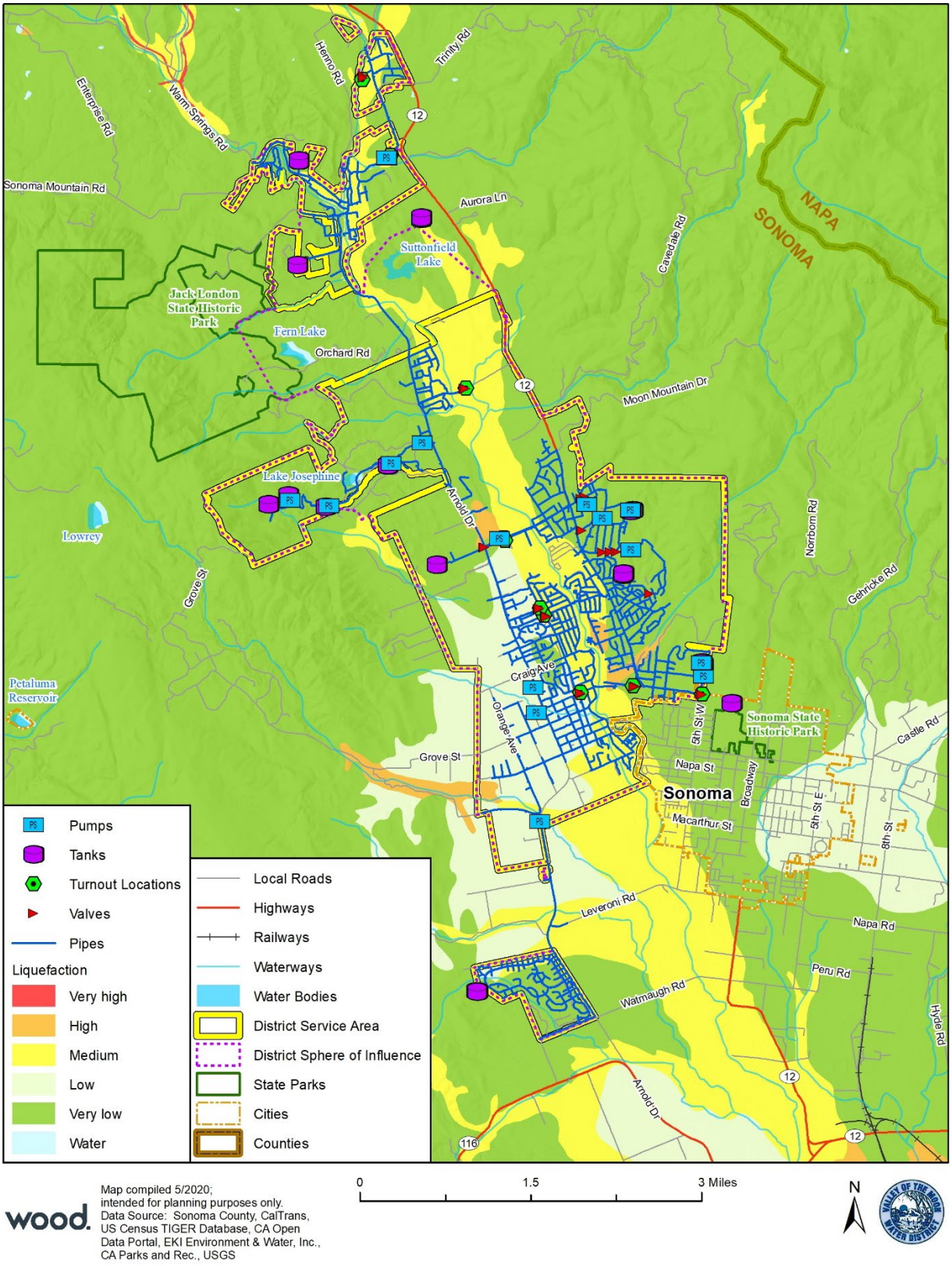
California is a seismically active area with numerous faults throughout the region. An active fault is defined by CGS as a fault that has had surface rupture or displacement within the last 11,000 years (Holocene times). This does not mean, however, that faults having no evidence of surface displacement within the last 11,000 years are necessarily inactive. Potentially active faults are those that have shown displacement within the last 1.8 million years (Quaternary period) but have not moved within the Holocene times. Any fault older than Pleistocene (>1.8 million years) is considered inactive and dormant. Although based on the history of fault movement and seismic activity in the area, it is known that the main faults posing risk to the District are the major faults within the San Andreas Fault system. According to the Working Group on California Earthquake Probabilities (WGEP) there is a very high probability (72 percent) of a major earthquake in the Bay Area in the next 30 years (SCWA 2018). The Rodgers Creek fault zone, one of the major faults within the San Andreas Fault system, is considered to be a major contributor to the high probability of future earthquakes. The Rodgers Creek fault is described in more detail under the Location subsection below.

Geographic Location

Extensive – The San Francisco Bay Area and Sonoma County are considered seismically active due to several major faults in the San Andreas Fault system. Notable faults adjacent to the District's Planning Area with the greatest potential of impacting the District's water supply facilities and infrastructure, are described in more detail below.

San Andreas Fault. The San Andreas Fault west of the District is a shallow fault and is considered the most active fault in California. It is expected to continue being the source of future earthquake activity in Sonoma County. The major faults within the San Andres Fault system include the Hayward, Rodgers Creek, Calaveras, San Gregorio and Maacama faults.

Figure 4-5 Liquefaction Susceptibility in the Valley of the Moon Water District



Rodgers Creek Fault. The Rodgers Creek Fault is an active fault associated with the Santa Rosa Plain, in Sonoma County. It is considered the northern extension of the Hayward fault. It is a strike slip fault, measuring around 117 kilometers in length. The most notable earthquake activity along this fault took place in 1969 during the Santa Rosa Earthquakes. These were a magnitude 5.6 and 5.7 strikes early October of that year, in Santa Rosa County to the north of the District's Planning Area. The Rodgers Creek Faults is identified in the Sonoma County Water Agency's LHMP as the greatest potential for damaging the Water Agency's water infrastructure. According to the LHMP and Working Group on California Earthquake Probabilities (WGCEP) there is an estimated 33 percent probability of a major earthquake on the fault in the next 30 years (SCWA 2018).

The seismic hazards in the region are from large earthquakes occurring along these two regional faults that are also located near the Geysers Geothermal Field, located to the north of Sonoma Valley in the Geysers-Clear Lake area. This area covers approximately 45 square miles between Lake, Mendocino, and Sonoma counties. Based on studies conducted by USGS, activities associated with the withdrawal of steam for producing electric power have been shown to cause or induce small quakes to occur in the field (USGS No Date).

Magnitude/Severity

Catastrophic – Extent (meaning the severity of an earthquake) refers to the amount of energy released during an earthquake and is usually expressed in terms of intensity or magnitude. These metrics are measured directly from the earthquake as recorded on seismographs.

Intensity represents the observed effects of ground-shaking at any specified location, and earthquake shaking decreases with distance from the earthquake epicenter. Intensity is an expression of the amount of shaking at any given location on the ground surface based on felt or observed effects. Seismic shaking is typically the greatest cause of losses to structures during earthquakes. Intensity is measured with the Modified Mercalli Intensity (MMI) scale (see Table 4-9).

Magnitude represents the amount of seismic energy released at the hypocenter of an earthquake and is based on the amplitude of the earthquake waves recorded. Seismologists have developed several magnitude scales; one of the first was the Richter Scale, developed in 1932 by Dr. Charles F. Richter of the California Institute of Technology. The Moment Magnitude Scale is the current scale used to quantify the magnitude or strength of the seismic energy released by an earthquake.

Table 4-9 below compares magnitude and the felt effects associated with the MMI scale. Damage typically occurs in MMI of VII or above and is based the ground shaking potential shown on Figure 4-. The majority of the District is found in areas where spectral acceleration is expected to surpass the 70 percent g (or gravitational velocity); this means that there is a high probability of the District experiencing strong seismic movements in the next few decades.

Table 4-9: Magnitude and Mercalli Intensity Scale Measurements and Associated Characteristics

Magnitude	Mercalli Intensity	Effects	Frequency
Less than 2.0	I	Micro-earthquakes, not felt or rarely felt; recorded by seismographs.	Continual
2.0-2.9	I to II	Felt slightly by some people; damages to buildings.	Over 1M per year
3.0-3.9	II to IV	Often felt by people; rarely causes damage; shaking of indoor objects noticeable.	Over 100,000 per year
4.0-4.9	IV to VI	Noticeable shaking of indoor objects and rattling noises; felt by most people in the affected area; slightly felt outside; generally, no to minimal damage.	10K to 15K per year

Magnitude	Mercalli Intensity	Effects	Frequency
5.0-5.9	VI to VIII	Can cause damage of varying severity to poorly constructed buildings; at most, none to slight damage to all other buildings. Felt by everyone.	1K to 1,500 per year
6.0-6.9	VII to X	Damage to a moderate number of well-built structures in populated areas; earthquake-resistant structures survive with slight to moderate damage; poorly designed structures receive moderate to severe damage; felt in wider areas; up to hundreds of miles/kilometers from the epicenter; strong to violent shaking in epicentral area.	100 to 150 per year
7.0-7.9	VIII<	Causes damage to most buildings, some to partially or completely collapse or receive severe damage; well-designed structures are likely to receive damage; felt across great distances with major damage mostly limited to 250 km from epicenter.	10 to 20 per year
8.0-8.9	VIII<	Major damage to buildings, structures likely to be destroyed; will cause moderate to heavy damage to sturdy or earthquake-resistant buildings; damaging in large areas; felt in extremely large regions.	One per year
9.0 and Greater	VIII<	At or near total destruction - severe damage or collapse to all buildings; heavy damage and shaking extends to distant locations; permanent changes in ground topography.	One per 10-50 years

Source: USGS

Previous Occurrences

Earthquakes have occurred nearby the Planning Area in the past (within Sonoma County and adjacent areas). According to the USGS, a recent earthquake event of a magnitude of 6.0 took place near South Napa, approximately 10 miles east of the District's Planning Area. This event occurred the morning of August 24, 2014 and had a reported intensity of VII in the Mercalli scale. The earthquake was on the West Napa Fault, which was not mapped under the Alquist-Priolo earthquake fault hazard zone and was the largest event of this kind in the San Francisco Bay area since the 1989 Loma Prieta earthquake. The seismic activity of this event had an estimated 11.1 kilometers of depth. Thousands of structures across Sonoma County were damaged, and hundreds of people were injured during the quake across the affected areas in the County. One person was reported as being killed during the earthquake. Because of the extensive damages, the California Governor issued an emergency proclamation on August 24, 2014, and the U.S. President declared the incident a major disaster on September 11, 2014. Total economic losses were around $400 million, and state and federal assistance surpassed the $30 million mark. The Small Business Administration granted over $21 million in low-interest disaster loans to local businesses and other agencies affected by the event.

In 2014 a 6.0 magnitude earthquake occurred in the southern portion of the City of Napa on the West Napa Fault, approximately 10 miles east of the District's Planning Area The event was the largest earthquake in the San Francisco Bay Area since the 1989 Loma Prieta earthquake. Total damage in the southern Napa and Vallejo areas ranged from $362 million to $1 billion.
Photo Credit: LA Times 2014

Other major historic earthquake events in Sonoma County were listed in the Sonoma County LHMP:

- **Pre-1900:** In 1868 a magnitude 7.2 earthquake occurred on the Hayward Fault, and in 1898 a magnitude 6.7 earthquake occurred on the Rodgers Creek Fault. Little to no damage was reported from either event due to the significantly smaller population at that time.
- **1906 San Francisco Earthquake:** A magnitude 8.3 earthquake took place on the northern segment on the San Andreas Fault. San Francisco was devasted and major damages were reported in Santa Rosa, Sebastopol, Healdsburg and Petaluma.
- **1969 Rodgers Creek/Healdsburg Fault Earthquake:** Two earthquakes at the Rodgers Creek and Healdsburg Faults with magnitudes 5.6 and 5.7 occurred two miles north of Santa Rosa. Total building damage was estimated to be $6 million.
- **1989 Loma Prieta Earthquake:** This magnitude 6.9 earthquake occurred on California's Central Coast in October 1989. The shock was centered approximately 10 miles northeast of Santa Cruz on a section of the San Andreas Fault System. The earthquake was responsible for 63 deaths and 3,757 injuries.

Other recent earthquake events in the area include smaller magnitude earthquakes such as:

- A magnitude 2.8 earthquake with reported intensity of III, on December 24, 2017. This event's epicenter was about 6 kilometers west of Temelec, near Sonoma. The depth of the event was of 1 kilometer.
- A magnitude 2.7 earthquake with reported intensity of II, on November 17, 2013. The epicenter of this incident was about 5 kilometers east-southeast of Penngrove, north of Petaluma. The depth of the event was of 4.4 kilometers.

Probability of Future Occurrences

Likely – Given the information presented herein as well as recent earthquake activity history, earthquake hazards are expected to be a likely occurrence in the District's boundaries as well as in Sonoma County. It is estimated that similar seismic activity events may occur every 20 to 30 years in the Planning Area and the overall San Francisco Bay region (State of California Seismic Safety Commission).

In 2015 the USGS released an updated study of earthquake probabilities for faults in California using the Uniform California Earthquake Rupture Forecast 3 model. According to the study there is a 72 percent probability of one or more strong earthquakes (of magnitude 6.7 or greater) on one of the Bay Area Region before 2032. This is an increase from a 2008 USGS study that stated a probability of 63 percent. The San Andreas fault is estimated of having a 33 percent chance of rupturing and causing earthquake activity, though the Rodgers Creek fault system's probability has decreased to about 15 percent chance of rupture (Uniform Earthquake Rupture Forecast Version 3 2014).

Climate Change Considerations

While climate change is not expected to directly affect earthquake frequency or intensity it could exacerbate indirect or secondary impacts of earthquakes. For example, climate change could increase the frequency and intensity of extreme precipitation events, in turn increasing the probability of landslides and liquefaction events during an earthquake if the earthquake coincided with a wet cycle. Increased precipitation due to climate change would also result in increased frequency of landslide potential, as the added weight of rain-saturated soils on steeper hill slopes and the weakening of slopes caused by the pressure groundwater exerts on porous hillsides could trigger slope failure (SHMP 2018). Refer to Section 4.3.4 Landslide for more details on landslide hazards and potential changes due to climate change.

Vulnerability Assessment

Ground shaking is the primary hazard related to earthquake activity. Many factors affect the survivability of structures and water supply systems from earthquake-caused ground motions. These factors include

proximity to the fault, direction of rupture, epicentral location and depth, magnitude, local geologic and soils conditions, types and quality of construction, building configurations and heights, and comparable factors that relate to utility, transportation, and other network systems. Ground motions become structurally damaging when average peak accelerations reach 10 to 15 percent of gravity, average peak velocities reach 8 to 12 centimeters per second, and when the MMI Scale is about VII, which is considered to be very strong (general alarm; walls crack; plaster falls).

Fault rupture itself contributes very little to damage unless the structure or system element crosses the active fault, which is the case of the Sonoma Aqueduct because it crosses the Spring Valley Fault. Locally generated earthquake motions, even from very moderate events, tend to be more damaging to smaller buildings, especially those constructed of unreinforced masonry.

Other common impacts from earthquakes include damage to infrastructure and buildings (e.g., crumbling of unreinforced masonry, failure of architectural facades, rupturing of underground utilities, and road closures). Earthquakes also frequently trigger secondary hazards, such as dam and levee failures, flooding, and fires that can become disasters themselves.

Earthquake impacts to water district infrastructure occurred during the 2014 South Napa Earthquake. The surface fault rupture and ground shaking from the Magnitude 6.0 earthquake caused physical damages to City of Napa's water system including over 200 water leaks, significant damages to water storage tanks causing it to drain in addition to damages to roads and highways. In total the City's water system suffered over $6.4 million in damages (SCWA 2018).

FEMA's loss estimation software, Hazus-MH was used to analyze the District's vulnerability to earthquakes, at the census tract level for 6 tract units that cover the District's Planning Area. These census tract boundaries do not neatly line up with the District's Planning Area boundary, and as such a slightly larger area was assessed to include District's entire Planning Area. Because of these boundary differences, the damage and loss estimates may be slightly exaggerated, given the larger coverage of structures and population.

2,500-Year Probabilistic Earthquake Scenario

The 2,500-year probabilistic Level 1 Hazus-based earthquake scenario results include loss estimates for water distribution assets for the District. This methodology was selected to support the vulnerability assessment, as it is a national standard for modelling earthquake loss. To evaluate potential losses associated with earthquake activity in the Planning Area, a Hazus 2,500-year probabilistic scenario was modelled for the six census tracts that the District covers, using a driving Magnitude of 7.0 as the parameter that would simulate a strong earthquake. Due to these inputs, this 2,500-year scenario represents a worst-case level of shaking that considers multiple faults in the region. Hazus estimates the number of people displaced, the number of buildings damaged and their type (e.g. construction material, occupancy class), the number of causalities, and the damage to transportation systems and utilities (e.g. critical facilities and lifelines). This assessment was performed to model potential impacts to the District's water supply and distribution assets; therefore, only the impacts on water supply facilities and distribution pipelines are discussed in detail.

In addition to the Hazus analysis, GIS analysis was also conducted to understand the District's vulnerabilities to ground shaking and liquefaction susceptibility. Results of both types of analysis are discussed under the Critical Water Facilities and Infrastructure subsection.

Customers

All of Sonoma County and its population is vulnerable to earthquake activity. Residential customers account for nearly 80 percent of the water supplied from the District. Significant damages to the District's

water supply and distribution infrastructure or the Sonoma Aqueduct from ground shaking and liquefaction hazards would lead to significant downtime of the District's ability to operate key water storage facilities, booster pump stations, and in turn result in a long-term disruption to water delivered to customers. Power outages due to an earthquake event could also lead to delays in the District's ability to provide water supply services.

Critical Water Facilities and Infrastructure

Large seismic events could have catastrophic effects on the District's water supply and distribution infrastructure, as well as the Sonoma Water infrastructure that the District's depends on for water supply. These seismic events could possibly lead to damages to the District's water assets including damages to the access roads to reach infrastructure. According to the Hazus analysis 578 miles of potable water pipelines are estimated to experience 428 breaks and 1,713 leaks. Hazus estimates damage to potable water distribution lines resulting in $7.7 million dollars in economic loss in the area analyzed, a loss ratio of 41.4 percent when compared to the total system inventory. Table 4-10 and Table 4-11 were generated from HAZUS-MH reports and summarize the utility systems including potable water pipelines that are expected to suffer site specific damages.

Table 4-10: Expected Utility System Pipeline Damage by Mileage

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	578	1713	428
Wastewater	347	860	215
Natural Gas	231	295	74
Oil	0	0	0

Source: Hazus 4.0

Table 4-11: Expected Utility System Pipeline Damage by Value

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0	0	0
	Facilities	0	0	0
	Distribution Lines	$18.6M	$7.7M	41.39
	Subtotal	$18.6M	$7.7M	

Source: Hazus 4.0

Ground Shaking

Ground shaking is measured in terms of ground acceleration and is recorded as the peak ground acceleration (PGA) and reported as a fraction of the earth's gravitational acceleration (g). GIS overlay analysis was conducted for the District's assets' risk in relation to the two percent probability of occurrence in 50 years, per the USGS analyses of nearby fault (refer to Figure 4-). The entire District and assets are vulnerable to moderate to high ground shaking potential. In total, all 89 assets, including 20 pump stations, 18 water storage tanks, 10 turnout locations and 41 valves are vulnerable to ground shaking of at least 90 percent g. The Eldridge tanks, which store water from the Sonoma Aqueduct between the northern and southern portions of the District near South Glen Ellen are vulnerable to 105 percent spectral acceleration, the amount of shaking experienced by the infrastructure (USGS). The Sonoma Tanks, which serve the City of Sonoma are located in an area with 95 percent spectral acceleration. Damages to these tanks could lead to a re-distribution of the water supply from an alternate and back-up source. The results for assets vulnerable to ground shaking are shown in Table 4-12 below.

Table 4-12: District's Assets at Risk to 2 Percent Probability of Ground Shaking in 50 Years

% of Spectral Acceleration*	Asset Type	Count	Replacement Value
90%-100%	Pump	10	$17,600,000
	Tank	7	$16,000,000
	Valve	7	$350,000
	Total	**24**	**$33,950,000**
100% - 120%	Pump	5	$8,500,000
	Tank	8	$14,500,000
	Turnout Location	4	$1,000,000
	Valve	13	$275,000
	Total	**30**	**$24,275,000**
120%-140%	Pump	5	$9,100,000
	Tank	1	$2,000,000
	Turnout Location	6	$1,500,000
	Valve	21	$485,000
	Total	**33**	**$13,085,000**
140%-160%	Tank	2	$8,000,000
	Total	**2**	**$8,000,000**
	Grand Total	**89**	**$79,310,000**

Source: Valley of the Moon Water District, Wood analysis, USGS

Liquefaction

Severe ground shaking can lead to liquefaction to occur, the process of water-saturated sediment to temporarily loose strength and act as fluid (USGS). Sonoma Creek, which crosses through the center of the District's boundaries is identified in the Sonoma County Hazard Mitigation Plan as an area susceptible to liquefaction. Based on the GIS analysis conducted, a majority of District's assets (80 of the 89 assets) are located in areas considered to have low to very low risk to liquefaction. While 9 of the assets including 3 turnout locations and 6 valves with a total replacement value of $870,000 are considered to be at medium risk to liquefaction. The Sonoma Aqueduct was identified in the SCWA Hazard Mitigation as vulnerable to liquefaction due to locations where the aqueduct crosses creeks and streams as well as the Spring Valley Fault. According to the HMPC an interruption of the Sonoma Aqueduct due to an earthquake would result in major impacts on the Districts' ability to supply water to customers. Refer to Liquefaction Susceptibility

Liquefaction can be defined as the loss of soil strength or stiffness due to a buildup of pore-water pressure during a seismic event, and is associated primarily with relatively loose, saturated fine to medium-grained unconsolidated soils with shallow groundwater. Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. If this layer is at the surface, its effect is much like that of quicksand for any structure located on it. If the liquefied layer is in the subsurface, the material above it may slide laterally depending on the confinement of the unstable mass. Liquefaction is caused by a sudden temporary increase in pore-water pressure due to seismic densification or other displacement of submerged granular soils. Liquefiable soil conditions are most common in alluvial deposits in floodplains and coastal areas where the groundwater level is shallow (i.e. 50 feet or less below the surface). Bedrock units, due to their dense nature, are unlikely to present a liquefaction hazard.

According to the USGS Earthquake Hazards Program data for liquefaction susceptibility, there are several areas of liquefaction susceptibility in the District's Planning Area (see Figure 4-5). The majority of the District's Planning Area is in the medium to low liquefaction susceptibility zone, but there are some areas of high susceptibility (along Carriger Creek near Grove Street and east of Arnold Drive) within more severe

liquefaction susceptibility zones. The District depends on water conveyance from the Sonoma Aqueduct, which traverses areas of moderate to high liquefaction susceptibility zones (SCWA 2018).

Earthquakes can also lead to secondary hazards including flooding, building structure failure, debris flows, and fire (among others). The District is at risk of flooding from dam failure from the Suttonfield Dam to the north as well as risk of broken pipelines and critical infrastructure, such as the turnout locations in the eastern portion of the District's Planning Area boundary.

Faults

California is a seismically active area with numerous faults throughout the region. An active fault is defined by CGS as a fault that has had surface rupture or displacement within the last 11,000 years (Holocene times). This does not mean, however, that faults having no evidence of surface displacement within the last 11,000 years are necessarily inactive. Potentially active faults are those that have shown displacement within the last 1.8 million years (Quaternary period) but have not moved within the Holocene times. Any fault older than Pleistocene (>1.8 million years) is considered inactive and dormant. Although based on the history of fault movement and seismic activity in the area, it is known that the main faults posing risk to the District are the major faults within the San Andreas Fault system. According to the Working Group on California Earthquake Probabilities (WGEP) there is a very high probability (72 percent) of a major earthquake in the Bay Area in the next 30 years (SCWA 2018). The Rodgers Creek fault zone, one of the major faults within the San Andreas Fault system, is considered to be a major contributor to the high probability of future earthquakes. The Rodgers Creek fault is described in more detail under the Location subsection below.

Geographic Location

Extensive – The San Francisco Bay Area and Sonoma County are considered seismically active due to several major faults in the San Andreas Fault system. Notable faults adjacent to the District's Planning Area with the greatest potential of impacting the District's water supply facilities and infrastructure, are described in more detail below.

San Andreas Fault. The San Andreas Fault west of the District is a shallow fault and is considered the most active fault in California. It is expected to continue being the source of future earthquake activity in Sonoma County. The major faults within the San Andres Fault system include the Hayward, Rodgers Creek, Calaveras, San Gregorio and Maacama faults.

Figure 4- for the identified areas susceptible to potential liquefaction.

Seismic impacts on Sonoma Water's supply system, specifically the Warm Springs and Coyote Valley dams would be similar to those in the vulnerability assessment in Section 4.3.2 Dam Incidents. Both dams are close to major active faults. The Warm Springs dam is located near the Healdsburg fault, a northward extension of the Rodgers Creek fault. It is also near the Maacama fault. The Coyote Dam is located near the Maacama fault, as well as the San Andreas, Rodgers Creek, and Healdsburg faults. Several of the regional water agency's diversion facilities and Sonoma Aqueduct are also located in areas of moderate, high, and very high liquefaction potential and areas with high lateral spread hazards (Sonoma Water 2018). The Sonoma Aqueduct crosses the Spring Valley segment of the Bennet Valley fault zone and has an increased likelihood of failure in a surface rupturing event on this fault (Sonoma Water 2018). The most obvious locations are where diversion pipelines and aqueducts cross active faults, creeks, stream crossings, and other areas with high potential for lateral spread.

Historic, Cultural, and Natural Resources

An earthquake in the District's Planning Area or in the surrounding region could cause earthquake-induced landslides or debris flows could significantly damage habitat and re-route streams and waterways, causing water quality impacts. Other types of ground deformation could also result. The Russian River system, which is the primary source of water for Sonoma Water and the District is particularly vulnerable to liquefaction. According to the *2018 SCWA LHMP*, the aquifer beneath and adjacent to Russian River could lose its permeability during a major earthquake event resulting in compression or dilation of the aquifer (SCWA 2018). Aquifers can lose a significant amount of production capacity but generally recover in a short period of time. In addition to water supply from the Russian River through purchases from Sonoma Water, the District also depends on groundwater wells for water supply. Large earthquakes can lead to changes in groundwater levels through oscillation while seismic waves pass through, but specific impacts will depend on the geologic conditions of the well.

According to the *2016 Sonoma County Operational Area HMP*, it is likely that many historic structures in the County may be located in areas at risk of liquefaction including within the District's Planning Area. While some of these structures likely survived previous large earthquakes, it should not be assumed they will survive future events undamaged.

Future Development

Due to the District's proximity to the San Andreas and Rodgers Creek Fault it is likely a major earthquake would take place in the future. Future residential development is planned within the District's service area, with the potential for the most development within the SDC Campus. The location of future water distribution lines, tanks, valves and other water infrastructure should take liquefaction susceptibility and ground shaking into consideration in their design and placement.

Risk Summary

- The overall risk significance of earthquake hazards to the District is **High**.
- Earthquakes and seismic activity are expected to have a probability of occasional occurrence in the future, given the local seismic conditions, past history, and input from the District.
- Two earthquake faults of concern can affect the City: The San Andreas Fault and the Rodgers Creek Fault. Both are considered to be currently active and the fault that may lead to more damages or losses in the future.
- The majority of the Planning Area is found in moderate, high, or very high ground shaking susceptibility.

- The central portion of the District's Planning Area near the Sonoma Creek is considered to be in medium liquefaction zones.
- The Sonoma Aqueduct, which supplies a majority of the water for the District is considered to be highly vulnerable to surface fault rupture from the Spring Valley Fault and highly susceptible to liquefication in some areas.
- According to HAZUS, 578 miles of potable water pipelines are estimated to experience 428 breaks and 1,713 leaks after a Magnitude 7.0 earthquake. HAZUS also estimates a loss ratio of 41.4 percent of potable water distribution lines resulting in $7.7 million dollars in economic loss.

4.3.2 Wildfire

Hazard Description

Wildfires are any uncontrolled fires that occur most often on undeveloped land and require fire suppression. They are caused by lightning or by human-activities such as smoking, arson, equipment misuse, and from electrical infrastructure. Wildfires are a significant concern throughout California. In recent years wildfires have occurred in vegetated areas in the vicinity of the City of Sonoma and the District's Planning Area. Wildfires in surrounding areas, even a few counties away, can create significant impacts to the District's water supply and transmission systems. Generally, the fire season extends from August through October of each year during the hot, dry months, but fires can occur year-round. According to the 2018 Strategic Fire Plan, climate change has rendered the term "fire season" obsolete, as wildfires now burn on a year-round basis across the State (CAL FIRE 2018). Fire conditions arise from a combination of high temperatures, intense sunlight, low rainfall, an accumulation of vegetation, and high winds.

Throughout California, communities are increasingly concerned about wildfire safety as increased development in the foothills and mountain areas and subsequent fire control practices have affected the natural cycle of the ecosystem. While wildfire risk is predominantly associated with wildland-urban interface (WUI) areas, significant wildfires can also occur in heavily populated areas. The WUI is a general term that applies to development adjacent to landscapes that support wildfire.

Geographic Location

Extensive –Wildfires affect grass, forest, and brushlands, as well as any structures populations located within or surrounding them. Where there is human access to wildland areas the risk of fire increases due to a greater chance for human carelessness and historical fire management practices. In other areas, large concentrations of highly flammable brush and grasslands located in flat open spaces are also susceptible to wildfire. The California Department of Forestry and Fire Protection's (CAL FIRE) Fire and Resource Assessment Program (FRAP) models map wildfire hazards using a science-based approach and computerized techniques to classify moderate, high, and very high fire severity zones in a Fire Hazard Severity Zone (FHSZ) dataset. The model uses existing CAL FIRE data and hazard information based on fuel, weather, and terrain, explained in more detail in the Extent (Magnitude/Severity) section below.

Figure 4-6 displays the fire hazard severity zones falling within State Responsibility Areas, or SRAs, around the District. Figure 4-7 shows these hazard severity zones within Local Responsibility Areas, or LRAs, in and surrounding the District. Fire threat zones are displayed in Figure 4-8. These three maps provide general indications of potential future fire behavior as well as where fire occurrence might take place.

Figure 4-6 FHSZs in SRAs around the Valley of the Moon Water District

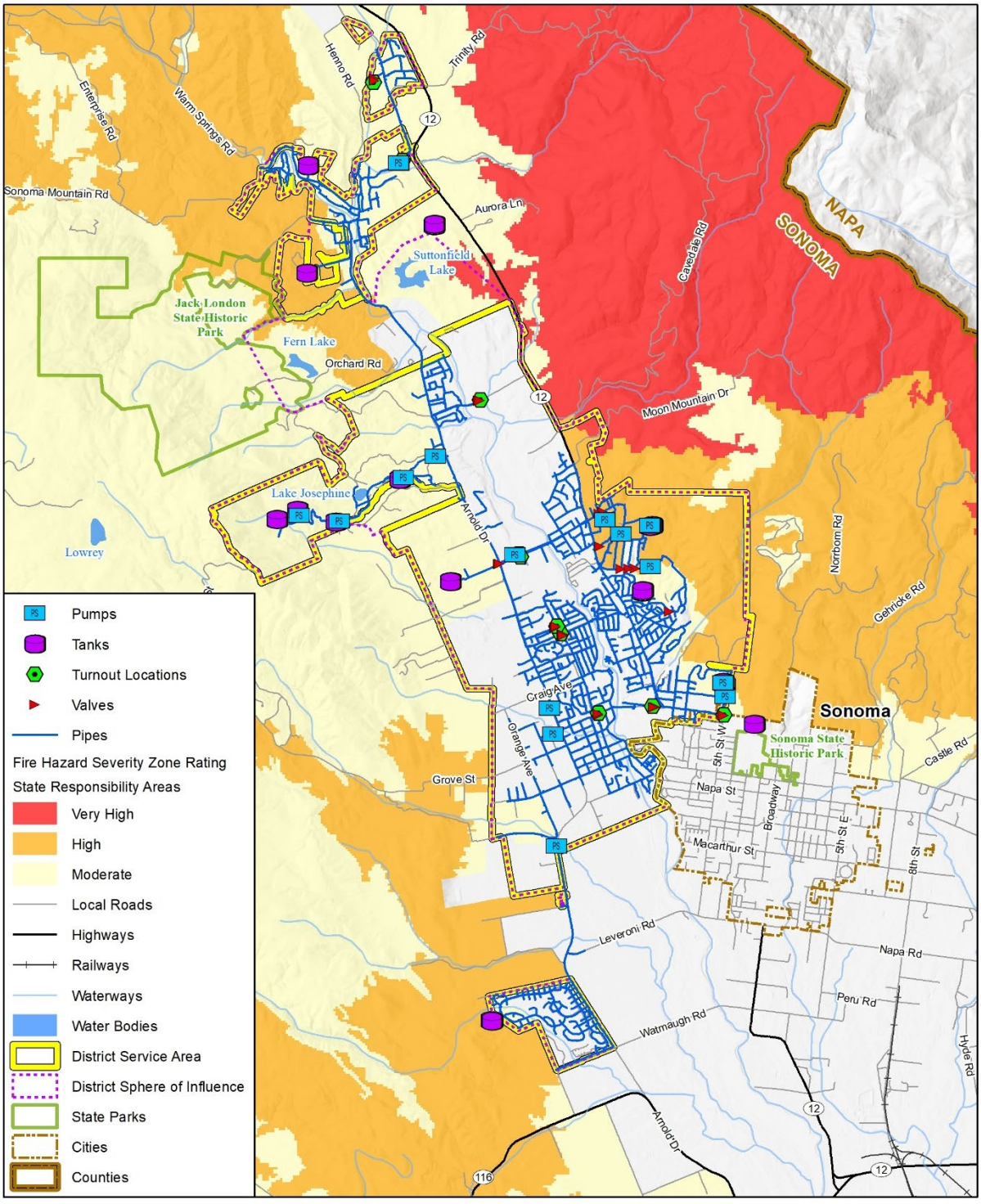


Figure 4-7 FHSZs in LRAs around the Valley of the Moon Water District

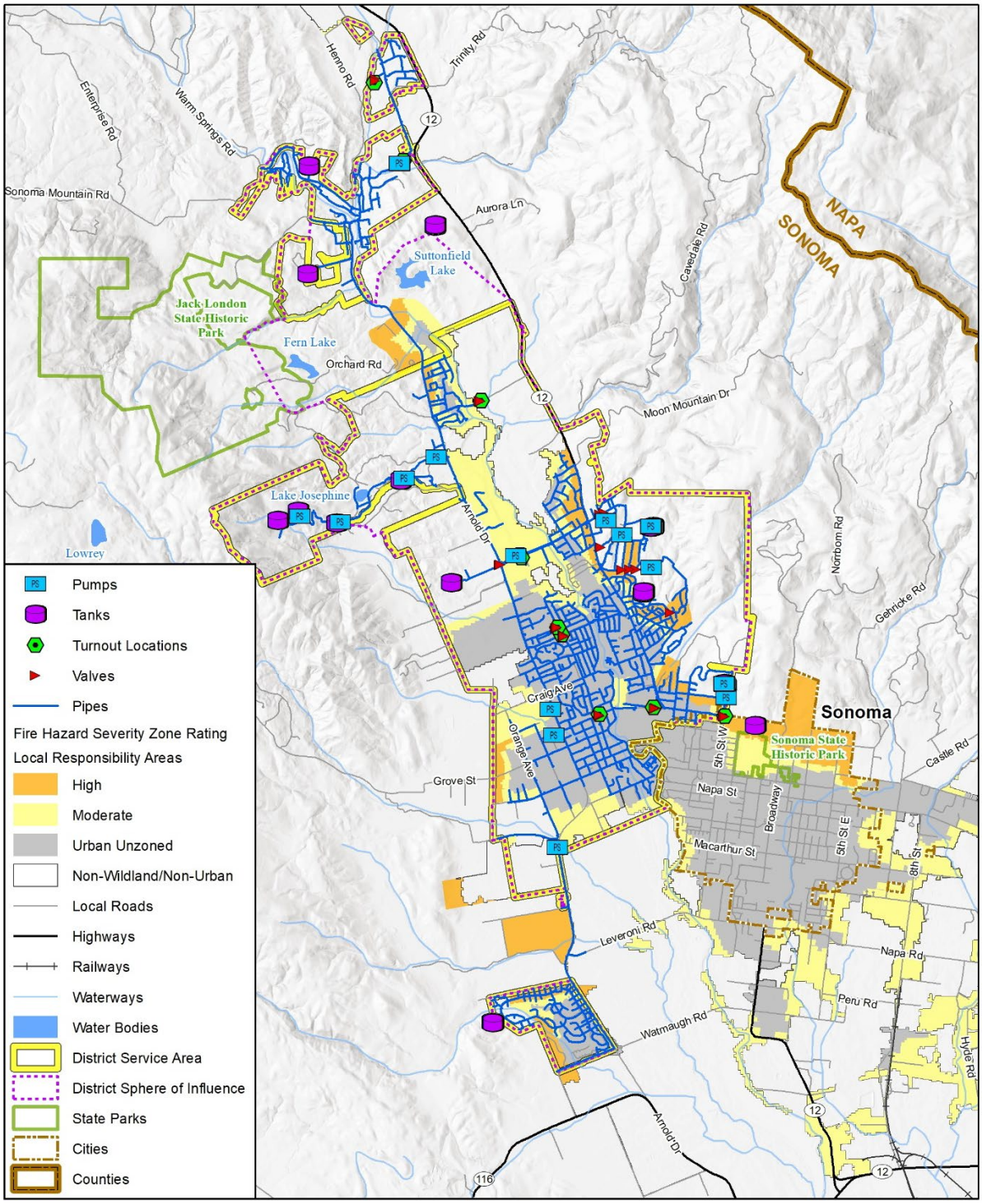
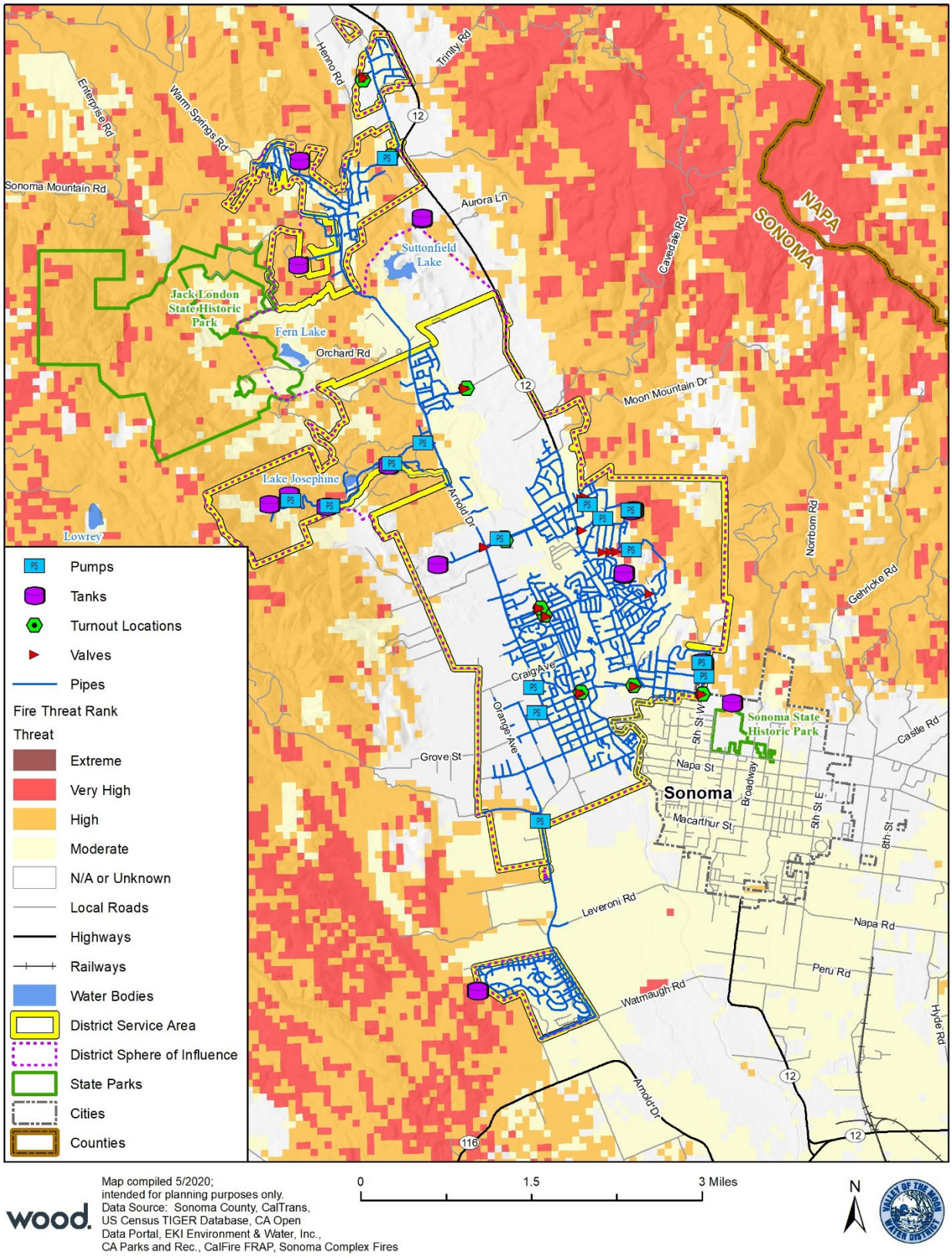


Figure 4-8 Fire Threat Zones in and near the Valley of the Moon Water District



The areas north and east of the District's boundaries show wildfire hazard areas based on fire threat data and the FHSZs mapped at both the SRA and LRA levels. Other potential areas of concern exist along the edges of the District boundary, on the western side where moderate and high severity zones intermingle.

Magnitude/Severity

Critical – Potential impacts from wildfires include damages to the District's facilities as well as the Sonoma Water's facilities that supply water to District, firefighting demands on water supply systems, residual impacts to water quality and erosion or sediment filling the Lake Sonoma Reservoir, and impacts to the community's way of life in Sonoma Valley. According to the HMPC there is currently not enough water for fire suppression because District's water infrastructure was designed to respond to urban fires, not wildland fires. In addition, catastrophic wildfires can create favorable conditions for other secondary hazards such as flooding, landslides, and erosion during the rainy season. Typically, the potential for significant damage to life and property exists in areas designated as "wildland-urban interface" areas, or WUIs, where development is adjacent to densely vegetated area.

There are three major factors that sustain wildfires and predict a given area's potential to burn. These factors are fuel, topography, and weather, as described below.

- **Fuel** - Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Manmade structures, such as homes and other associated combustibles are also fuel sources. The type of prevalent fuel directly influences the behavior of wildfire. Fuel is the only factor that is under human control. Fuel types within Sonoma County are diverse with redwood forest found throughout. The southern portion of the county where VOMWD is located is characterized by grasslands and oak woodland. East of the District boundary along the Napa County line is considered highly fire-prone nob cone pine and chaparral landscapes (Sonoma County 2017).
- **Topography** - An area's terrain and land slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.
- **Weather -** Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires, creating a situation where fuel will more readily ignite and burn more intensely. Thus, during periods of drought, the threat of wildfire increases. Weather in Sonoma County during the wildfire season tends to be warmer and drier during the day. Peak summer day temperatures can be between 80° and 108°F and relative humidity ranges between 10% and 35% (Sonoma County 2017). However, the climatological conditions proceeding the 2017 wildfires included above-normal temperatures during the summer and above-normal precipitation during the previous winter, which lead to abundant dry grass the provided fuel for the wind-drive wildfires (Mass et all 2019). Wind is the most treacherous weather factor. The greater a wind, the faster a fire will spread and the more intense it will be. Lightning can also ignite wildfires, often in difficult to reach areas for firefighters. Santa Ana winds, strong, dry north-east winds that occur during the fall months increases the likelihood and severity of wildfires across the state.

Overall, wildfire severity can usually be quantified in terms of acres burned during an event, number and cost of properties/structures damaged (including critical facilities), money lost from disruption of services, and population affected by the fires (e.g. people displaced, injured or killed).

Previous Occurrences

Wildfires are a significant concern throughout California. According to CAL FIRE, vegetation fires occur across California on a regular basis; most can be controlled and contained early with limited damage. The foothills and mountain areas of California have experienced numerous devastating fires over the last 100 years, with the fire risk significantly increasing in recent years due to high fuel loads and expansion of development into the WUI areas. For those ignitions that are not readily contained and become wildfires, damage can be extensive. There are many causes of wildfire, from naturally caused lightning fires to human-caused fires linked to activities such as smoking, campfires, debris burning, equipment use, and arson. Recent studies conclude that the greater the population density in an area, the greater the chance of an ignition from human sources, as well as powerlines or other electrical or utility infrastructure.

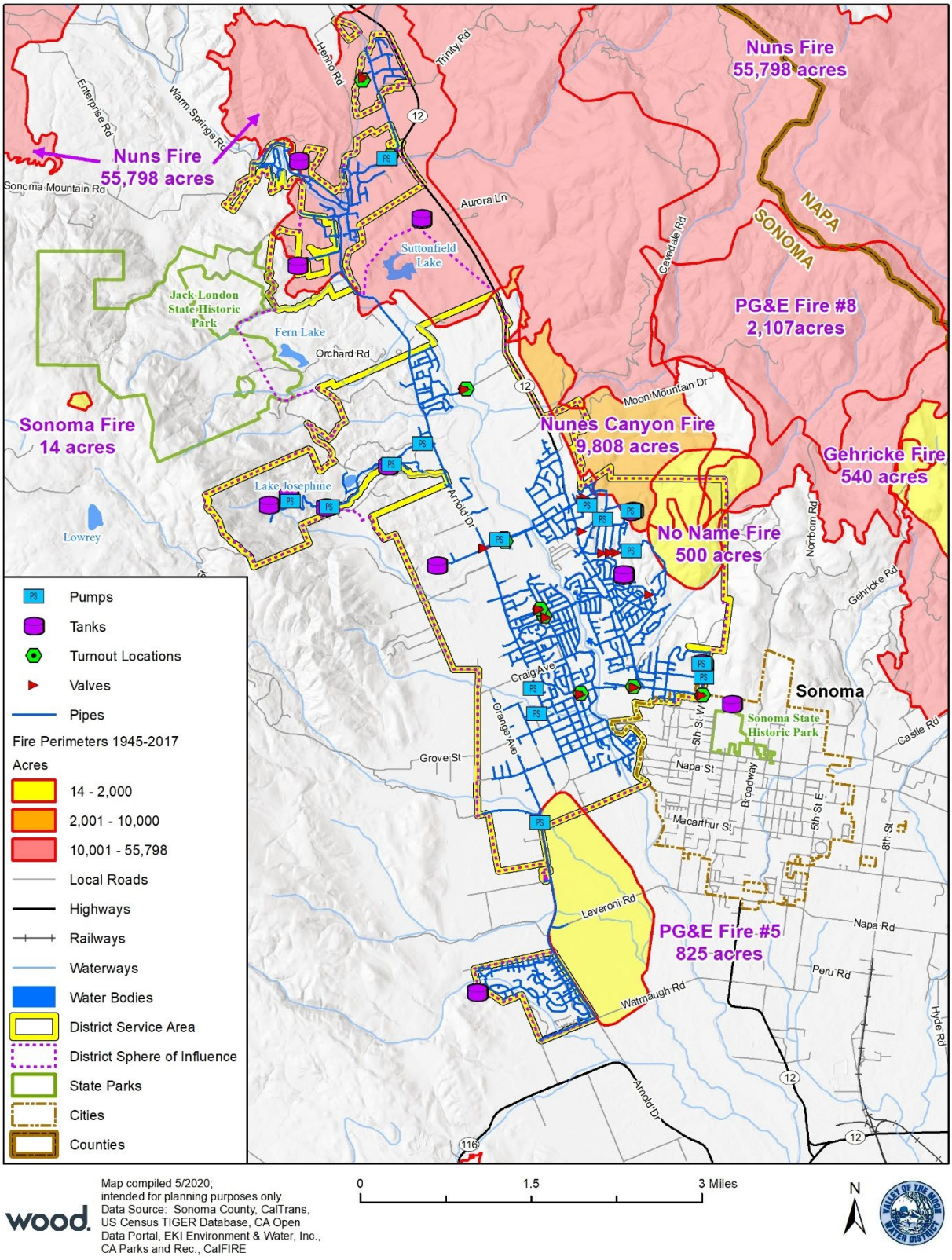
CAL FIRE has identified areas in Sonoma County as "historic wildland fire corridors" including repetitive fire losses in Sonoma Valley. Although not fully representative of annual fire activity, data from CAL FIRE supplemented with the Wildland Fire Occurrence databases from USGS (e.g. the Geospatial Multi-Agency Coordination, or GeoMAC) reported 7 fires affecting the vicinity of the District from 1945 to 2017. Table 4-13 below summarizes these fires that occurred around the Valley of the Moon Water District, while Figure 4-9 displays the fires that have occurred close to the District. The fires have been organized in chronological order, with the oldest fire taking place in 1945 and the most recent of record in October 2017. The Nuns Fire in 2017 had direct impacts on the District, destroying a water tank (Saddle Tank) and causing the Glen Ellen Tank to be drained to only three feet.

Table 4-13: Summary of Fire History near the Valley of the Moon Water District

Fire Name	Year	Cause of Fire	Acres Burned	Details/Agency in Charge
No Name	1945	Unknown / Unidentified	500	California Department of Forestry and Fire Protection
P.G.&E. #5	1961	Unknown / Unidentified	825	California Department of Forestry and Fire Protection
Nuns Canyon	1964	Unknown / Unidentified	9,808	California Department of Forestry and Fire Protection
Gehricke	1980	Unknown/ Unidentified	540	California Department of Forestry and Fire Protection
PG&E #8	1996	Unknown/ Unidentified	2,107	California Department of Forestry and Fire Protection
Sonoma	2017	Unknown/ Unidentified	14	California Department of Forestry and Fire Protection
Nuns	2017	Unknown / Unidentified	55,798	California Department of Forestry and Fire Protection

Source, CalFire 2019, USGS/BLM/BIA/FS/NPS (from Federal Wildland Fire Occurrence database, 2020)

Figure 4-9 Historical Fire Perimeters near the Valley of the Moon Water District, 1945-2017



Probability of Future Occurrences

Likely – Considering the local fuels, weather conditions, and the flat topography in the area combined with a lack of extensive WUI development means that fires may only occur occasionally in or immediately surrounding the District. A widely damaging wildland fire within the District's boundaries is considered to be more unlikely, although changing issues and increasing record-high temperatures accompanied by low humidity, strong winds, and drought conditions could worsen the likelihood of fires in the Planning Area in the future. Based on the CAL FIRE Probability and Carbon Accounting mapping, which is based on Mann et al.'s projections for the years 2026-2050 (shown on Figure 4- below), the annual probability of fire occurrence is low within most of the District. The northwest corner has a slightly higher probability. The areas west of the District's boundaries are considered to be 41 percent probability and greater in some areas.

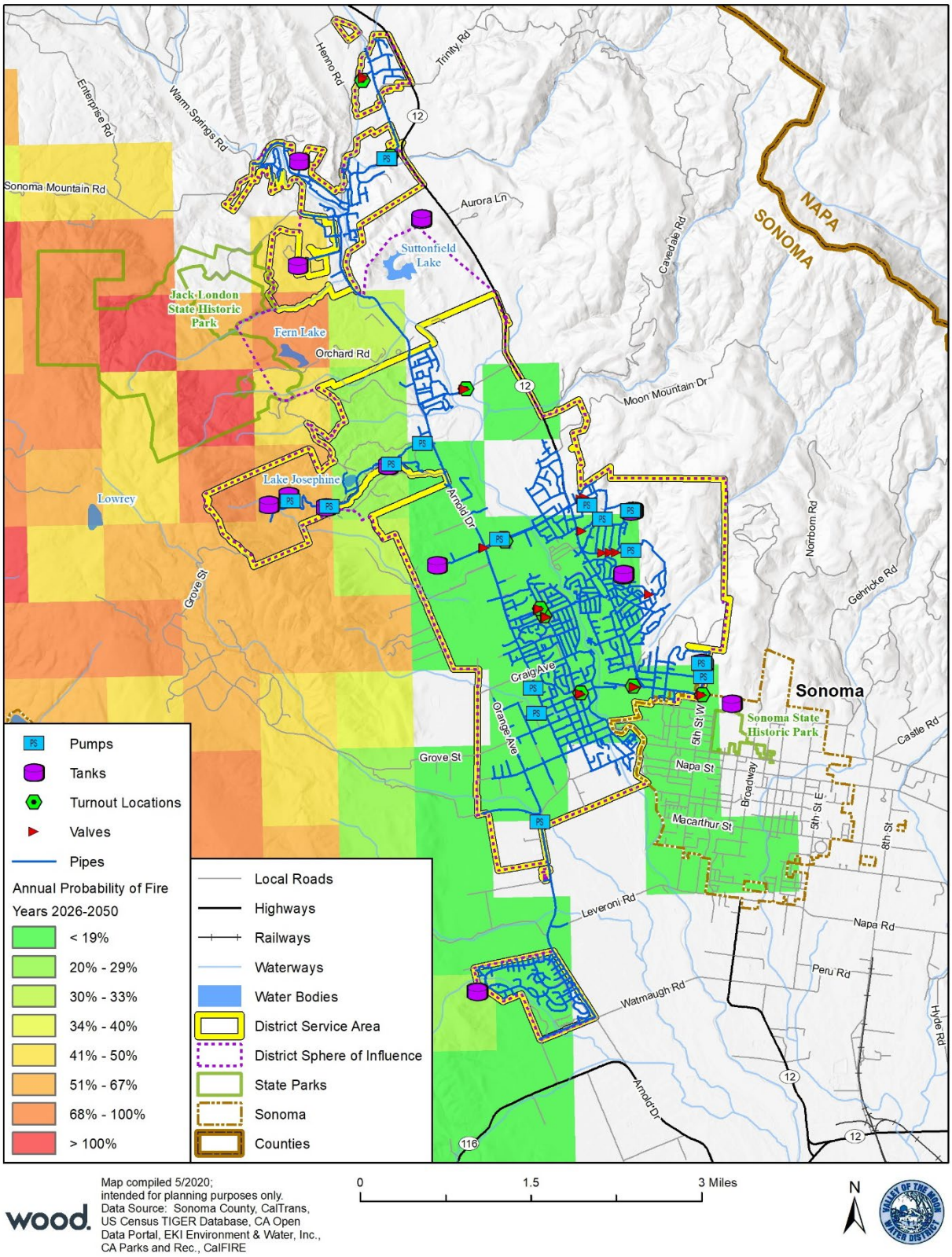
There are five District assets (2 pump stations and 3 tanks) that are located in areas with a greater than 50 percent probability of annual fire and a combined replacement value of $6,400,00. Refer to Figure 4-10 for the location of the vulnerable assets. Table 4-14 shows the breakdown the probability of assets vulnerable to annual fire events.

Table 4-14: Valley of the Moon Water District Assets Vulnerable to Annual Probability of Wildfire

Probability	Asset Type	Count	Replacement Value
51% -67%	Pump	2	$3,400,000
	Tank	3	$3,000,000
	Total	**5**	**$6,400,000**
41% - 50%	Tank	1	$2,000,000
	Total	**1**	**$2,000,000**
20%-29%	Tank	2	$8,000,000
	Pump	1	$1,700,000
	Valve	2	$2,050,000
	Total	**5**	**$11,750,000**
Less Than 19%	Pump	7	$11,900,000
	Tank	3	$8,000,000
	Turnout Location	7	$1,750,000
	Valve	28	$745,000
	Total	**45**	**$22,395,000**
Grand Total		**56**	**$42,545,000**

Source: EKI, Sonoma County, Cal FIRE, Wood analysis

Figure 4-10 Annual Wildfire Probability in the Valley of the Moon Water District, 2026-2050



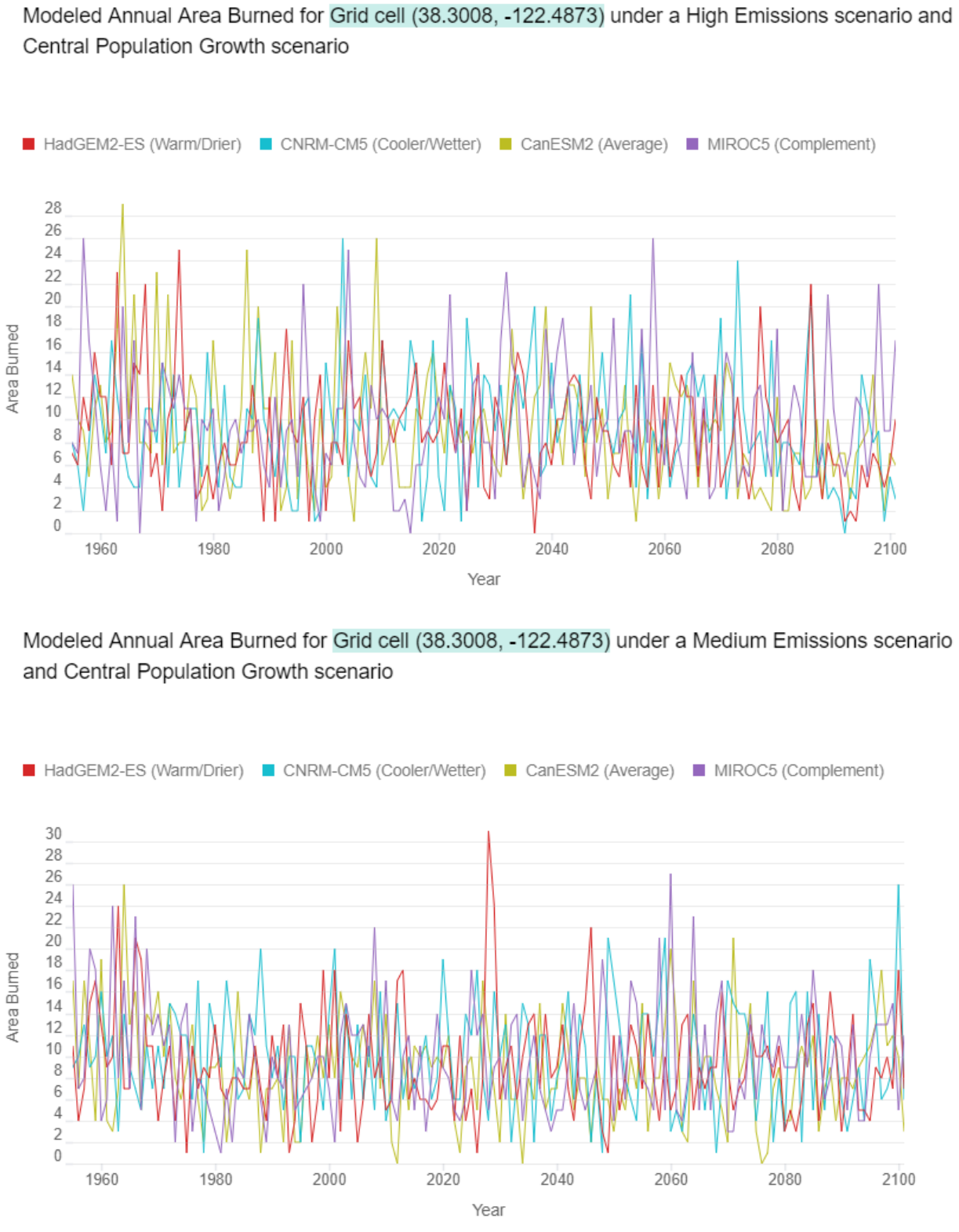
Climate Change Considerations

Increases in greenhouse gases coupled with population growth and development are expected to continue impacting California's forests and natural resources. Likewise, the effects of climate change will impact wildfire behavior, the frequency of ignitions, fire management, and fuel loads. Increasing temperatures will intensify wildfire threat and susceptibility to more frequent wildfires in the grasslands that surround the Planning Area, in addition to wildlands throughout Sonoma County.

Uncertainty exists in how climate change will affect total precipitation, but models suggest that there is a tendency for wetter conditions in the northern part of the state and drier conditions in the south (California Natural Resources Agency 2018). Forests are also sensitive to variable precipitation events, and damaging droughts, such as the multi-year event from 2012-2017 contributed to widespread tree mortality (e.g. Sudden Oak Death, etc.) as warmer temperatures stressed trees and made them more susceptible to pests and pathogens (California Natural Resources Agency 2018). Wildfire risk is expected to increase in the Sonoma region due to climate change increasing dry conditions, drought events and higher temperatures over a longer fire season (SCWA 2015). Studies noted in California's Fourth Assessment report indicate climate change impacts on wind patterns may strongly affect forests, potentially serving as a trigger mechanism for conversion of forest to other types of vegetation (California Natural Resources Agency 2018).

Cal-Adapt conducted wildfire risk projections based on statistical modeling from historical data of climate, vegetation, population density, and fire history. The wildfire risk simulations were used in California's Fourth Climate Change Assessment and based on four models that produced a warm/dry simulation (HadGEM2-ES), cooler/wetter simulation (CNRM-CM5), average simulation (CanESM2), and a simulation that is most unlike the first three for the best coverage of different possibilities (MIROC5). These wildfire risk simulations are shown in Figure 4-11. The upper chart shows the modeled annual averages of area burned in the District under the RCP 8.5 scenario, while the lower chart shows modeled annual averages of area burned for the District under the RCP 4.5 scenario.

Figure 4-11 Future Annual Averages of Acres Burned in the Valley of the Moon Water District under Low and High Emission Scenarios



Source: Cal-Adapt 2020

According to the Sonoma County's 2016 Regional Community Action Plan (CAP), climate change is expected to result in more frequent and intense wildfires. These risks are expected to continue to rise due to increased dryness of vegetation compounded by the productivity of plants in the spring. Based on the Regional CAP data, by the end of the century, the chances of one or more fires during a 30-year period are projected to increase from 15 to 20 percent to 25 to 33 percent in the mountainous areas of the County. As previously noted, this finding on more frequent and intense wildfire risk was made before the Sonoma County firestorms in 2017, 2018, and 2020. Taken into consideration the wildfire activity that occurred in the past five years in the County, the frequency and severity of wildfires has greatly increased and this future wildfire projection from the County's CAP is expected to also increase.

While the CAL FIRE program actively collaborates with state, local, and national agencies to reduce climate change impacts, current scientific models expect California will be affected by increased numbers of forest fires with added intensity due to longer warmer seasons, reduced distribution of biodiversity, lack of moisture, changes in ecosystems, drought impacts (e.g. pest diseases and continued spread of invasive species), and other such impacts in coming years. Due to these increasingly worsening and recurring issues, wildfire hazards should be carefully studied by the District with regards to future negative effects in or near the District Planning Area related to wildfire risk. For these reasons, climate change would have a "high" influence on wildfire hazards.

Vulnerability Assessment

The District's wildfire risk and vulnerability is a medium concern. Wildfire can also damage or destroy property and infrastructure, injure people or even cause death. During the August to October fire season, the dry vegetation and hot sometimes windy weather, combined with a growing population, results in an increase in the number of potential ignitions. Any fire, once ignited, has the potential to quickly become a large, out-of-control fire. Fires that prevent the District's ability to access its infrastructure could negatively affect local residents and businesses as well as fire departments that depend on the District's supply for fire suppression, impacting the community's overall livelihood.

The Walbridge Fire in northern Sonoma County started on August 17, 2020. It burned 55,209 acres west of Healdsburg within Dry Creek Valley. The smoke contributed to several weeks of extremely poor air quality in Sonoma Valley and the surrounding Bay Area. The Walbridge Fire was part of the larger LNU Lightning Complex Fire that contained the Hennessey, Gamble, 15-10, Spanish, Markley, 13-4, and 11-16 fires, which spread across five counties to the east and burned approximately 363,220 acres. During the same time, parts of Sonoma Valley were without electricity due to planned power shutoffs.
Photo Credit: John Burgess/The Press Democrat 2020

The CAL FIRE-produced FHSZs within LRAs and SRAs displayed in Figure 4-12 and 4-13, were used to assess general wildfire risk in the Planning Area. The District's asset inventory was used to identify the locations of each asset and overlaid with the CAL FIRE FHSZs in LRAs, ranked by severity to determine general risk based on the severity rank categorization, all in GIS. Through this process each asset was identified as either "in" a fire threat layer of type "moderate severity," "high severity," or "very high severity," or "out" of any of these fire threat categories (e.g. in Urban Unzoned or Non-Wildland/Non-Urban areas). Assets falling in the FHSZs are listed in Table 4-15 along with a summary of all replacement values. Using a similar methodology, assets at risk to wildfire in SRAs were also analyzed. Both analyses are shown in Figure 4- above, which illustrates the areas surrounding the District pose a moderate to very high threat.

Customers

Wildfires near the Russian River in northwestern Sonoma County could directly impact the water quality in Lake Sonoma, the main supply for the Russian River, which could significantly impact Sonoma Water's ability to supply water to District. In addition to threatening the water supply and quality for the District's customers, potential impacts to communication lines and electrical power utilities during wildfires could hinder the District's ability to use pumping facilities (e.g. BPS) leading to disruptions in services to customers as well as limited fire suppression. The District's water supply is also used by the Sonoma Valley and Glen Ellen Fire Departments to use in fire suppression. Further, the District's infrastructure is primarily designed to supply water for firefighting to respond to urban fires and was not designed to handle wildfires.

Critical Water Facilities and Infrastructure

Damages to the water supply and distribution assets could have significant impacts on the District's ability to serve customers. The fire threat for the District, as shown in Figure 4- ranges from moderate to very high. In total 57 of the Districts assets and replacement value of $58,040,000, are located within these fire threat areas. Two water tanks, Temelec 1 and Temelec 2, are both located in very high threat areas. The District has a history of being directly impacted by wildfires. During the October 2017 Sonoma Fires the District's Saddle Tank was destroyed by the fire (EKI 2018). The Glen Ellen Tank, in the northeast portion of the District is also located in a high fire threat area, and experienced direct damages in 2017, draining it to only 3 feet. The Sonoma Aqueduct, while not a District owned asset, is surrounded by areas of moderate to very high fire threat. Further, any impacts to the Sonoma Aqueduct would directly impact the District's ability supply water to customers, particularly given the limited back-up water supply.

Table 4-15 shows the results of the GIS analysis conducted to understand the District's assets vulnerability to wildfire.

Table 4-15: Fire Threat to Valley of the Moon Water District Assets

Fire Threat	Asset Type	Count	Replacement Value
Very High	Tank	2	$8,000,000
	Total	**2**	**$8,000,000**
High	Pump	9	$16,700,000
	Tank	10	$16,500,000
	Valve	2	$100,000
	Total	**21**	**$33,300,000**
Moderate	Pump	7	$11,100,000
	Tank	2	$4,000,000
	Turnout Location	4	$1,000,000
	Valve	21	$640,000
	Total	**34**	**$16,740,000**
Grand Total		**57**	**$58,040,000**

Source: EKI, Sonoma County, Cal FIRE, Wood analysis

The FHSZs and asset overlay analysis described above yielded the following results. In total there are 42 assets that fall within the LRAs, a majority (18) are located in the "urban unzoned" area, as shown in Table 4-16. In terms of SRAs, 47 assets are located in areas with state responsibility as listed in Table 4-17. Refer to Figures 4-12 and 4-13 for locations of each asset.

Table 4-16: Assets in Fire Hazard Severity Zones within Local Responsibility Areas

Fire Threat	Asset Type	Count	Replacement Value
High	Tank	1	$4,000,000
	Turnout Location	1	$250,000
	Valve	7	$260,000
	Total	**9**	**$4,510,000**
Moderate	Pump	1	$1,700,000
	Turnout Location	2	$500,000
	Valve	7	$170,000
	Total	**10**	**$2,370,000**
Urban Unzoned	Pump	2	$4,000,000
	Turnout Location	4	$1,000,000
	Valve	12	$240,000
	Total	**18**	**$5,240,000**
Non-Wildland Non-Urban	Pump	1	$1,700,000
	Turnout Location	1	$250,000
	Valve	3	$60,000
	Total	**5**	**$2,010,000**
	Grand Total	**42**	**$14,130,000**

Source: EKI, Sonoma County, Cal FIRE, Wood analysis

Table 4-17: Assets in Fire Hazard Severity Zones within State Responsibility Areas

Fire Threat	Asset Type	Count	Replacement Value
High	Pump	5	$9,500,000
	Tank	5	$14,000,000
	Valve	3	$150,000
	Total	**13**	**$23,650,000**
Moderate	Pump	11	$18,300,000
	Tank	12	$22,500,000
	Turnout Location	2	$500,000
	Valve	9	$230,000
	Total	**34**	**$41,530,000**
	Grand Total	**47**	**$65,180,000**

Source: EKI, Sonoma County, Cal FIRE, Wood analysis

A wildfire in the Russian River system could also result in cascading impacts on Sonoma Water's ability to provide drinking water to its service area and to the District. The intense heat of wildfire could modify the soil structure, which may result in hydrophobic soils that do not allow rainfall to infiltrate into the ground, which may result in increased runoff. These soil types, in combination with the lack of tree canopy and the relative slope around each reservoir (Lake Sonoma and Lake Mendocino) would increase runoff and erosion into the water supply system. Increased erosion would result in property loss, mobilize nutrients, create turbidity, reduce storage, and could potentially deposit debris in the riverbed causing flooding. This vulnerability could be further exacerbated by increased frequency of drought and flooding as a result of climate change (Sonoma Water 2018). Increased turbidity in the Russian River as a result of wildfires could also decrease overall water quality, which could potentially impact the diversion system. There is minimal

vulnerability to Sonoma Aqueduct from fire because the piping is buried and constructed of fire-resistant materials consisting of mostly steel and concrete.

Historic, Cultural, and Natural Resources

A wildfire event near the Russian River would significantly impact the Sonoma Water's ability to supply water to District. Post-fire sedimentation or landslides into Lake Sonoma, the main supply for the Russian River and the District would impact the Lake's water quality due to the increased sediment, dissolved organic carbon, metals and nutrients to waterways (SCWA 2018). In addition to threatening the water supply and quality for the District's customers, it could also impact the habitat, as well as potential impacts to the endangered and threated species in the watershed.

Future Development

The District and its customers are likely to continue to be impacted by wildfire events in the County in the future. The District's ability to be able to continue to supply water during a wildfire event or power outages due to wildfire risk should be taken into consideration by developers and the County, and during the planning process for the *Sonoma Development Center Specific Plan*. The location of future water storage tanks and other water infrastructure should also take fire threat and vulnerability into consideration in their design and placement.

Risk Summary

- The overall risk significance of wildfire hazards to the Valley of the Moon Water District is **High.**
- The level of wildfire risk will likely increase in the future due to the effects of climate change, and as the District assesses and monitors the level of risk, they will adjust the emergency preparedness and hazard mitigation efforts accordingly.
- Wildfires are expected to have a probability of occasional occurrence in the future, given the local fuel, topography, and weather conditions and the extent of the WUI. Based on recent CAL FIRE future fire occurrence probability mapping, portions of the District are expected to have a moderate to high likelihood of fire from years 2026 to 2050.
- The fire threat for the District ranges from moderate to very high and a total of 57 of the District's critical water assets with a replacement value of $58,040,000, are located within these fire threat areas, including two water tanks, which are both located in very high threat areas.
- Wildfires could cause post-fire sedimentation or landslides into Lake Sonoma, a main source of water supply for the District, which could have devasting impacts on water quality and the Sonoma Water's ability to supply water to the District.

4.3.3 Drought and Water Supply

Hazard Description

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, many times over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Drought is a complex issue involving many factors; it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its causes or effects:

- **Meteorological** drought is usually defined by a period of below average water supply.

- **Agricultural** drought occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- **Hydrological** drought is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.
- **Socioeconomic** drought occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

The California DWR says the following about drought:

> "One dry year does not normally constitute a drought in California. California's extensive system of water supply infrastructure—its reservoirs, groundwater basins, and inter-regional conveyance facilities—mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Hydrologic conditions constituting a drought for water users in one location may not constitute a drought for water users elsewhere, or for water users having a different water supply. Individual water suppliers may use criteria such as rainfall/runoff, amount of water in storage, or expected supply from a water wholesaler to define their water supply conditions."

The drought issue in California is further compounded by water rights. Water is a commodity possessed under a variety of legal doctrines. The prioritization of water rights between farming and federally protected fish habitats in California is part of this issue.

Drought impacts are wide-reaching and may be economic, environmental, or societal. Also, during a drought, allocations go down and water costs increase, which results in reduced water availability. Voluntary water conservation measures are typically implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding. Droughts can also increase wildfire risk.

Geographic Location

Extensive – Drought is a regional hazard, and during severe drought conditions, it can affect the entire state of California with varying levels of dryness. In other words, drought affects all aspects of the economy and environment and the community simultaneously. The most significant impacts associated with drought on the District are those related to water supply and water use intensive activities, such as municipal water use, agricultural use, tourism, recreation, and wildfire protection. According to the District's WMP and UWMP, the District obtains its water from a mix of sources including water from the Russian River purchased from the Sonoma Water, recycled water, and groundwater production (VOMWD 2019; VOMWD 2015).

As previously mentioned, the District, along with nine other cities and special districts in Sonoma and Marin County, has a water supply agreement with Sonoma Water for the purchase of Russian River water. Sonoma Water purchases represent an average of 80 percent of District's total water production over the last eight years. This water is delivered to the District through the Sonoma Aqueduct. The District's remaining water is supplied by six groundwater wells that are owned and operated by the District. The District also conserves water supplies through a standard management program and practices.

Historical water use is based on total annual SCWA water purchases and local groundwater production. Total potable water use in 2015 was 2,528 acre-feet and in 2017 was 2,415 acre-feet. According to the 2019 WMP, potable water use has generally decreased over the past 20 years even though there has been steady and slow population growth in Sonoma Valley (as described in Section 2.7), although significant variations have occurred from year to year and are believed to be associated with changing hydrologic

and economic conditions. Water demand was also suppressed during drought years due to water conservation that occurred in response to the drought of 2012 through 2015 that included "demand hardening" as a result of new plumbing standards, drought and conservation incentives, lawn removal, and toilet and appliance upgrades. Between 2015 and 2020 the District's potable water demand increased by approximately 19 percent. This increase reflects a potential rebound from the multi-year drought. This historical water demand in 2015 and 2020 and projected acre-feet water use through 2030 and 2040 are summarized in Table 4-18.

Table 4-18: Valley of the Moon Water District Current Water Use and Projected Availability through 2040

Water Use	2015 Historical Water Demand (acre-feet)	2020 Projected Water Demand (acre-feet)	2030 Projected Water Demand (acre-feet)	2040 Projected Water Demand (acre-feet)
Single Family	1,547	1,878	1,871	1,874
Multi-Family	456	533	522	518
Commercial	175	202	205	207
Landscape	41	54	56	57
Institutional/Governmental	80	103	106	109
Losses	229	352	353	252
TOTAL	**2,528 acre-feet**	**3,121 acre-feet**	**3,111 acre-feet**	**3,117 acre-feet**

Sources: Water System Master Plan 2019; Urban Water Management Plan 2015

Notes:
1. One Acre-Foot = 43,560 cubic feet.
2. Losses are the total differential between water supply and metered water use.

Water use in the District's service area is predominantly associated with residential use. Residential customers account for approximately 79 percent of the total water deliveries in 2017, with single-family residential use accounting for 61 percent and multi-family residential use accounting for 18 percent. Commercial and institutional accounts represent 7 percent and 3 percent of total use, respectively and include agricultural customers in Sonoma Valley. Irrigation accounts account for the smallest percentage of water deliveries at less than 2 percent of total (VOMWD 2016).

Sustainable Groundwater Management Act of 2014

Groundwater resources plays a significant role in the development, growth, and sustainability of the Sonoma Valley. Groundwater is the primary source for domestic and agricultural use by rural property owners in the Sonoma Valley Basin, while urban water supply to the District is primarily imported from Russian River surface water. The residents of Sonoma Valley and all of California have been experiencing significant drought and water shortages since 2011 and only recently did the District and the majority of the state come out of drought. In January 2014 the Governor declared an emergency proclamation due to multiple years of drought. The proclamation called on citizens to reduce water use by 20 percent; with a subsequent executive order that directed urban water agencies to reduce water use by 25 percent. In September 2014, the Governor signed a three-bill package (California Senate Bills 1168 and 1319, and Assembly Bill 1739), known as the Sustainable Groundwater Management Act of 2014 (SGMA). The SGMA establishes local Groundwater Sustainability Agencies (GSAs) to manage groundwater sustainability within the groundwater sub-basins defined by DWR.

There are three GSAs in Sonoma County: Santa Rosa Plain, Sonoma Valley, and the Petaluma Valley. The Sonoma Valley Groundwater Subbasin spans 44,000 acres within the San Francisco Bay Hydrologic Region. It is bound on the west by the Sonoma Mountains and the east by the Mayacamas Mountains. It extends from San Pablo Bay northward to about two miles south of the town of Kenwood and incorporates the City of Sonoma and the communities of El Verano, Boyes Hot Springs, and Glen Ellen.

Sonoma Creek drains the Subbsain, which is tidally influenced from approximately Schellville downstream to the mouth at San Pablo Bay.

Groundwater produced from wells located in the Sonoma Valley Subbasin represents the largest source of water supply utilized in Sonoma Valley (nearly two-thirds of all water demands are estimated to be met by local groundwater for the Subbasin and contributing watershed areas (Sonoma Water 2014). Groundwater represents the primary, or in some cases only available, source of supply for agriculture, rural residents, mutual water companies, irrigated park lands, golf courses, and other commercial businesses located outside of the City of Sonoma and the District service area. Local groundwater also represents an important supplemental source of supply for both the City of Sonoma and the District, which operate municipal wellfields within the Subbasin and contributing watershed areas.

Groundwater levels within Sonoma Valley's shallow aquifers are generally steady, although localized declining trends have been observed in the El Verano/Fowler Creek area (SVGSP 2020). Deep zone aquifers have also declined over the past decade, and do not recover during wet years according to monitoring wells and stream level observations. These chronic declines indicate that groundwater withdrawals are occurring at a higher rate than recharge or replenishment (SVGSP 2020). Groundwater quality is generally good within Sonoma Valley. However, wells in southern Sonoma Valley (generally south of Highway 116) have been affected by brackish or salty groundwater. If groundwater levels continue to drop in the north, brackish water could be drawn further north, potentially affecting more northern wells and rendering groundwater unusable (SVGSP 2020).

Magnitude/Severity

Critical – Magnitude can be measured according to a scale developed by the United States Drought Monitor, which measures drought in five categories: "abnormally dry," "moderately dry," "severely dry," "extremely dry," and "exceptionally dry". The District is vulnerable to all levels of drought, which are further subject to the effects of climate change, precipitation trends, and wet and dry periods. Drought can have a widespread impact on the environment and economy in the Planning Area, but it typically does not result in loss of life or damage to property. Rather drought may have an impact on agriculture, business, and the movement of goods and services related to agricultural, commodities, tourism and recreation, and water supply sectors.

Given that the District's water users fall within the categories of residential (79 percent of water users) and commercial and institutional (non-residential represents 21 percent of water users), it can be assumed that three main factors have an effect on water demands: climatic, demographic, and economic. These are described below and are expected to influence water demands in the future, as they have in the past.

- **Climatic.** The weather in Sonoma Valley is mild with distinct wet and dry seasons and a mean annual temperature of 70 degrees Fahrenheit. Average annual precipitation is about 28 inches based observed data from a climate station located near the General Vallejo Home State Park near the City of Sonoma. Climate has the most dramatic annual effect on water demands, and severe deviations from normal temperatures and average rainfall can increase or decrease annual water demands. Although the District's water supply doesn't fully rely on surface water sources, precipitation shortages can have negative effects on what the District receives from and can process for potable and other key uses.
- **Demographic**. Since water use is related to demographics and population change, an accurate description of population and housing stock in the service area serves as a basis for water planning activities described in the District's 2015 UWMP or other planning mechanisms. According the District's 2015 UWMP, the District's customer base was 23,782 in 2015. This population estimate was obtained by compiling population estimates from the 2010 Census for each Census Block contained in the District's service area. This population estimate was then compared to the total number of

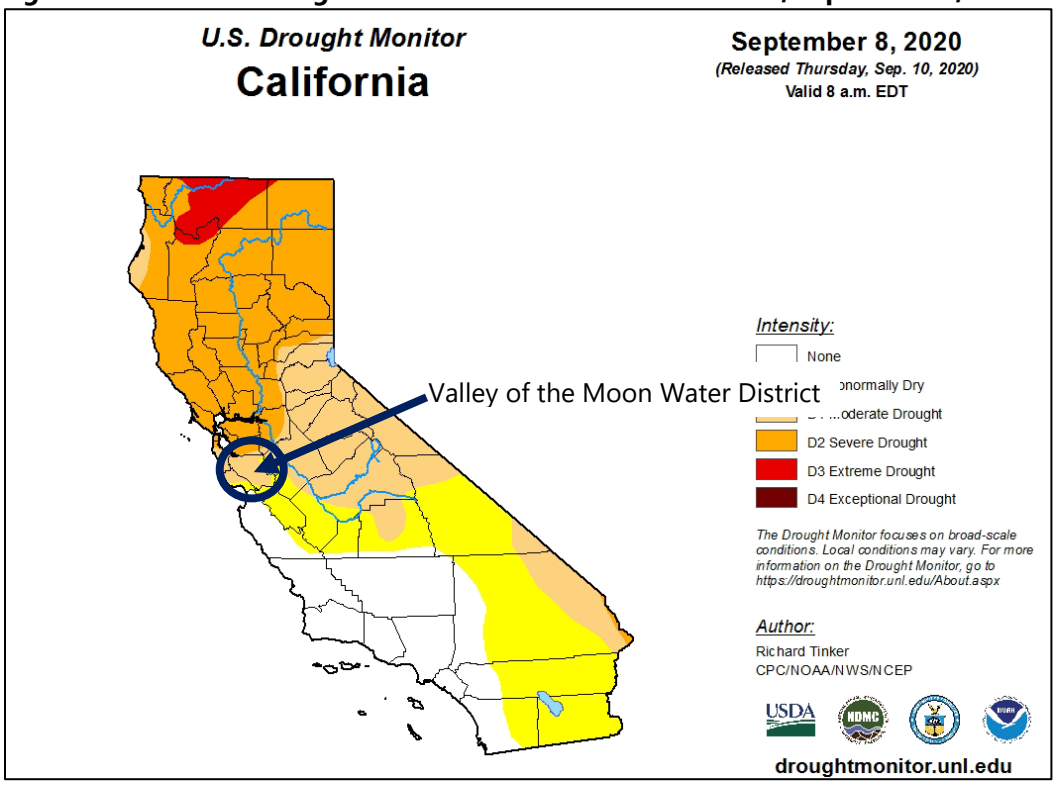
service connections in 2010 (6,841) to determine the number of persons per connection (3,455). This persons-per-connection factor for the most recent Census year was then multiplied by the number of service connections in 2015 (6,884) to estimate the service area population. Population projections for the District summarized in the 2015 UWMP indicate an increase to 24,873 in 2020 and an increase to 26,300 by 2040, or an increase of about 8 percent (UWMP 2016).

- **Economic.** Commercial water users have the second highest water demand after residential users (both single family and multi-family). According to the District's 2015 UWMP, commercial water users demand for potable and raw water is projected to increase from a volume of 175 acre-feet to 207 acre-feet by 2040. Although agricultural areas are within the District's Planning Area, the District does not currently supply water to these areas but does have plans to expand services in the future.

The magnitude or severity of a drought across the District could vary and is difficult to predict. However, understanding the total population affected as well as economy and resources vulnerable provides insight on how to estimate potential losses and damages to the District's assets; drought related information can be obtained and measured from the National Drought Mitigation Center's Impact Reporter and Drought Monitor tools (United States Drought Monitor 2018; United States Drought Impact Reporter 2018).

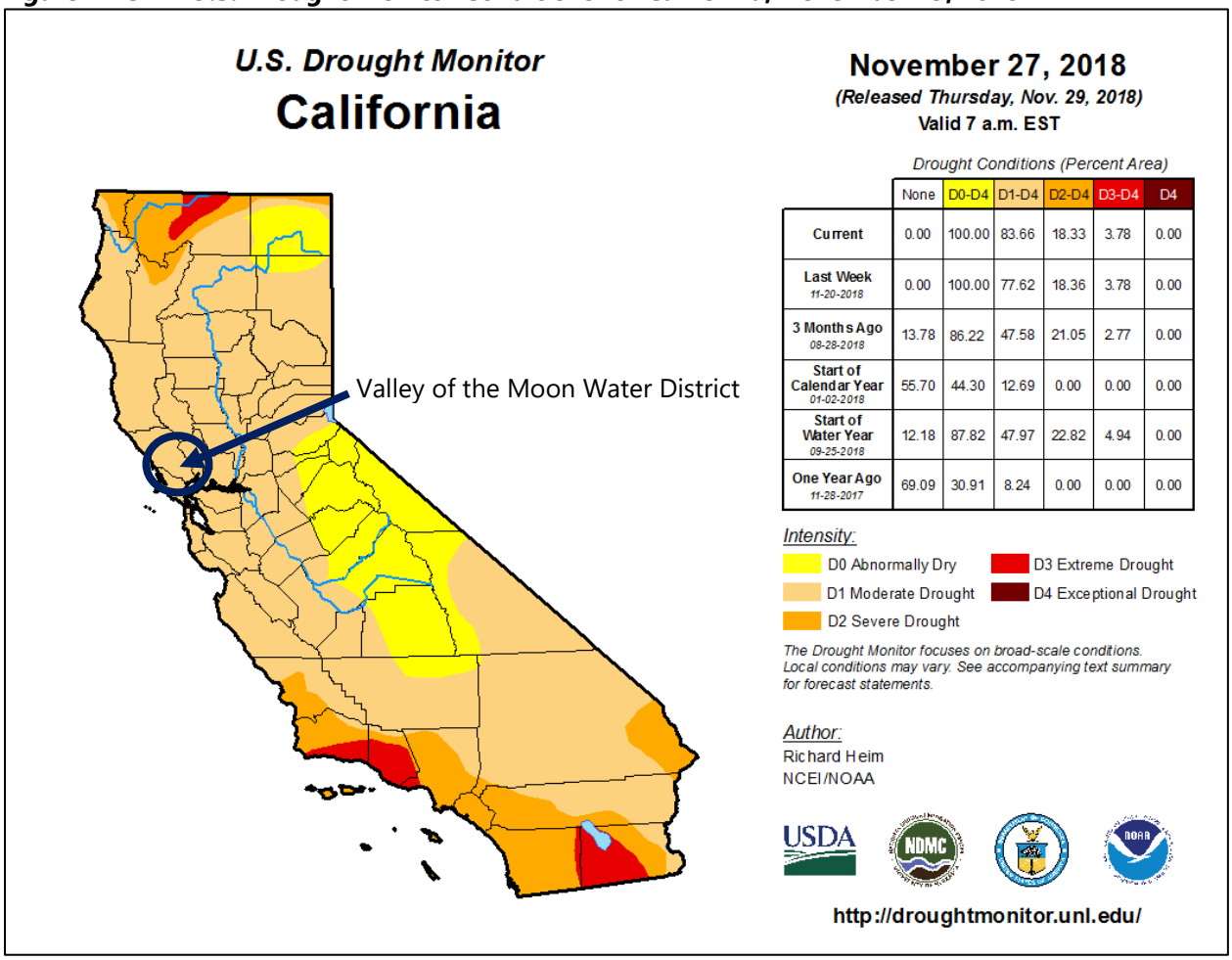
Figure 4-12, Figure 4-13, and Figure 4-14 provide "snapshots in time" of the drought conditions in California as of September 200, November 2018, and August 2015 (during the period of the last multi-year drought in the state, from 2012- 2017). The snapshots selected are instrumental in depicting both the historic and potential change in drought's geographic range and severity in Sonoma County and the District's Planning Area (circled in blue). These maps were extracted from the National Drought Mitigation Center and consider several factors including the Palmer Drought Index, Soil Moisture Models, U.S. Geological Survey (USGS) Weekly Streamflows, Standardized Precipitation Index, and Satellite Vegetation Health Index (United States Drought Monitor 2018).

Figure 4-12 U.S. Drought Monitor Conditions for California, September 8, 2020



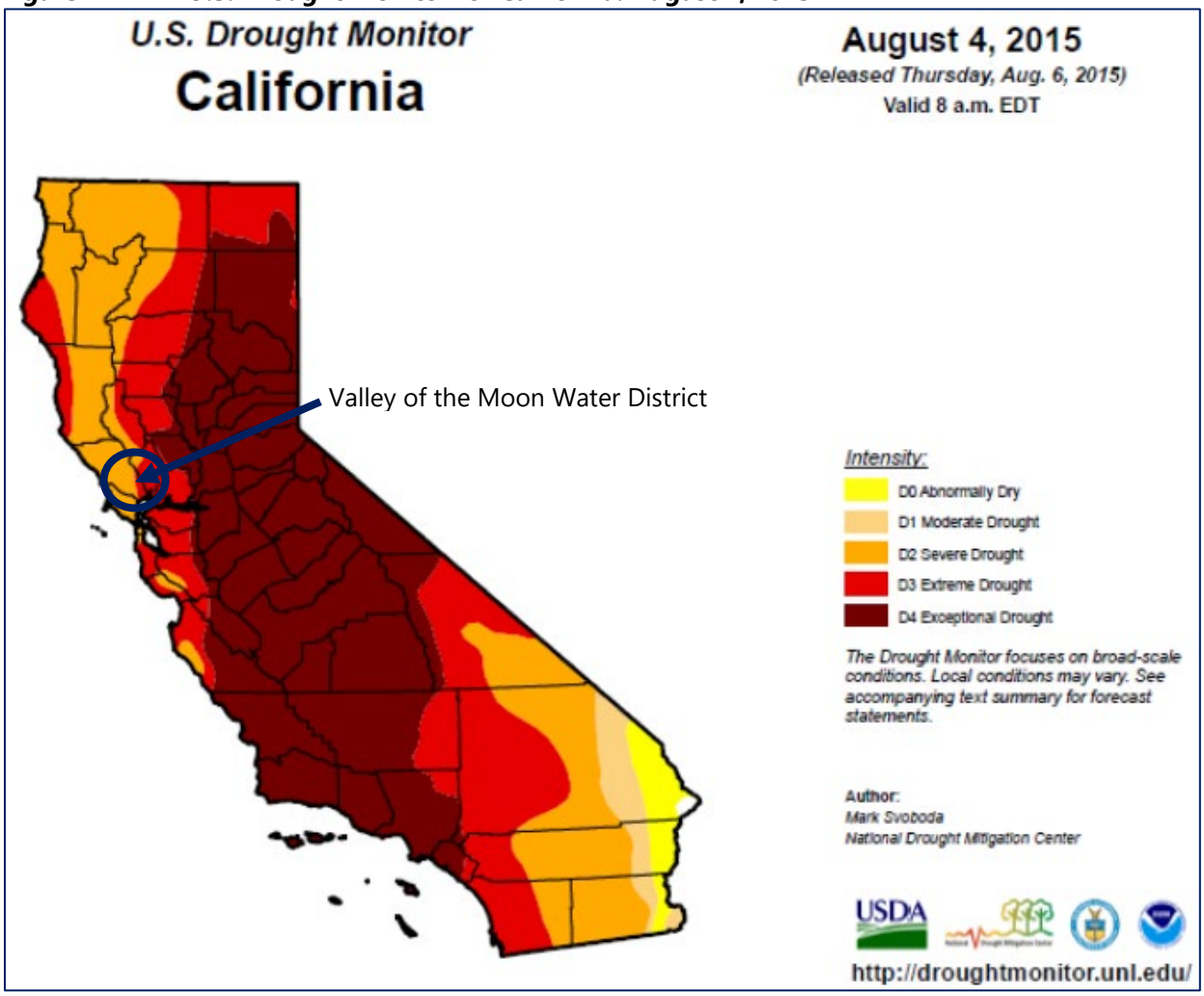
Source: National Drought Mitigation Center, 2020

Figure 4-13 U.S. Drought Monitor Conditions for California, November 29, 2018



Source: National Drought Mitigation Center, 2018

Figure 4-14 U.S. Drought Monitor for California: August 4, 2015

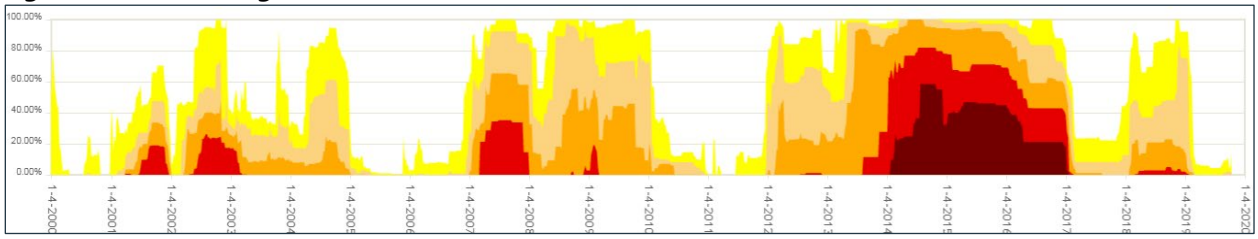


Source: National Drought Mitigation Center, 2018

Previous Occurrences

Historically, California has experienced multiple severe droughts. According to California's DWR, droughts exceeding three years are relatively rare in Northern California, the source of much of the state's developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. Figure 4-15 depicts California's multi-year historical dry periods from 2000-2019.

Figure 4-15 Drought Conditions in California: 2000 – 2019



Source: U.S. Drought Monitor https://droughtmonitor.unl.edu/Data/Timeseries.aspx

Since the year 2000 there have been several cases of multi-year droughts across California; these are described below:

2007-2009 – Water years 2007-2009 were the seventh driest three-year period in the measured record for state-wide precipitation and the fifteenth driest three-year period for DWR 8-station precipitation index (a rough indicator of potential water supply available to the State Water Project and Central Valley Project).

2012-2017 – The water years of 2012-14 stand out as California's driest three consecutive years in terms of statewide precipitation. The drought occurred at a time of record warmth in California, with new climate records set in 2014 for statewide average temperatures. On January 17, 2014, California declared a drought state of emergency and during this time the state assisted farmers and communities that were most impacted by the drought conditions and helped with drinking water shortages. The state also directed all state agencies to use less water and expand their water conservation campaigns. During this time, these factors have led to excessively dry conditions in the Districts Planning Area and the surrounding areas in Sonoma Valley than in past years, often requiring disaster declarations to be enacted to combat drought conditions. Sonoma County declared a Proclamation of Local Emergency Due to Drought Conditions from February 2015 to the end of 2015.

Prior to 2014, the District had never implemented its Water Shortage Contingency Plan (WSCP). Instead, the District relied on Board Resolutions and community outreach and participation to successfully achieve the required water use reductions (voluntary conservation goal of 20 percent). As the historic drought of 2012 through 2015 intensified, the State Water Resources Control Board (SWRCB) enacted a series of statewide prohibitions that covered certain water uses and mandated statewide conservation targets that were determined independent of local water supply conditions. To achieve the mandated water conservation standard of 20 percent, the District moved from voluntary conservation to mandatory conservation.

On August 5, 2014, the District implemented Stage 2 of its WSCP. These restrictions were extended on April 7, 2015 in response to the SWRCB's continuation of mandatory water conservation requirements. These Stage 2 restrictions were extended again on February 2, 2016. Water supplies eventually returned to normal following a normal year of rainfall and on May 24, 2016, the District Board of Directors lifted the Stage 2 water supply restrictions for its customers. This drought period now marks the second time a statewide proclamation of emergency has been issued for this hazard. On April 17, 2017 Executive Order B-40-17 was issued, which officially ended the drought state of emergency in California, except for Fresno, Kings, Tulare, and Tuolumne counties. Table 4-19 summarizes the drought-related disaster declarations proclaimed for Sonoma County from 1976 through 2020. These declarations include those from FEMA, the USDA's Secretary of Agriculture, and events noted in the State of *2018 California SHMP*.

Table 4-19: Disaster Declarations and Proclamations Related to Drought in Sonoma County

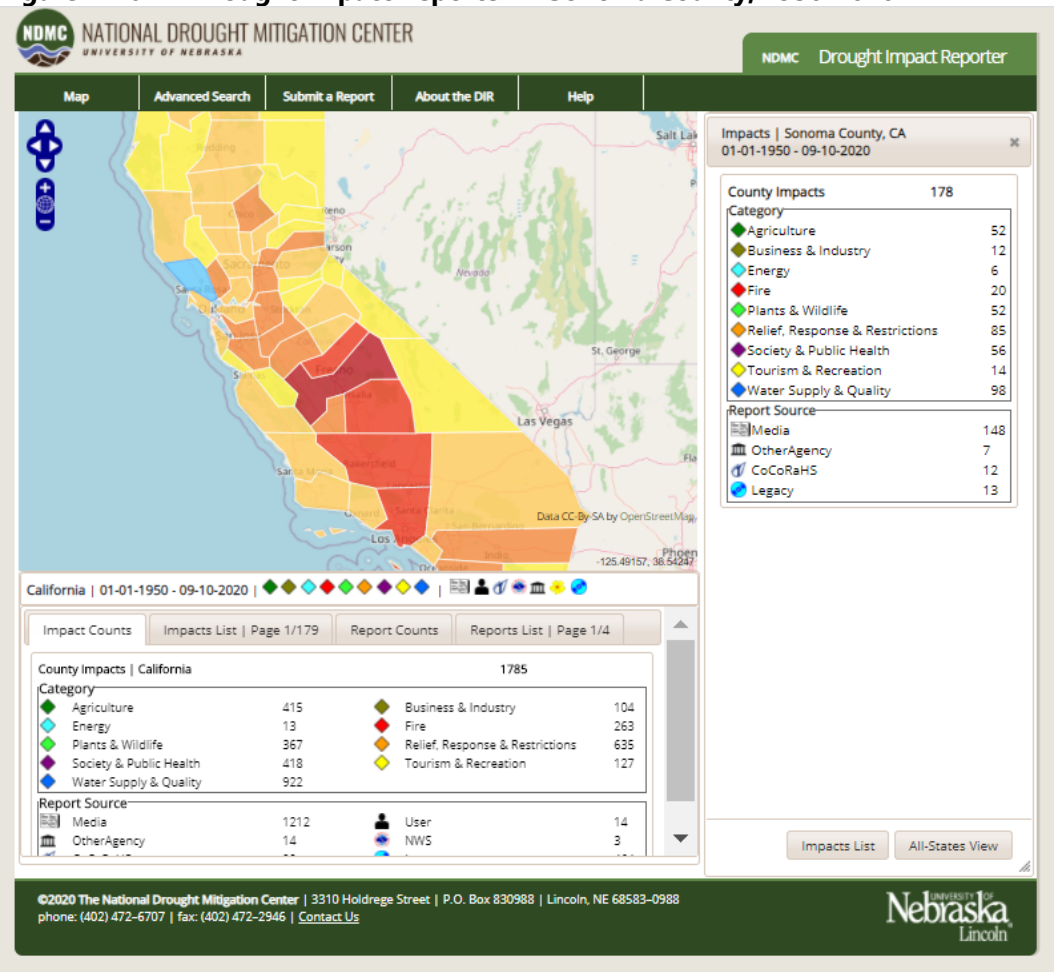
Declaration or Order	Date
1976 Drought (State)	1976
EM-3023 (FEMA)	1/20/1977
S3248 (Secretary of Agriculture)	2012
S3452 (Secretary of Agriculture)	2012
S3565 (Secretary of Agriculture)	2013
S3569 (Secretary of Agriculture)	2013
S3637(Secretary of Agriculture)	2014
S3743 (Secretary of Agriculture)	2014
S3797 (Secretary of Agriculture)	2014
S3784 (Secretary of Agriculture)	2015
S3943 (Secretary of Agriculture)	2015

Declaration or Order	Date
S3952 (Secretary of Agriculture)	2016
S3964 (Secretary of Agriculture)	2016
S4163 (Secretary of Agriculture)	2017
S4691 (Secretary of Agriculture)	2020
SF697 (Secretary of Agriculture)	2020

Source: USDA Disaster Designations 2019; California SHMP 2018; FEMA

Figure 4-16 graphically displays the amount of drought-related reported impacts to Sonoma County (United States Drought Impact Reporter 2019). While it is difficult to extract the impacts specifically affecting the District, a total of 178 reports were made within Sonoma County between January 1, 1950 and September 10, 2020. It is assumed that these drought-related impacts for areas across Sonoma County are likely to have also affected the District at some point or to some extent. Based on the summary of negative effects to Sonoma County since 1950, the categories of water supply/quality have had the most reports, followed by relief, response, and restrictions operations and society and public health. Agriculture and plants and wildlife have also suffered the effects of drought, but to a lesser extent.

Figure 4-16 Drought Impact Reporter in Sonoma County, 1950-2020



Source: National Drought Mitigation Center Drought Impact Reporter, 2020

2019-2020 Sonoma County Civil Grand Jury Investigation

The Sonoma County Civil Grand Jury investigated both emergency water shortages in Sonoma Valley and regional water resource availability in 2019, as documented in *Emergency Water Shortages in Sonoma*

Valley and *Sonoma Valley Regional Water Resources*. Based on the findings, the demand for potable water becomes critical during emergency conditions related to drought, earthquakes, flooding, and wildfires because the District has historically relied on the surface water supplies at the SDC campus. As a result, proper emergency response often means close cooperation among the regional water suppliers.

The reports concluded that District must deal with the reductions in its emergency water resources given they are the presumed water supplier for the SDC campus because it is within the District's SOI. The lack of adequate emergency water supply for the District presents significant water resource planning, costs, financial investments, and unclear liabilities due to the aging infrastructure associated with the SDC WTP. Both reports concluded that the water districts in Sonoma Valley will need to adopt a regional approach to water management because of the ongoing challenges, such as population growth and climate change in the region.

Probability of Future Occurrences

Likely – Historical drought data for California and more particularly the Sonoma County municipalities and special districts indicate there have been significant droughts and negative effects from water shortages in the past and the present. Based on this data, droughts are likely to affect the District's Planning Area and surrounding parts approximately every ten years; some of these droughts may persist for multiple years. This data was reiterated in the various reports completed by the *Sonoma County Civil Grand Jury in 2019 and 2020.*

Climate Change Considerations

Scientific studies prepared for various California climate assessments and adaptations strategies show that drought conditions in California are likely to become more frequent and persistent over the next century due to climate change. Temperatures are warming, heat waves are more frequent, and precipitation has become increasingly variable (Natural Resources Agency 2018a). Water resources are also already experiencing the following stresses: population growth, poor water quality, groundwater overdraft, and aging water infrastructure.

The recent drought conditions over the past decade underscore the need to examine water supply and distribution management, conservation, and use policies. California and Sonoma County have experienced a succession of dry spells, and with warmer temperatures the impacts of drought conditions have increased (OEHHA 2018). In an average year, approximately 40 percent of the state's total water supply comes from groundwater, and during a dry year this increases to more than half of the state's water supply, with groundwater acting as a critical buffer against the impacts of drought and climate change (Natural Resources Agency 2018a). The District only uses groundwater in emergencies, but the Sonoma Valley Subbasin has shown to have a reduction in groundwater levels (Sonoma Valley GSA 2020).

According to California's Climate Adaptation Strategy, also referred to as *Safeguarding California Plan: 2018 Update*, climate change is likely to significantly diminish California's future water supply. As a result, the state must change its water management, as climate change will create greater competition for limited water supplies (California Natural Resources Agency 2018b). Similarly, as summarized in the Sonoma County CAP, climate change could result in hotter and drier weather, and more frequent and intense droughts. The CWA (numeric measure of drought stress that quantifies the extent to which plants need for water exceeds moisture available in soil) for the region is projected to increase over this century, producing 10 to 20 percent drier soil conditions in the summer months, leaving less water available for groundwater recharge or runoff into rivers and creeks (RCAP 2016).

The greatest increases in soil dryness are projected in the south and southeastern portions of the County, where the District is located (RCAP 2016). These water management concerns, need to protect scarce resources and increase resiliency to respond to water emergencies will impact Sonoma Water, the

District's main water supplier, as well as all the separate water districts and entities in the County. For these reasons, climate change would have a "high" influence on drought hazards and water shortages.

Vulnerability Assessment

Vulnerability—High

Drought impacts to the District vary but are usually related to water supply issues because the 80 percent of the District's water supply consists of surface water, which is particularly vulnerable to seasonal and climatic variability and related shortage. Historically, a significant portion of the water needs in the District come from surface water drawn from the Russian River system from Sonoma Water via the Sonoma Aqueduct. The District does not possess water rights but is one of several water districts that hold water supply contracts with Sonoma Water, collectively known as the *Restructured Agreement for Water Supply* (VOMWD 2016). Sonoma Water is authorized by the State to store up to 245,000 acre feet of water in Lake Sonoma and up to 122,500 acre-feet in Lake Mendocino. Sonoma Water can also divert and redivert 180 cubic feet per second (cfs) of water up to a maximum of 75,000 acre feet from the Russian River at the Wohler and Mirabel facilities. The *Restructured Agreement for Water Supply* provides for the financing, construction, and operation of existing and new diversion facilities, transmission lines, storage tanks, booster tanks, wells, and other facilities (VOMWD 2016). It also specifies the maximum amounts of water allocations for each of Sonoma Water's contractors. Of the total allocation, the District is entitled 8.5 million gallons per day during any month and an annual maximum of 3,200 acre-feet provided supply is available (VOMWD 2016).

The District has experienced periods when water supplies were reduced and responded by passing resolutions prohibiting certain uses of water. When the Water Conservation Bill of 2009 (SB X7-7) was passed it included elements of the 20x2020 Water Conservation Plan, which set forth a roadmap to reduce the statewide per capita urban water use by 20 percent over an established baseline by the year 2020. The Water Conservation Bill of 2009 also requires urban water suppliers to report base daily per capita water use (baseline), an urban water use target, an interim urban water use target, and compliance daily per capita water use in their UWMPs. This enables water agencies, like the SWRCB and DWR to track progress towards decreasing daily per capita urban water use throughout the state.

In response to the historic drought of 2012 through 2015, the SWRCB implemented a series of state-wide prohibitions covering certain water uses and these mandated water use restrictions resulted in significant decline in residential water use throughout the state and in the District. On April 1, 2015 the State issued Executive Order 5-29-15 directing the SWRCB to impose restrictions to achieve a statewide 25 percent reduction in potable water use. The SWRCB mandated water reductions by water suppliers and their customers and this resolution assigned mandatory water conservation savings goals to each water supplier. The District was assigned a mandatory water conservation standard of 20 percent and through March 2016 achieved a 28 percent reduction in water demand. Beginning in 2016, water suppliers, such as the District were also required to comply with the conservation requirements in SB X7-7 to be eligible for State water grants and loans.

For the District, water allocations go down during a drought, and the District's contractual surface water entitlements with Sonoma Water may be reduced at any time. According to the 2015 UWMP, because the District relies more on surface water supplies from the Russian River, available groundwater supplies can be used as a buffer during drought conditions, but this may only provide a short-term solution.

Water restrictions and other conservation measures are typically implemented during extended droughts, and these can result in economic impacts on water utilities like the District. The District manages mandatory water reductions through implementation of their WSCP, which was adopted in January 1992 in response to Assembly Bill 11X. The WSCP was subsequently revised five times between 1996 and 2014

and in 2015 to address water restrictions that were mandated by the SWRCB (i.e. Resolution 150401). The WSCP provides the District flexibility to address supply shortfalls that may result from droughts, extreme weather events, natural disasters, extended power outages, and reduced Sonoma Water deliveries.

Prior to 2014, the District never implemented the WSCP (VOMWD 2016). Instead, the District relied on Board Resolutions and community outreach to achieve the required water use reductions. It was not until the historic drought of 2012 through 2015 intensified and the SWRCB implemented mandated statewide conservation targets that the District moved from voluntary conservation to mandatory conservation through the implementation of Stage 2 of the WSCP (Resolution NO. 14801) (VOMWD 2016). Stage 1 requires up to a 25 percent voluntary reduction in supply. Stage 2 requires up to a 25 percent mandatory reduction in supply. Stage 3 requires up to a 35 percent mandatory reduction in supply. Stage 4 requires to up a 50 percent mandatory reduction in supply. The Stage 2 restrictions were in place through mid-2016 when water supplies returned to normal following a normal year of rainfall (VOMWD 2016).

Based on historical information, the occurrence of drought in California, including Sonoma Valley, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users. The vulnerability of the District to drought is District wide and countywide, but the extent of the impacts may vary by area and include reduction in water supply, agricultural losses, and an increase in dry fuels. According to the Drought Impact Reporter the Sonoma County recorded a total of 178 impacts to drought in the survey period between 1/1/1950 and 9/10/2020 (70-year period). Of these, the majority of the impacts were associated with Water Supply and Quality; and Relief, Response, and Restrictions. These statistics are shown in Figure 4- (above). While the Drought Impact Reporter data reflects impacts at the county-level, the data should be used to develop an ongoing record of drought impacts that can be more specifically tied to events that occur within the District's Planning Area to better understand utility-specific vulnerable sectors and impacts.

In summary, drought impacts are wide-reaching and may be economic, environmental, or societal, but the most significant impacts associated with drought in the District's Planning Area are those related to water intensive activities, such as agriculture, municipal water use, commerce, tourism, and recreation. As such, the vulnerability of a water intensive activity to the effects of drought usually depends on its water demand, whether the demand is met, and what water supplies are available to meet the demand.

Customers

Drought is different than many other hazard events as it is a slow onset event unlikely to damage buildings or facilities. However, as a water district, drought can be one of the most detrimental hazards on customers and requires the most substantive planning as local conditions change and populations grow. Given the District supplies a majority of its water (80 percent) to residential users, the District's residential customers would in turn be most impacted by water use restrictions put in place during drought years. Further, as the population increases in Sonoma Valley in the future, this projected population growth would add additional strain to the surface water supplies from the District's main water supplier, Sonoma Water.

The District has several initiatives in place, such as the WSCP that emphasize water conservation. Water conservation will ensure that the six existing groundwater wells remain operational during severe drought conditions and readily available during emergencies as a back-up supply. The most recent impacts from the multi-year drought were observed from 2012 through 2015 when the SWRCB implemented the state-wide prohibitions covering certain water uses. These mandated water use restrictions, and customer's general willingness to conserve water during a drought, resulted in a significant decline in residential customer's water use throughout the state and in the District (VOMWD 2016). Executive Order 5-29-15

(EO 5-29-15) directed the SWRCB to impose restrictions to achieve a statewide 25 percent reduction on potable water use, and the District subsequently adopted resolutions to mandate actions by the water suppliers, such as Sonoma Water, and customers to reduce potable water use in order to meet their mandatory water conservation standard of 20 percent. During these restrictions, the District met their SWRCB-mandated reduction target and achieved a 28.2 percent reduction in water demand related to water demand in 2013 (VOMWD 2016). Given the magnitude of the total savings in recent years the drought appears to have had a significant effect.

In the past, the District has often borne cost themselves and not implemented any sort of surcharge to customers or rate increase. For example, extreme heat conditions can lead to water distribution problems similar to conditions that might occur during a drought event, including increased power and treatment expense and reduced consumptive revenue. However, from 2014 through 2015 the District implemented the "water shortage charge" (WSC) and the customers conserved water above the conservation target, and the District recovered from the less than expected revenues because they were able to balance the budget by purchasing less water from Sonoma Water. Still, to prevent similar issues in the future, the District adds a small WSC to one of the tiers (i.e., Tier 1) in a Stage 2 shortage. This WSC is structured to be added in a Stage 3 and 4 shortages as incrementally greater percentages (e.g., +10%, +25%) to offset the loss of revenue from reduced water sale and added costs for the water shortage response. Because Stage 1 is voluntary, no changes in water rate structure are applied, and the District can be exposed to some financial risk. During Stages 2, 3, and 4 of the WSCP, the District will experience a reduction in net revenue brought on by the mandatory reductions in water sales and increased costs for the water shortage response effort. These impacts are mitigated by the use of available reserves and the introduction of a WSC on each unit of water sold (VOMWD 2016). For the customers, the WSC is designed so that those meeting the allocation limits during each Stage will have lower water bills than they do with normal use (VOMWD 2016).

Drought conditions can also result in impacts on the District's back-up water supply used during emergencies. Since September 2019 when the SDC WTP went offline, the District has not been able to depend on SDC for back-up water supply. According to the *Sonoma County Civil Grand Jury Report*, the District's emergency water supply plan, which relies on groundwater sources and the mutual aid agreement with the SDC is impaired by the reduction of water available from those sources, which increases the risks that the District customers will not have sufficient water in an emergency. In other words, the District and its customers are vulnerable to drought, but voluntary conservation measures that are implemented in the early stages of a drought and more restrictive mandatory measures that are implemented during prolonged drought can minimize impacts. This means that water use is restricted to essential uses, which may reduce watering for landscaping; this also means that mandatory water use restrictions may be put back in place regardless of a state drought declaration.

Drought can also cause secondary impacts, such as public health problems related to poor water quality, and respiratory health problems can become exacerbated due to dust and poor air quality. The community may also exhibit a range of abilities to prepare for, respond to, and recover from drought hazards, as these conditions impact populations with health-related issues related to heat-related illness, respiratory problems, and people who work outdoors. These conditions can also impact lower-income populations, as food and water prices increase. There are sensitive and socially vulnerable populations residing in Planning Area that may be the most susceptible to water restrictions, and health-related illnesses. Socially vulnerable populations may also be sensitive to increases in water rates and in turn, increased food prices.

Critical Water Facilities and Infrastructure

The most direct impact of drought will be on the District's water supply given drought conditions can directly affect the water storage, treatment, and distribution and conveyance systems. The District provides 6,884 water service connections and the water storage system consists of 15 storage tanks, all of which are constructed of steel. While these tanks are well-constructed, should a catastrophic event, such as an earthquake occur that could cause any of these tanks to fail, the District is at risk of being unable to provide potable water for domestic use or water for fire suppression purposes. In 2019 the District said their customers are at a greater risk of emergency now than a year ago due to the State of California DGS closure of the SDC WTP. According to the Sonoma County's *Emergency Water Shortages in Sonoma County* report, the need for potable water becomes critical during emergency conditions associated with drought.

Drought impacts to the local and regional economy can be difficult to quantify but can be extensive and long-lasting depending on the circumstances during and after a severe drought event. If water resources are limited, effects would be more severe for industries that rely on large amounts of water, such as the agricultural and vineyard industries in Sonoma Valley, and any prolonged drought would intensify these impacts. While there are water intensive agricultural uses within the District's Planning Area, the District does not supply agricultural areas with potable water. However, long lasting droughts can be indirectly detrimental to the District's groundwater supply, as there has been a significant increase in irrigated agriculture, such as vineyards. According to the SVGSP, by 2000 more than half of the water demand in Sonoma Valley was met by groundwater (57 percent), followed by imported water (36 percent), with the remaining demand met by recycled water (7 percent) and local surface water. Irrigation made up the largest use of groundwater at 72 percent, followed by rural domestic use at 18 percent, and municipal/urban demand at 9 percent (VOMWD 2016).

Compliance with the SWRCB-mandated reduction target mandates may also result in negative economic impacts on the District's revenue stream when water use demand decreases due to the restrictions and WSC are not put in place. Further, while population growth in the District's Planning Area has remained stable, few new service connections limit the District's ability to collect new sources of revenue, which may further limit the District's ability to obtain revenue. Reduced revenue may also reduce the District's budget for routine maintenance and repair activities, which could in turn, shorten the lifespan of the District's existing facilities and infrastructure, as well as infrastructure located outside their SOI (i.e. SDC Campus). In summary, the impact of aging infrastructure has a compounding effects on all of the natural hazards that could affect the District.

Historic, Cultural, and Natural Resources

Severe, prolonged drought can impact the natural environment. Wildlife and natural habitats including the Sonoma Creek can be affected, including the shrinkage of habitat, habitat fragmentation, reduced food supply for wildlife, and possibly the migration of species in the nearby hillsides that define the Sonoma Valley landscape. Prolonged drought can also cause poor soil quality, loss of wetlands, tree mortality (along the periphery of the District's Planning Area), and increased soil erosion. Prolonged drought conditions (and current water diversions) have also reduced the water levels at Suttonfield Lake and Fern Lake, which provide valuable habitat for wildlife and recreational opportunities for residents.

Tree mortality is identified as a cascading impact that can affect (or worsen) other hazards, such as wildfire and wind conditions. For example, drought-impacted trees can become susceptible to diseases and insect infestations that further exacerbate the risk of tree mortality. Bark beetles can infest the inner bark along trucks and branches of trees, which can in turn weaken, stress, or eventually kill the trees. Sudden Oak Death, which is caused by a water mold pathogen, is also common in Sonoma County. One of the most prevailing impacts of drought to the natural environment is the increased risk of wildfires, as seen during

the 2017-2018 and 2019-2020 wildfire seasons. Wildfires now burn larger and more intensely during dry conditions and are happening outside the typical fire season. Lastly, drought conditions can cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Impacts to the historic and cultural building inventory within Sonoma Valley may be negligible, and District may have limited regulatory authority as a water district to prevent impacts on these resources. The County open spaces and park and public lands can suffer during droughts, as well as the adjacent City of Sonoma open spaces and park facilities. However, the City of Sonoma's ability to use recycled water for irrigation purposes can offset this vulnerability.

Future Development

Future development and water conservation are the focus of each update to the District's UWMP and this planning process specifically address drought conditions and water contingencies. The UWMP describes how current and future water resources and demands within the District's service area will be managed to provide adequate and reliable water supply. As the population grows over time the District will have to revise their reliability and supply projections from the Sonoma Water through a multi-agency planning effort or development of a regional water management plan. Sonoma Water may reduce water deliveries as water levels in major reservoirs decrease. Therefore, as new development occurs in the District's Planning Area, particularly associated with the *Sonoma Development Center Specific Plan*, it will be important to assess the availability and reliability of multiple water sources, such as groundwater and recycled water.

The District currently supplies a majority of water supply to single family and multi-family residents. Between 2015 and 2020 the District's potable water demand increased by approximately 19 percent largely as a result as the rebound from the multi-year drought. However, current demand for potable and raw water is expected to slightly decrease by less than one percent by 2040 based on a sustained decrease in per capita water use as a result of water efficiency improvements by the District and their customers. Also, consistent with Senate Bill 610, any proposed developments in the County are mandated to estimate future water uses and identify water supplies that may be used to meet their uses. This water supply assessment process is intended to ensure that adequate water supplies exist to support new growth; such assessments will likely be completed for the Environmental Impact Report for the *Sonoma Development Center Specific Plan*.

Risk Summary

- There have been six multi-year droughts since 1950, three of which have occurred since 2000. The most recent drought lasted from 2012 to 2017 and resulted in a declared state of emergency.
- 178 drought impact reports were made within Sonoma County between 1950 and 2020.
- As of 2015, the District was supplying 2,528 acre-feet of water, the majority of which is supplied to single family and multi-family residential properties. The City's 2015 UWMP projects that demand for potable and raw water will increase to 3,117 acre-feet, or by 19 percent by the year 2040.
- Population is expected to increase to 26,300 by 2040, or an increase of about 100 people per year; this projected growth would add strain to the water supply, particularly during future severe drought events.
- Climate change projections indicate the region will experience more frequent and intense droughts due to drier soil conditions in the summer months, leaving less water available for groundwater recharge.
- Sonoma County recorded a total of 178 impacts to drought in the survey period between 1/1/1950 and 9/10/2020 (70-year period). Of these, the majority of the impacts were associated with Water Supply and Quality; and Relief, Response, and Restrictions.

- The District has responded to drought conditions and mandated conservation targets from the State by passing resolutions prohibiting certain uses of water. The enforcement of water conservation policies and regular updates to the UWMP and WSCP ensure the District is more resilient to drought events in the future.
- According to the *Sonoma County Grand Jury Investigation*, the need for potable water in Sonoma Valley is critical and the decision of the California Department of General Services to close the SDC Campus and the SDC WTP has severely impacted the back-up water supply needed during emergency situations associated with drought, earthquakes, and wildfires.
- The District's emergency water supply plan, which relies on groundwater sources and the mutual aid agreement with the SDC is impaired by the reduction of water available from the SDC campus sources, which increases the risks that the District customers will not have sufficient water in an emergency.
- The District, City of Sonoma, and SDC (State of California) need to reduce the water supply shortage risk by sharing water during emergencies, using existing interconnections, and developing a regional water management plan.
- The overall significance of drought on the District's water supply is **High**.

4.3.4 Flood

Hazard Description

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. In Sonoma County, flooding is the most frequent natural hazard that has caused the greatest amount of property damages and highest number of declared disasters. Flooding in Sonoma County is generally the results of thunderstorms, winter storms and atmospheric rivers.

Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. Certain health hazards are also common to flood events; standing water and wet materials in structures can become breeding grounds for microorganisms such as bacteria, mold, and viruses. Standing water or affected infrastructure can in turn cause disease, trigger allergic reactions, and damage materials long after the flood. When floodwaters contain sewage or decaying animal carcasses, infectious disease also becomes a concern. Direct impacts such as drowning can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts.

Floodplains are defined as the areas immediately adjacent to a channel from a river, stream, or other waterway. Floodplains are illustrated on inundation maps, which show areas of potential flooding and water depths. In its common usage and based on FEMA guidelines, the floodplain most often refers to the area that is inundated by the 100-year flood, or the flood that has a one percent chance in any given year of being equaled or exceeded. The 100-year flood is the national minimum standard to which communities regulate their floodplains through the FEMA National Flood Insurance Program (NFIP). The 500-year flood is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year. A 500-year flood event would be slightly deeper and cover a greater area than a 100-year flood event. The potential for flooding can change and increase through various land use changes and changes to land surface, which then may result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity.

The District's infrastructure and water supply systems are most susceptible to riverine flooding. This type of flooding is defined as the condition when a watercourse (e.g. river or channel) exceeds its "bank-full" capacity, generally occurs as a result of prolonged rainfall, or rainfall that is combined with already

saturated soils from previous rain events. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include one or more independent river basins. The onset and duration of riverine floods may vary from a few hours to many days. Factors that directly affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface due to urbanization. In the District's Planning Area, flooding is largely caused by heavy and continued rains, increased outflows from upstream dams, and heavy flow from tributary streams. Local intense storms can overwhelm nearby waterways as well as the integrity of flood control structures. The warning time associated with slow rise floods assists in life and property protection.

Geographic Location

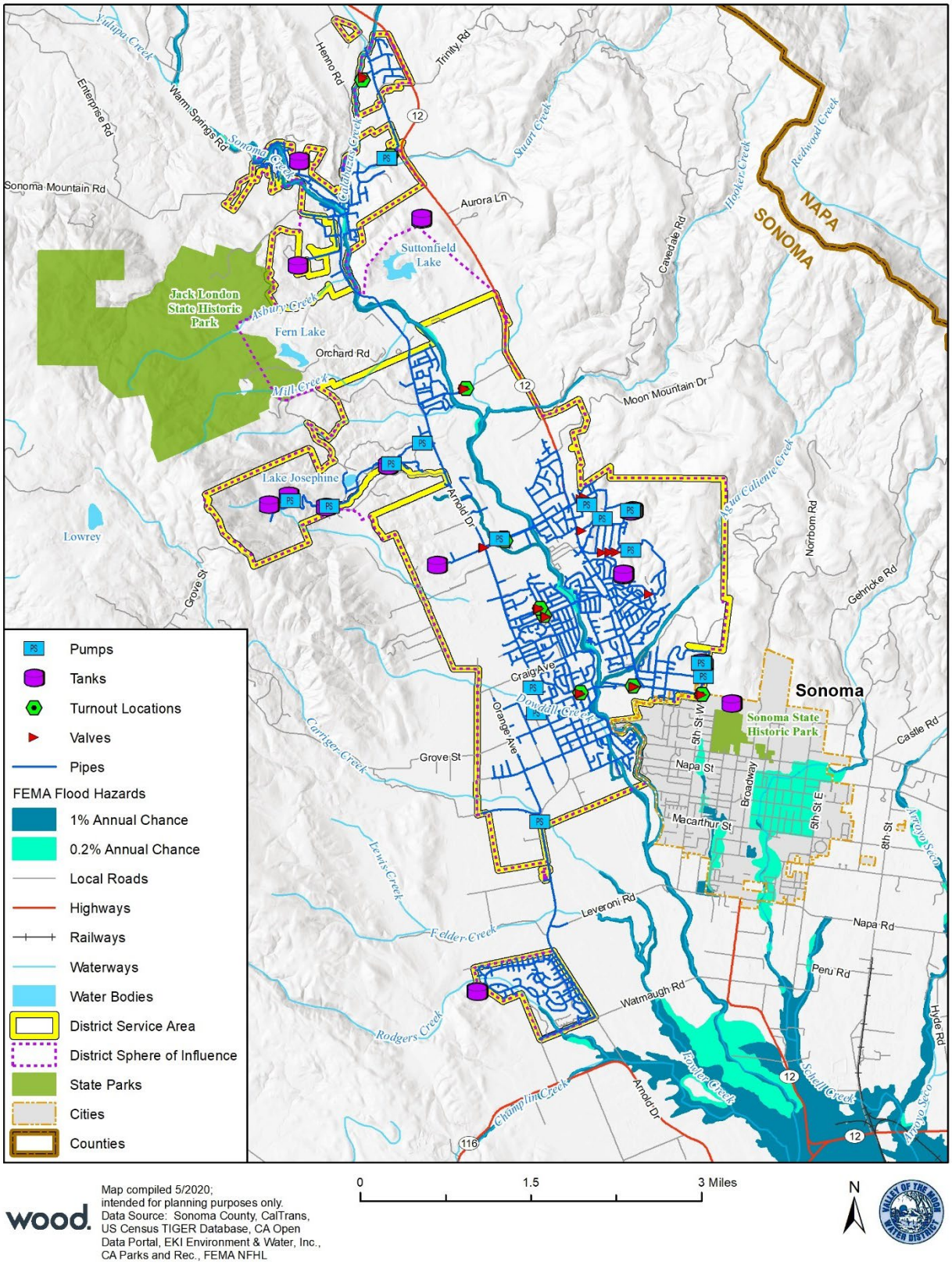
Limited – The 1 percent (100-year) and 0.2 percent (500-year) floodplains of the Sonoma Creek are located within central and eastern portions of the District's Planning Area. GIS analysis shows impacts to District water facilities and infrastructure from the Creek is less likely to impact the District's system compared to flooding on the Russian River. The District receives a majority of its water supply (85%) from the Russian River, delivered from the Sonoma Aqueduct through purchases from Sonoma Water. As a result, riverine flooding from the Russian River poses the greatest risk to Sonoma Water infrastructure including the Sonoma Aqueduct. Figure 4-17 shows the 1 percent and 0.2 percent floodplains within the District's boundaries.

Floodplain Mapping and Studies

FEMA established standards for floodplain mapping studies as part of the NFIP (FEMA 2019). The NFIP makes flood insurance available to property owners in participating communities adopting FEMA-approved local floodplain studies, maps, and regulations. Floodplain studies that may be approved by FEMA include federally funded studies; studies developed by state, city, and regional public agencies; and technical studies generated by private interests as part of property annexation and land development efforts. Such studies may include entire stream reaches or limited stream sections depending on the nature and scope of a study. A general overview of floodplain mapping and related components is provided in the following paragraphs.

Flood Insurance Study (FIS) - The FIS develops flood-risk data for various areas of a community that are used to establish flood insurance rates and assist the community in its efforts to promote sound floodplain management. The latest FIS applicable to the District was included in a five-volume report along with other incorporated jurisdictions and unincorporated areas studied in Sonoma County; this recent report was last revised March 7, 2017.

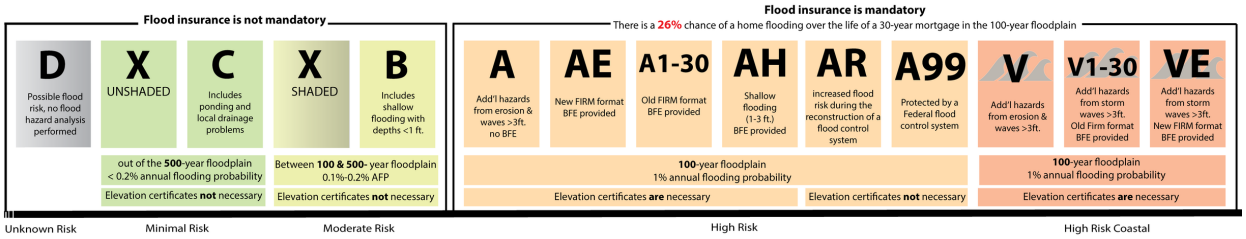
Figure 4-17 Valley of the Moon Water District FEMA 100-year and 500-year Flood Hazards



Flood Insurance Rate Map (FIRM) - The FIRM is designed for flood insurance and floodplain management applications. For flood insurance, the FIRM designates flood insurance rate zones to assign premium rates for flood insurance policies. The designated flood zones are based on flood risk in the area. For floodplain management, the FIRM delineates 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydrology and hydraulic analyses and local floodplain regulations

Land areas that are high risk within the 100-year floodplain (meaning they have a one percent annual chance of flooding), are called Special Flood Hazard Areas (SFHAs) and are mapped as A or AE zones. The difference between A and AE zones are the level of detail in analysis and mapping, so that A zones are more general while AE contain additional detail and also display Base Flood Elevations, or BFEs. In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to Zones A and AE (i.e., those areas subject to a 100-year flood event).

What are flood zones?



Flood zones are geographic areas on a flood map that indicate flood risk. Zones are determined by assessing the expected height of a flood that has a 1 percent chance of occurring in any given year ("100-year flood"), as well as potential wave heights, the distance from the nearest water body, and the ground elevation. While there is only a 1 percent chance of a flood of such magnitude to occur every year, there is a 26 percent chance of such a flood to occur over the lifecycle of a 30-year mortgage.
Source: Wetlands Watch 2019

The Sonoma County FIRMs, as with most portions of California and larger developments across the U.S., have been replaced by new digital flood insurance rate maps (or DFIRMS) as part of FEMA's Risk Map and Map Modernization programs. DFIRMs and related datasets (e.g. cross sections used in floodplain studies and analyses, Base Flood Elevations [BFE], etc.) are now delivered via National Flood Hazard Layer (NFHL) databases, accessible for free online at FEMA's Flood Map Service Center site.

These digital DFIRMs achieve the following purposes:

- Incorporate the latest flood study updates (LOMRs and LOMAs)
- Utilize community supplied data
- Verify the currency of the floodplains and refit them to community supplied base maps and base data
- Upgrade the FIRMs to a GIS database format to set the stage for future updates and to enable manipulation, storage, and support for GIS analyses and other digital applications
- Solicit community participation

The most current DFIRMs for the unincorporated areas within Sonoma County are included in the County's NFHL database. Like the FIS, the latest effective date for DFIRMS in the County is March 7, 2017. The spatial features available in this NFHL database, such as floodplains and levees, were used for the analyses and mapping in this plan as they relate to flooding hazards.

Flood maps can be used as an indicator of flood extent, but floods can and do occur outside of mapped floodplains. Flood depth and velocity also affect the extent of flood hazards and resulting damage. The deeper and faster flood flows become, the more damage they can cause in a community. However, shallow flooding with high velocities (e.g., such as a flash flood event caused by precipitation) can cause

as much damage as deep flooding with a slow velocity (e.g., from a riverine flood event). This typically happens when a channel migrates over a floodplain and redirects flows and transports debris and sediment.

Major Sources of Flooding

The main sources of flooding in Sonoma County are primarily associated with thunderstorms and atmospheric rivers during the winter season. Atmospheric rivers are long, narrow regions of the atmosphere, like a river in the sky, that transports most of the water vapor outside of the tropics. Atmospheric rivers are responsible for up to 50 percent of California's precipitation annually and 65 percent seasonally (Arcuni, 2019). Atmospheric Rivers provide approximately half of the major rainfall in the Russian River watershed and have caused a majority of the floods (34 of 39 percent) in the watershed in the last 60 years (Sonoma Water 2018). Flooding in Sonoma County most often occurs within 24 to 48 hours after a storm event and recedes within three days. This type of flood results from prolonged heavy rainfall over tributary areas and is characterized by high peak flows of moderate duration. Flooding is more severe when antecedent rain has resulted in saturated ground conditions.

The latest FEMA NFHL data indicate that 1 percent and 0.2 percent floodplains are predominantly located along the Sonoma Creek (see Figure 4-) that run through the central portion of the District boundary. According to the County FIS, flooding in the Sonoma Creek basin is the result of short, intense periods of rain occurring within longer duration storms.

While the Russian River is not within the District, flooding along this river can impact Sonoma Water's critical water facilities and infrastructure, and as a result would impact the Districts water supply. The Sonoma Aqueduct, which is supplies the District with water from Sonoma Water also crosses several creeks that may be susceptible to flooding.

Magnitude/Severity

Limited – Rainfall and the intensity and duration of events are an important factor in determining the magnitude of flooding. Table 4-20 from the *Sonoma County Operational Area HMP* shows the projected rainfall levels expected in the southeast portion of Sonoma County, where the District is located, during recurring storms.

Table 4-20: Rainfall intervals Associated with 24 Hour Storm Events in Southeast Sonoma County

Average Recurrence Interval	Inches
2-year	3.0
10-year	3.5
25-year	4.0
50-year	4.5
100-year	5.0

Source: Sonoma County 2017, Data from Western Precipitation Frequency Maps, NOAA

Table 4-21 below summarizes the general FEMA-available flood zones for context.

Table 4-21: FEMA's Special Flood Hazard Area Zone Descriptions

Flood Zone	Definition
FEMA Special Flood Hazard Areas (SFHA) Subject to Inundation by the 100- or 500-Year Floods	
Zone A	100-year floodplain, or areas with a 1% annual chance of flooding. Because detailed analyses are not performed these areas, no depths or base flood elevations are shown in Zone A areas.

Flood Zone	Definition
Zone AE	Detailed studies for the 100-year floodplain. The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 zones.
Zone AH	Areas with a 1% chance of shallow flooding, usually in the form of a pong with an average depth ranging from 1 to 3 feet. These are flood elevations derived from detailed analyses.
Zone AO	River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. Average flood depths derived from detailed analyses.
Zone A99	100-year floodplain, areas with a 1% annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
Other Flood Areas	
Floodway	A regulatory floodway is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.
Zone X (shaded)	Areas with a 0.2% annual chance flooding (1 in 500 chance), between the limits of the 100-year and 500-year floodplains. This zone is also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, shallow flooding areas with average depths of less than one foot, or drainage areas less than 1 square mile.
Zone X (unshaded)	500-year floodplain (0.2% annual chance). Area of minimal flood hazard.

Source: FEMA Flood Map Service Center, 2018

Previous Occurrences

While the District has not historically been directly impacted by flooding, events have occurred on Sonoma Creek and the Russian River that have indirectly impacted Sonoma County and Sonoma Water's infrastructure. Severe winter storms and flooding in January and February 2017 resulted to damage on Sonoma Water's water supply infrastructure. Three Major Disaster Declarations were declared for the State of California, and Sonoma County was included in two of the Disaster Declarations, DR-4301 and DR-4308, as a result of the severe storms and flood events.

Probability of Future Occurrences

Likely – The 100-year flood is the flood that has a one percent chance in any given year of being equaled or exceeded, while the 500-year flood is expected to have a 0.2 percent chance of occurring (or being exceeded) in any year, respectively. As such, it is likely that riverine flooding will occur in the future, though localized stormwater flooding and general flash flooding may also take place especially during the wet months and heavy rain or storm events but are not likely to directly impact the infrastructure within the District boundaries.

Climate Change Considerations

Emerging findings from California's Fourth Climate Assessment show that costs associated with direct climate change impacts by 2050 will be dominated by human mortality, coastal damage, and the potential for droughts and mega-floods (California Natural Resources Agency 2018). Scientific studies outlined in the same assessment also indicated shifts in California's precipitation regime, which show more dry days, more dry years, and a longer dry season, mixed with increases in occasional heavy precipitation events and floods (i.e. a shift towards potentially less frequent but more extreme precipitation events). Studies also project great storm intensity with climate change, resulting in more direct runoff and flooding due to the flash flooding or precipitation nature of these expected events. As a result of fewer but more violent precipitation events, high frequency flood events will increase with climate change. Also, with wildfires

already being a problem in California, increasing periods of drought and lack of precipitation are expected to exacerbate conditions for fires to occur, and in turn worsen the potential for runoff and flooding associated with burned areas due to increased impermeability and damage terrain and soils.

This Fourth Climate Assessment indicates that climate change is expected to alter built water supply systems, so that current management practices for flood control and water supplies across the state of California may need to be revised. Future revisions should aim to account for subsidence-prone infrastructure (e.g. levees), which coupled with rising sea levels and worsening storm conditions can lead to overtopping or failure of these flood control structures (California Natural Resources Agency 2018).

Based on Sonoma County's 2016 CAP and GHG emission modelling, climate change is projected to result in an increased risk of extreme flooding, and an increased seasonal variability of precipitation, runoff, and stream flows for Sonoma County, along with increased likelihood of "extreme" precipitation and drought events. There may be more years with more frequent storm events and occasional events that are much stronger than historical ones and the length of season over which storm events occur is predicted to increase (SCTA 2016). Also, according to the CAP, more frequent coastal flooding and increased erosion is anticipated. In addition to flooding, sea levels are projected to rise between 16.5 and 65.8 inches by 2100. Rising sea levels combined with increased storm surge is anticipated to lead to more frequent inundation of the low-lying areas, and flooding of homes, infrastructure, agricultural land, and natural areas on the shores of San Pablo Bay to the south of the District's Planning Area. The greatest impacts are anticipated during winter storms. For these reasons, climate change would have a "high" influence on flooding hazards.

Vulnerability Assessment

Historically, flooding has not directly impacted the District's water facilities and infrastructure. Other problems associated with flooding that could directly impact Sonoma Water's ability to supply water include erosion, sedimentation, degradation of water quality, loss of environmental resources, certain health hazards, and the inconvenience or potential financial and accessibility issues that come with road closures and other access issues due to flowing. These direct impacts to Sonoma Water's critical water facilities would result in indirect impacts on the District's water supply. Flooding in January and February 2017 resulted in damages to Sonoma's infrastructure that in turn impacted all of Sonoma County.

The Valley of the Moon Water District is a special district and is not eligible to participate in the NFIP. Therefore, the District does not have any repetitive or severe repetitive loss properties related to flooding.

Customers

Flooding is frequent in all of Sonoma County leading to the County being the top ranked County in California for repetitive losses, as defined by the NFIP. While the District's assets may not suffer direct impacts from flooding its likely customers of the District, particularly those residing along Sonoma Creek may be impacted by flood events. The *Sonoma County Operational Area HMP* estimated that potentially 9,016 persons live in homes that are at risk of a 100-year flood event.

Critical Water Facilities and Infrastructure

While there are mapped flood hazard areas, there are no District water assets within these flood hazard areas. Water supply may be impacted if the Sonoma Water's infrastructure is impacted by flooding. The Russian River poses the greatest risk to the water agency. Some of Sonoma Water's infrastructure risk has been mitigated through the elevation of the water facilities located in the floodplain, including pumps and a generator that are now sited above the 100-year base flood elevation. According to the Sonoma Water

LHMP seven vertical wells are located in the Russian River floodplain but have the ability to be sealed to prevent contamination when flood alerts are issued.

Historic, Cultural, and Natural Resources

Climate change studies at the county and regional level indicate the likelihood that increasingly unpredictable flash flooding and uncertainty in storm occurrence will lead to a worsening in erosion and sedimentation conditions. However, natural areas within the floodplain often benefit from periodic flooding as a naturally recurring phenomenon, and these natural areas often reduce flood impacts by allowing absorption and infiltration of floodwaters. Nevertheless, other cultural or historical resources such as older buildings in Sonoma Valley may be more affected by these flooding hazards, given their likely older construction methods, weaker materials, and failure to meet current building code standards.

Future Development

There are no planned facilities that will be built in or near the flood zone.

Risk Summary

- Overall, the significance of flood hazards is **Medium**.
- Flood impacts are likely to directly impact the Sonoma Water's water assets and ability to supply water to the District.
- Impacts that are not directly quantified but could be anticipated in large future events include: 1) injury and loss of life; 2) disruption of and damage to public infrastructure; 3) disruption to trade, commerce, commuting, mobility, and other activities that may rely on the road networks; 4) health hazards associated with mold and mildew; 5) significant direct and indirect economic impact (jobs, sales, tax revenue) upon the community; and 6) negative impact on commercial and residential property values.
- None of the District's critical water facilities or infrastructure occur within the floodplain.

4.3.5 Severe Weather: General

Severe weather is generally any destructive weather event, but usually occurs in the Planning Area as localized thunderstorms that bring heavy rain, hail, lightning, high winds, and dense fog. Severe weather can also include extreme heat events.

The NOAA NCEI has been tracking severe weather since 1950. Their Storm Events Database tracks severe weather events on a county basis and contains data on the following: all weather events from 1993 to current (except from 6/1993-7/1993); and additional data from the Storm Prediction Center, which includes tornadoes (1950-1992), thunderstorm winds (1955-1992), and hail (1955-1992). This database contains 558 severe weather events that occurred in Sonoma County between January 1, 1950, and September 14, 2020. Table 4-22 summarizes these events.

Table 4-22: NCEI Hazard Event Reports for Sonoma County* 1950-2019

Type	# of Events	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Debris Flow	54	25,916,000	20,000,000	1	0
Dense Fog	4	100,000	0	0	2
Dense Smoke	8	0	0	0	0
Extreme Cold/Wind Chill	2	0	0	1	0
Flash Flood	44	8,018,000	164,000	1	1
Flood	189	208,097,400	6,150,000	1	0

Type	# of Events	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Frost/Freeze	3	60,000	3,000,000	0	0
Funnel Cloud	1	0	0	0	0
Hail	15	0	0	0	0
Heat	7	0	0	1	0
Heavy Rain	22	383,500	20,000,000	1	2
High Wind	75	713,500	0	2	0
Lightning	2	1,000,000	0	0	1
Strong Winds	148	3,145,200	0	3	5
Tornado	13	1,558,500	500	0	1
Wildfire	13	505,000	5,000	0	5
Total**	**558**	**$249,497,100**	**$49,319,500**	**11**	**17**

Source: NOAA's National Centers for Environmental Information https://www.ncdc.noaa.gov/stormevents/

*Note any reference to a coastal type weather event for Sonoma County has been excluded from this table.

**Losses reflect totals for all impacted areas, inclusive of Sonoma County

The NCEI table above summarizes severe weather events that have occurred in Sonoma County. Only a few of the events resulted in state and federal disaster declarations. While the HMPC recognizes these inconsistencies, this data provides value in depicting the County's "big picture" hazard environment.

As previously mentioned, several state and federal disaster declarations including the District's Planning Area have been a result of severe weather. For this plan, severe weather is broken down as follows:

- Extreme Heat
- Heavy Rain/Thunderstorm/Hail/Lightning/Dense Fog
- High Winds

4.3.6 Severe Weather: Extreme Heat

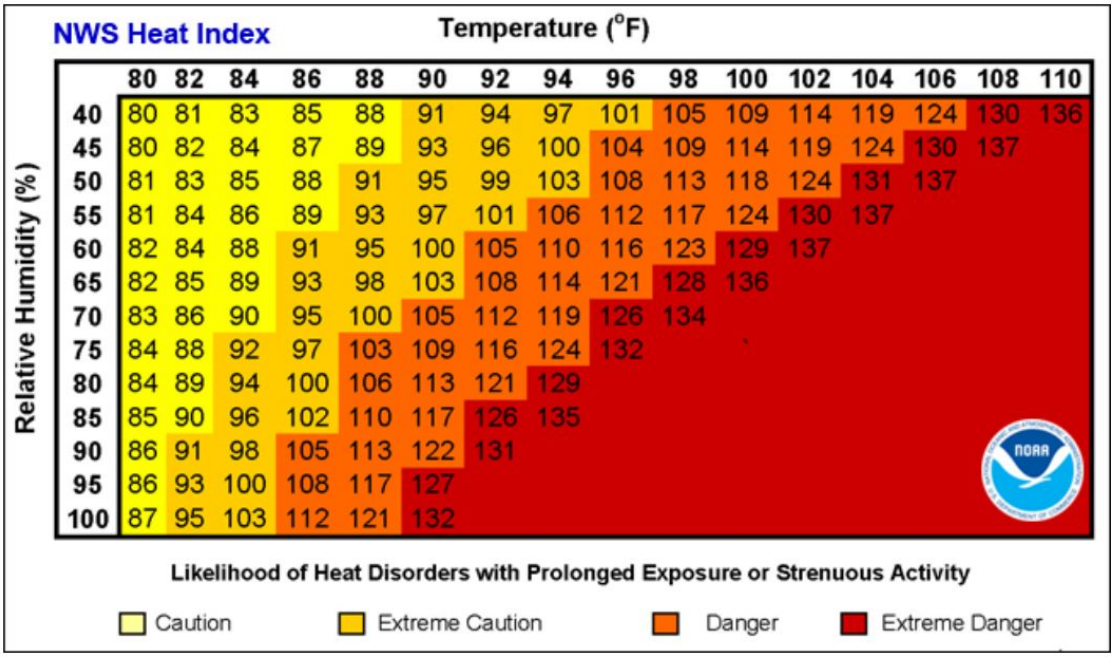
Hazard Description

Extreme heat events can have severe impacts on human health and mortality, natural ecosystems, the agriculture sector and other economic sectors. According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. According to the National Weather Service (NWS), among natural hazards, only the cold of winter takes a greater toll nationally — not lightning, hurricanes, tornadoes, floods, or earthquakes. However, there are a lack of cold weather and extreme cold temperatures events in Sonoma County. During the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died. The 2018 California SHMP notes the heat wave during the summer of 2006 lead to 650 deaths in a 13-day period (Cal OES 2018), and in the past 15 years heat waves have claimed more lives in California than all other declared disaster events combined (California Climate Adaptation Strategy 2018).

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise, and heat-related illness may develop. The elderly, small children, patients with chronic medical conditions, those on prescription medication therapy, and people with weight or alcohol problems are particularly susceptible to heat

reactions, especially during heat waves in areas where moderate climate usually prevails. Figure 4-18 illustrates the relationship of temperature and humidity to heat disorders.

Figure 4-18 National Weather Service Heat Index



Source: National Weather Service

Note: Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

Geographic Location

Extensive – Severe weather events related to extreme heat have the potential to happen anywhere in the Planning Area. According to the City and HMPC, extreme heat, occasional heavy rain and thunderstorms, and wind events have occurred in the District's Planning Area.

Magnitude/Severity

Limited – The District's Planning Area begins to experience hot weather in June or July of each year, and the heat continues throughout the summer months. According to the Western Regional Climate Center (WRCC), the average high temperature for Sonoma Valley in July is 88.6°F. Temperatures that are 10 degrees above normal are considered excessive. The California OES Contingency Plan for Excessive Heat Emergencies (2014) indicates that through the use of historical weather and mortality data, the NWS and the California Department of Public Health (CDPH) have identified five major types of climate regions within California to account for climate differences among regions in order to recognize what constitutes an excessive heat event in each of the regions. When temperatures spike for two or more consecutive days without an adequate drop in nighttime temperature to cool the outdoor and indoor environments, there is a significant increase in the risk to vulnerable populations.

The NWS has in place a system to initiate alert procedures (advisories, watches, and warnings) when high temperatures are expected to have a significant impact on public safety. The expected severity of the heat determines which type of alert is issued. During past heat waves, Sonoma County has designated facilities as Cooling Centers. In the most recent heat waves of August 2020, Sonoma County designated the Sonoma Valley Veteran's Building in Sonoma as a Cooling Center. In summary, extreme heat impacts would likely be limited in the Planning Area, with 10 to 25 percent of the Planning Area affected. Extreme

heat will have an impact on vulnerable populations and could also impact livestock and crops if the event occurs during certain times of the year.

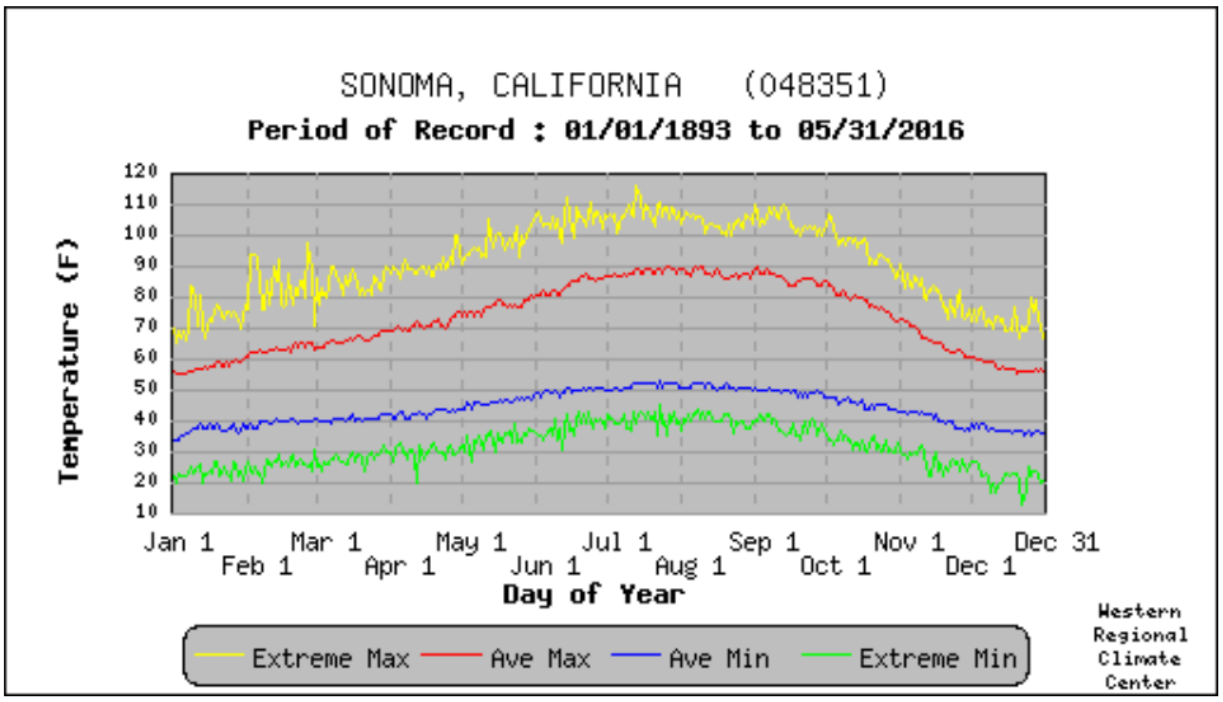
Previous Occurrences

Information from the closest weather station with the most comprehensive data, the Sonoma Weather Station (048351), is summarized below and in Figure 4-19 to illustrate daily temperature averages in the District's Planning Area.

City of Sonoma (Sonoma Weather Station, Period of Record 1893 to 2016)

In the City of Sonoma, monthly average maximum temperatures in the warmest months (May through October) range from the mid-70s to the upper 80s. Monthly average minimum temperatures from November through April range from the mid-50s to low-70s. The highest recorded daily extreme was 116°F on July 13, 1972. The lowest recorded daily extreme was 13°F on December 22, 1990. In a typical year, maximum temperatures do not exceed 88°F and minimum temperatures do not fall below 37°F.

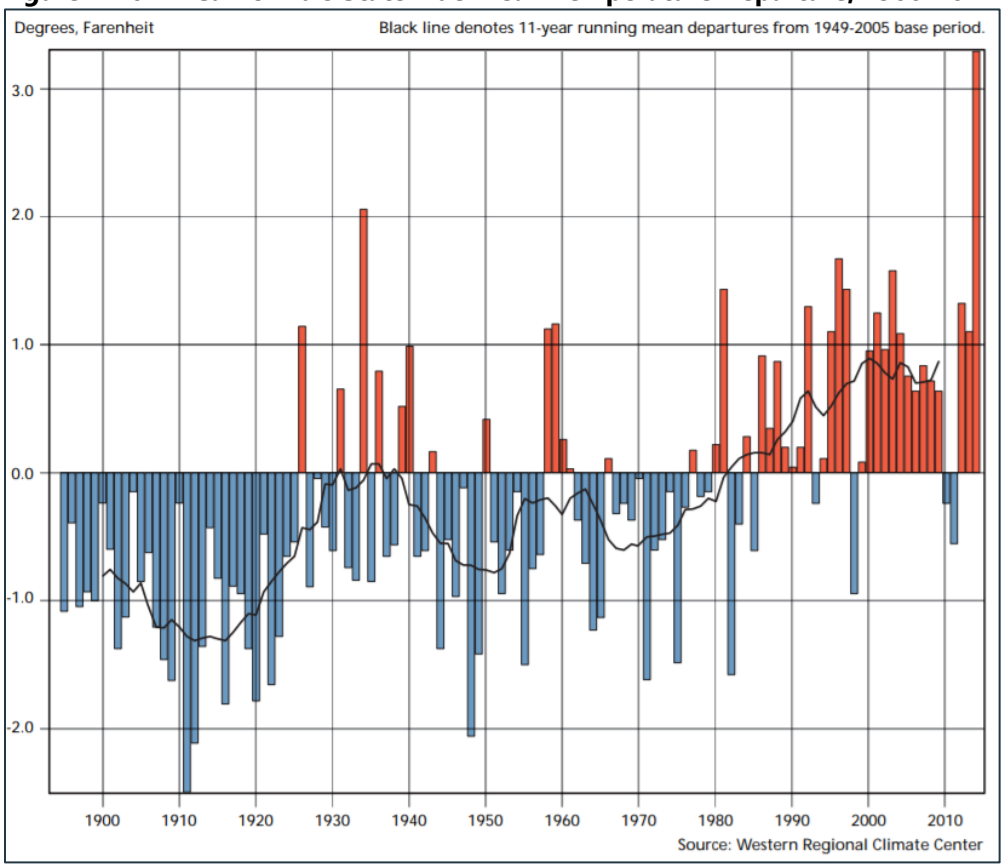
Figure 4-19 City of Sonoma's Daily Temperature Averages and Extremes



Source: Western Regional Climate Center, www.wrcc.dri.edu/

The California statewide mean temperature departures from the 1900s to mid-2010s are displayed in Figure 4-20. This graphically highlights the general warming trend across the state, and how climate change can have significant implications in future water supply availability from progressively higher mean temperatures.

Figure 4-20 California's Statewide Mean Temperature Departure, 1900-2014



Source: Drought in California Report (CA DWR; Natural Resources Agency; State of California, 2015)

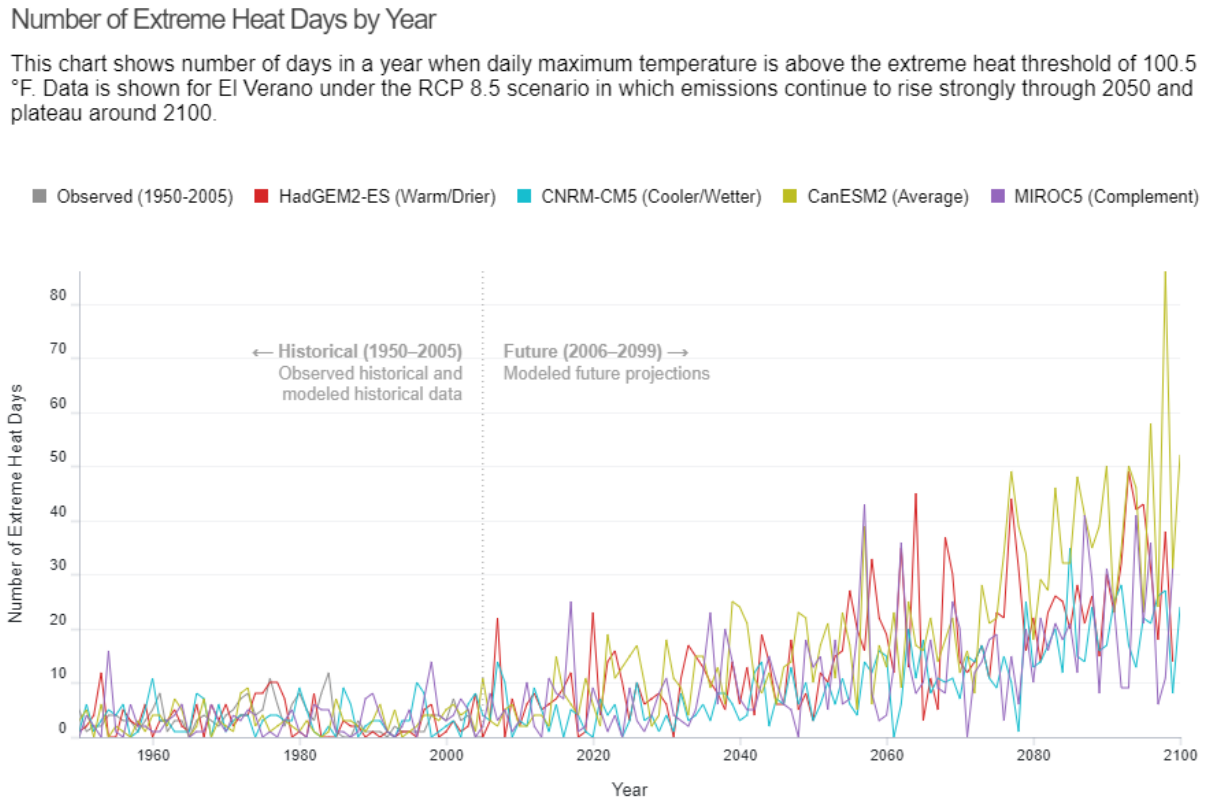
Probability of Future Occurrences

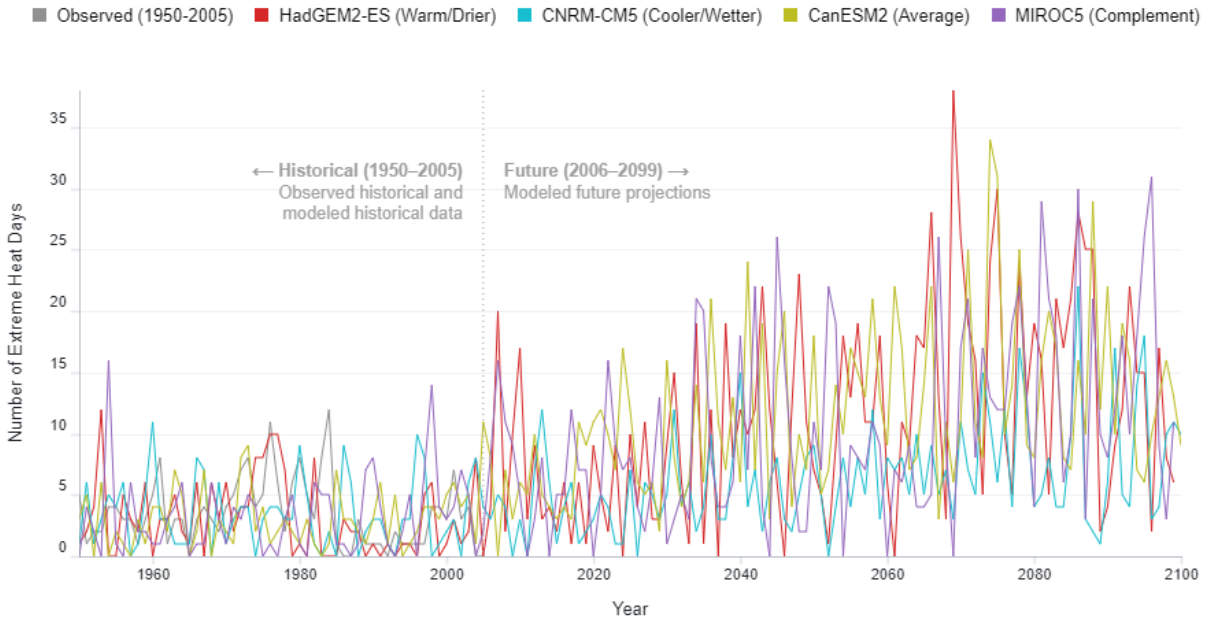
Likely – Temperatures of extreme heat are likely to continue to occur annually in the Planning Area.

Climate Change Considerations

Heat waves are likely to become more frequent, which will have direct impacts on human health in terms of heat related illness. With the general trend of increased warming of average temperatures, extreme high temperatures will likely also increase. Cascading impacts include increased stress on water quantity and quality, degraded air quality, and increased potential for more severe or catastrophic natural events such as heavy rain, droughts, and wildfire. Another cascading impact includes increased duration and intensity of wildfires with warmer temperatures. According to the 2013 document, *Preparing California for the Extreme Heat*, Cal-Adapt projects that throughout California urban and rural population centers will experience an average of 40 to 53 extreme heat days by 2050 and an average of 40 days by 2099 (Cal-Adapt 2013). This compares to a historical average of four days per year (Cal-Adapt 2013). Cal Adapt also projects that overall temperatures are expected to rise substantially throughout this century. Future temperature estimates from Cal Adapt for the community of El Verano under high and low emission scenarios are shown in Figure 4-21. The top graph shows the number of days per year when daily maximum temperature is above the extreme heat threshold of 98°F under the RCP 8.5 scenario (business as usual). The bottom graph shows the number of days per year when daily maximum temperature is above the extreme heat threshold of 103.9°F under the RCP 4.5 scenario.

Figure 4-21 El Verano – Future Extreme Heat Days in High and Low Emission Scenarios





Source: Cal-Adapt 2019

Extreme heat has also been shown to accelerate wear and tear on the natural gas and electrical infrastructure (California Natural Resources Agency 2018). Projected increases in summer demand associated with rising temperatures may increase risks to energy infrastructure and may exceed the capacity of existing substations and distribution line infrastructure and systems.

A recent study on extreme heat released by the Union of Concern Scientists in July 2019 analyzed three global climate scenarios associated with different levels of heat-trapping emissions and future warming. The results of the analysis showed that with no actions taken to reduce heat-trapping emissions by midcentury (2036-2065) the average number of days per year in the United States with a heat index above 100°F will double, while the number of days per year above 105°F will quadruple. The modeling completed for the study showed that the most dramatic transformations will be felt in areas where the climate has been temperate. The District's Planning Area could experience up to 11 more times as many days per year in which the heat feels like 90 degrees (KQED 2019). According to Cal-Adapt Climate Projections for the Bay Area Region as stated in the *2017 Climate Change Health Profile Report for Sonoma County*, by 2100 the number of heat waves in the Bay Area Region is expected to be between 6 to 10 heatwaves per year.

Based on Sonoma County's 2016 CAP, climate change is also expected to result in higher average temperature and more extreme heat events. If future GHG emissions are mitigated or reduced over time, summer high temperatures are expected to rise by 1 to 2°F. Whereas, if GHG emissions are not mitigated average summer high temperatures will increase by up to 9 to 11°F by 2100 (RCAP 2016). For these reasons, climate change would have a "high" influence on extreme heat hazards.

Vulnerability Assessment

Recent research indicates that the impact of extreme heat, particularly on populations, has been historically under-represented. The risks of extreme heat are often profiled as part of larger hazards, such as drought or wildfire. However, as temperature variances occur independent of other hazards or outside of the expected seasons, extreme heat can incur large costs and it is important to examine them as stand-alone hazards. Extreme heat can overload demands for electricity to run air conditioners in homes and businesses during prolonged periods of exposure and presents health concerns to individuals who are outside.

Extreme heat can be a secondary effect of droughts or may cause temporary drought-like conditions. Several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist. Extreme heat can cause infrastructure damage to roads. In summary, all property is vulnerable from extreme heat.

Customers

Traditionally, the very young and very old are considered at higher risk to the effects of extreme heat, but any populations outdoors during periods of extreme temperatures are exposed, including infants, young children under age of five, individuals with disabilities, individuals with impaired mobility, and homeless populations. While everyone is vulnerable to extreme heat incidents, some populations are more vulnerable than others. Extreme heat poses the greatest danger to outdoor laborers, such as highway crews, police and fire personnel, and construction workers. The elderly, children, people in poor physical health, and the homeless are also vulnerable to exposure. Arguably, the young-and-otherwise-healthy demographic may also experience a higher vulnerability of exposure, due to the increased likelihood that they will be out in temperatures of extreme heat, whether due to commuting for work or school, conducting property maintenance such as lawn care, or for recreational reasons. As a result, it is difficult to isolate the District's specific vulnerability to this hazard, as the impacts from extreme heat can be

spread across an entire state or region. In general, all the District's customers can be considered at-risk to this hazard, and particularly if there is a water shortage.

Critical facilities may be vulnerable to the indirect impact of prolonged excessive heat (i.e., electrical power outages), which may impact response capabilities or care capabilities for hospitals and clinics. Hospitals and clinics may see a surge in patients during the heat event as the exposed population suffers from the effects of the heat, but it is not anticipated that these temperature increases will overwhelm the capacities of hospitals and clinics in Sonoma. Essential infrastructure, especially the electrical distribution system, is also posed to be stressed during extreme heat events as demand increases to run air conditioning. Peak demand exceeding the local utility's capacity for supply can then lead to blackout or brownout conditions. Unplanned blackouts and PSPS is a reduction in or a restriction in the availability of electrical power in a particular area. When PSPS happen because of two natural hazard events, for instance high winds and extreme heat, the risk of heat-related illnesses and death increases on sensitive populations.

Critical Water Facilities and Infrastructure

Extreme heat can affect critical infrastructure, but the impacts are expected to be minimal given there are a limited number of days where temperatures stay high, which give critical infrastructure periods to cool down between temperature cycles. However, critical infrastructure that relies on public utility systems that could be overloaded may result in impacts during extreme heat events. As previously mentioned, the loss of utilities or power outages during extreme heat events could also result in adverse secondary impacts to sensitive populations.

Historic, Cultural, and Natural Resources

Extreme heat may cause temporary drought-like conditions. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist. Changing heating and cooling patterns globally can also have secondary impacts, intensifying a variety of weather-related disasters that directly impact municipalities' historic and cultural resources.

Future Development

Since structures are not usually directly impacted by severe temperature fluctuations, continued development is less impacted by this extreme heat than others in the plan. Continued development implies continued population growth, which raises the number of individuals potentially exposed to temperature variations. Public education efforts should help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of extreme heat.

Risk Summary

- The average high temperature for Sonoma Valley in July is 88.6°F and the highest recorded temperature was 110°F on June 2, 1960.
- Extreme heat can have severe impacts on human health, the natural environment, and the economy.
- The very young, the elderly, people with poor physical health, and the homeless are more susceptible to the impacts of extreme temperatures.
- The average number of days per year in the United States with a heat index above 100°F will double, while the number of days per year above 105°F will quadruple if no actions to reduce heat-trapping emissions are taken.

- Extreme heat impacts on critical water infrastructure are expected to be minimal given there are a limited number of days where temperatures stay high, which give critical infrastructure periods to cool down between temperature cycles.
- Climate change is expected to result in higher average temperature and more extreme heat events. In other words, climate change will have a "high" influence on the number of extreme heat days.
- Overall, the significance of extreme heat is **Low.**

4.3.7 Severe Weather: Heavy Rain/ Thunderstorm/ Hail/ Lightning/ Dense Fog

Hazard Description

Severe storms in the Planning Area are generally characterized by heavy rain accompanied by strong winds, and lightning. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado.

Heavy Rain

Atmospheric rivers, a climate pattern that leads to adverse weather in Sonoma Valley, are responsible for up to 50 percent of California's precipitation annually and 65 percent seasonally (Arcuni, 2019). An atmospheric river (AR) is a long, narrow region of the atmosphere, like a river in the sky, that transports most of the water vapor outside of the tropics. ARs can be 300 miles wide, a mile deep and more than 1,000 miles long and carry an amount of water vapor roughly the same as the average flow of water at the mouth of Mississippi River (NOAA 2015). Warm water storms over the Pacific Ocean lead to evaporation and create a high concentration of moisture in the air, while prevailing winds create the distinctive river shape, which is often compared "to a fire hose pointed at California" (Arcuni 2019). When an atmospheric river reaches land, it releases the water vapor in the form of rain or snow. Atmospheric rivers play an important role in the global water cycle and are closely tied to both water supply and flooding risk.

Research suggests that atmospheric rivers contributed to the collapse of both Orville Dam spillways in February 2017 (NASA Global Hydrology Resource Center 2018), as well as the winter flooding in 1861-1862, which inundated Sacramento and is considered the worst flood event in California's history (Ingram 2013). When an atmospheric river forms in the tropical regions of the Pacific near Hawaii it is known as a "Pineapple Express". This type of atmospheric river can produce as much as five inches in one day (NOAA 2018). In 2018, two Pineapple Express ARs hit California causing significant heavy precipitation events throughout state.

Sonoma Water entered into a cooperative agreement with Scripps Institution of Oceanography and the Center for Western Extremes (CW3E) to advance the research in ocean science and meteorology. Three projects have come from the initial agreement: 1) research to help define the role of atmospheric rivers in filling Lake Mendocino and potentially offering predictability in retaining water without increasing flood risk; 2) a NOAA-funded climate program project to study the role of atmospheric rivers in ending droughts on the Russian River; and 3) cooperation in developing a feasibility assessment for potential use of forecast-informed reservoir operations for Lake Mendocino in cooperation with the U.S. Army Corps of Engineers.

Hail

Hail is formed when water droplets freeze and thaw as they are thrown high into the upper atmosphere by the violent internal forces of thunderstorms. Hail is sometimes associated with severe storms within the Planning Area. Hail falls when it becomes heavy enough to overcome the strength of the updraft and is

pulled by gravity towards the earth. Hailstorms occur throughout the spring, summer, and fall in the region, but are more frequent in late spring and early summer. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 mph. Hail causes nearly $1 billion in damage to crops and property each year in the United States. Hail is also one of the requirements that the NWS uses to classify thunderstorms as 'severe.' If hail more than ¾ of an inch is produced in a thunderstorm, it qualifies as severe. Severe hailstorms can be quite destructive, causing damage to roofs, buildings, automobiles, vegetation, and crops.

The NWS classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-23 below indicates the hailstone measurements utilized by the NWS.

Dense Fog

Fog results from air being cooled to the point where it can no longer hold all of the water vapor it contains. For example, rain can cool and moisten the air near the surface until fog forms. A cloud-free, humid air mass at night can lead to fog formation, where land and water surfaces that have warmed up during the summer are still evaporating water into the atmosphere. This is called radiation fog. A warm moist air mass blowing over a cold surface also can cause fog to form, which is called advection fog.

Sonoma County is made up of three major climactic zones, with the major climatic influence being the Pacific Ocean. The three major climate zones include the marine zone, coastal cool zone, and the coastal warm inland zone. The District falls within the coastal warm inland zone, which is the driest, hottest, and coldest in the County. The marine and coastal cool zone influences fade in this climate zone, but it continues to have a moderating influence, especially in the winter when the average lows are lifted above freezing. The prevailing weather and winds tend to come from the Pacific Ocean from the northwest. Areas such as Sonoma Valley tend to receive more precipitation in the fall and winter and more wind and fog in early morning of the summer months.

Lightning

Lightning is an electrical discharge between positive and negative regions of a thunderstorm. A lightning flash is composed of a series of strokes with an average of about four. The length and duration of each lightning stroke vary, but typically average about 30 microseconds.

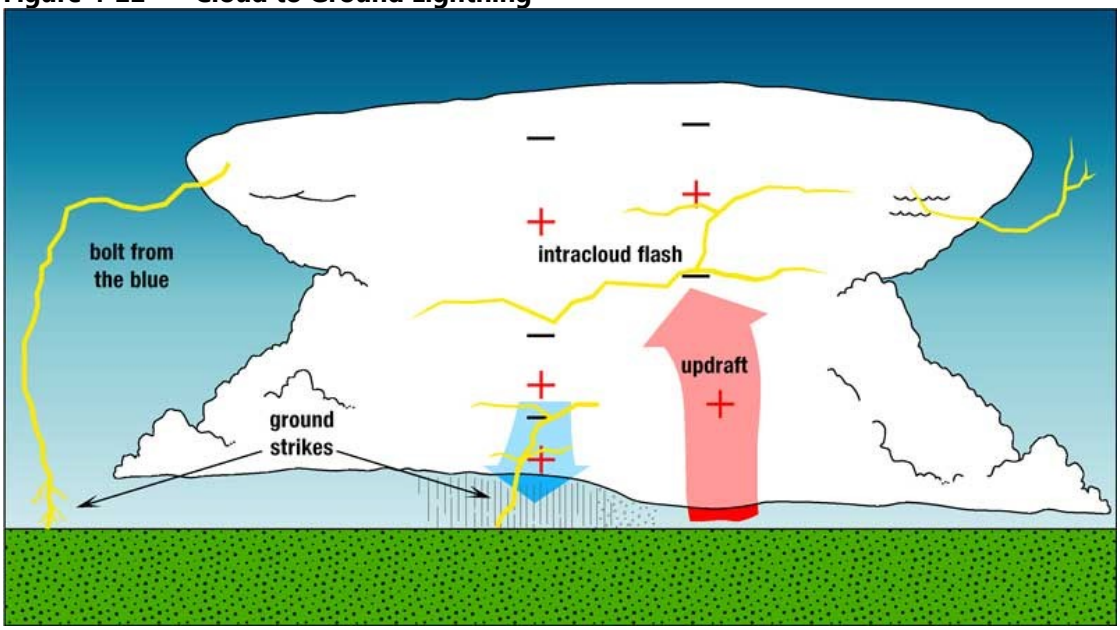
Lightning is one of the more dangerous weather hazards in the United States. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines, and electrical systems. Lightning also causes forest and brush fires, and deaths and injuries to livestock and other animals. According to the National Lightning Safety Institute, lightning causes more than 26,000 fires in the United States each year. The Institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be in excess of $6 billion per year. Impacts can be direct or indirect. People or objects can be directly struck, or damage can occur indirectly when the current passes through or near it.

Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly

dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat (see Figure 4-22). Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

Figure 4-22 Cloud to Ground Lightning



Source: National Weather Service Pueblo Office

The ratio of cloud-to-ground and intra-cloud lightning can vary significantly from storm-to-storm. Depending upon cloud height above ground and changes in electric field strength between cloud and earth, the discharge stays within the cloud or makes direct contact with the earth. If the field strength is highest in the lower regions of the cloud, a downward flash may occur from cloud to earth.

Geographic Location

Extensive – Heavy rains and severe storms have the potential to occur anywhere in the Planning Area.

Magnitude/Severity

Limited – Extent for severe weather, particularly severe storms that involve heavy rain and hail, can be measured according to hail by diameter size, as it corresponds to everyday objects to define the severity to the population (Table 4-23).

Common problems associated with severe storms include the loss of utilities or immobility. Loss of utilities can occur when severe thunderstorms cause trees or tree limbs to fall and damage power lines. Lightning can also cause severe damage and injury, particularly when it causes wildfires. Loss of life is uncommon but can occur during severe storms. Immobility can occur when roads become impassable due to dense fog, flooding, downed trees, ice, or a landslide.

Extent for dense fog is described in terms of reduced visibility and this is the primary reason fog can be a hazard. Visibility is a measure of the distance at which an object or light can be clearly discerned, and it depends on the transparency of the surrounding air. Fog specifically poses a risk to commuters and driving conditions as fog typically forms rapidly in the early morning hours and reduces visibility.

Nighttime driving in the fog is also dangerous and multi-car pileups have resulted from drivers using excessive speed for the conditions and visibility.

During an average summer there are many days when fog maintains a band of cold air along the Sonoma coastline and cold breezes blow a fog bank in through the Petaluma gap and northward toward Santa Rosa and northwestward toward Sebastopol (UC Davis 2008). The fog band also moves around Sonoma Mountain, but does not typically reach the Glen Ellen area or northern Sonoma Valley since the coastal warm zone is protected from the early fog bank by elevation, the mountain range, and distance (distance to the San Pablo Bay and time). As a result, northern Sonoma Valley experiences limited early morning fog during the summer months due to its distance from the fog path and due to the mountain range. Whereas, southern Sonoma Valley, including El Verano and the City of Sonoma is within the coastal cool zone where cold foggy air can linger due to the proximity to the San Pablo Bay.

While dense fog results in limited visibility and can affect traffic flow (road, water, and air travel), it rarely has a direct effect on water utility infrastructure, such as aboveground water storage facilities and underground water conveyance pipelines. For this reason, dense fog is not high priority hazard for the District compared to the impacts heavy rain and lightning can have on the District's critical water infrastructure. Therefore, the District does not have dense fog mitigation actions in this plan.

The NWS classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-23 indicates the hailstone measurements utilized by the NWS.

Table 4-23: Hail Measurements

Average Diameter	Corresponding Household Object
.25 inch	Pea
.5 inch	Marble/Mothball
.75 inch	Dime/Penny
.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball
1.75 inch	Golf-Ball
2.0 inch	Hen Egg
2.5 inch	Tennis Ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

There is no clear distinction between storms that do and do not produce hailstones. Nearly all severe thunderstorms probably produce hail aloft, though it may melt before reaching the ground. Multi-cell thunderstorms produce many hailstones, but not usually the largest hailstones. In the life cycle of the multi-cell thunderstorm, the mature stage is relatively short so there is not much time for growth of the hailstone. Supercell thunderstorms have sustained updrafts that support large hail formation by repeatedly lifting the hailstones into the very cold air at the top of the thunderstorm cloud. In general, hail two inches (5 cm) or larger in diameter is associated with supercells (a little larger than golf ball size which the NWS considers to be 1.75 inch.). Non-supercell storms are capable of producing golf ball size hail.

In all cases, the hail falls when the thunderstorm's updraft can no longer support the weight of the ice. The stronger the updraft the larger the hailstone can grow. When viewed from the air, it is evident that hail falls in paths known as hail swaths. They can range in size from a few acres to areas 10 miles wide and

100 miles long. In some instances, piles of hail have been so deep that snowplows were required to remove them, and occasionally hail drifts have been reported.

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the NWS to define lightning activity into a specific categorical scale. The LAL is a common parameter that is part of fire weather forecasts nationwide. The District is at risk to experience lightning in any of these categories. The LAL is reproduced inTable 4-24.

Table 4-24: Lightning Activity Level Scale

LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five-minute period
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five-minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five-minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five-minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning.

Source: National Weather Service

The heavy precipitation that is possible in the District and all of California is often the result of an atmospheric river. Atmospheric rivers are categorized by a unit of measurement known as the Integrated Water Vapor Transport (IVT), which considers the amount of water vapor in the system and the wind that moves it around. For a storm to be classified as an atmospheric river it has to reach an IVT threshold of 250 units; 1,000 IVT or more is considered to be "extreme" (Arcuni, 2019). In 2019 a system for categorizing the strength and impacts of atmospheric rivers was developed by the Center for Western Weather and Water Extremes (CW3E), out of the Scripps Institution of Oceanography at the University of California San Diego. The newly developed scale ranks ARs into five categorizes from weak to exceptional. Unlike the Fujita scale for tornadoes that focuses on potential damages, the AR scale accounts for both storms that may be hazardous and storms that can provide benefits to the local water supply. A category one AR is considered to be primarily beneficial, generally lasting only 24 hours and produces modest rainfall. On the other end of the scale, a category five AR is considered "exceptional" and primarily hazardous, lasting for several days and associated with heavy rainfall and runoff that may cause significant damages. Table **4-25** describes the scale further. The Center developed the scale as a tool for officials with an operational need to assess flooding potential in their jurisdictions before the storms makes landfall.

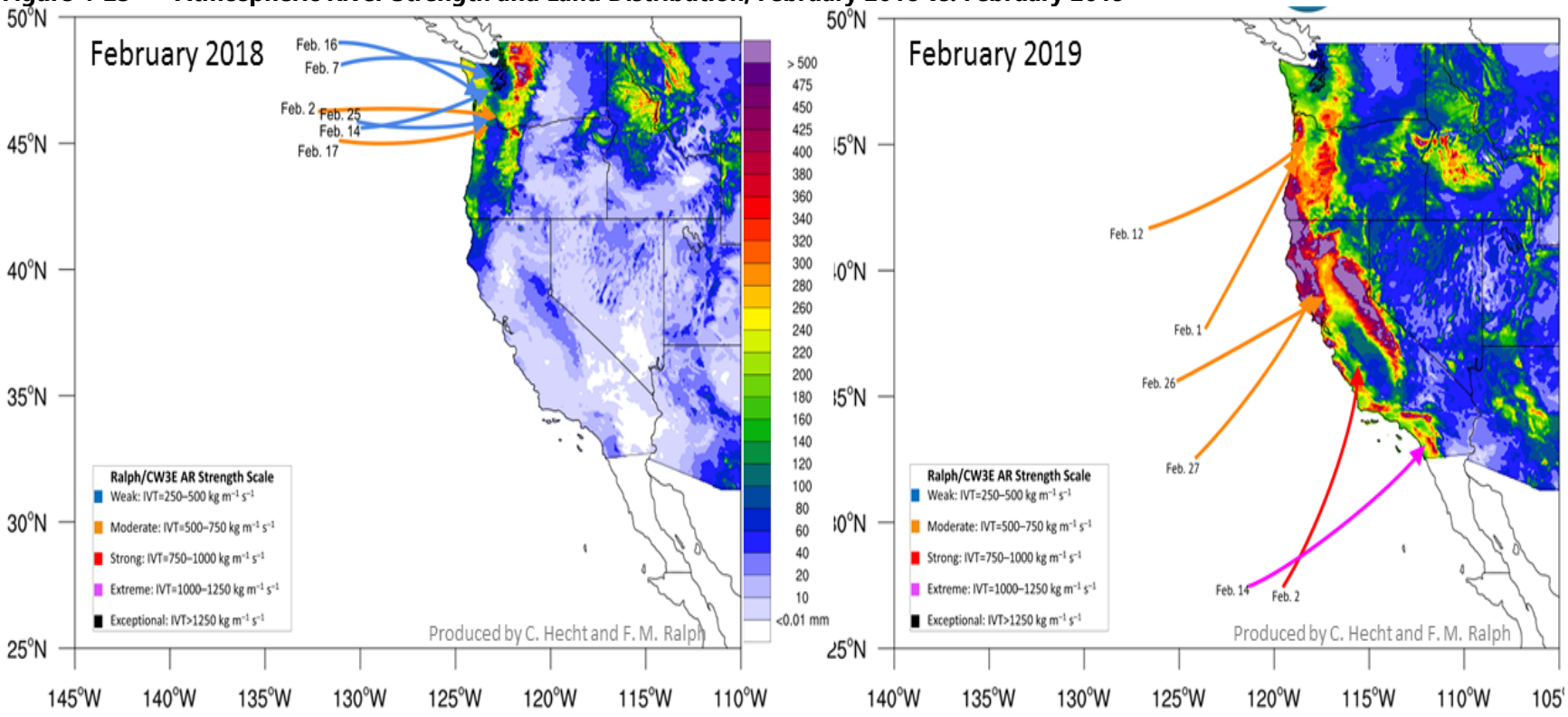
In both February 2018 and 2019 the West Coast experienced six atmospheric rivers. But as Figure 4-23 from the Center for Western Weather and Water Extremes shows, California experienced vastly different precipitation totals due to the location of where the atmospheric river made landfall as well as each atmospheric river's IVT. Using the AR scale developed by CW3E, the ARs in February 2019 were all considered to be moderate to extreme and concentrated more on California, resulting in heavy precipitation.

Table 4-25: Atmospheric River Categories

Category	Potential Impacts
AR Cat 1: Weak	Primarily beneficial. For example, a Feb. 2, 2017 AR hit California, lasted 24 hours at the coast, and produced modest rainfall.
AR Cat 2: Moderate	Mostly beneficial, but also somewhat hazardous. An atmospheric river on Nov. 19-20, 2016 hit Northern California, lasted 42 hours at the coast, and produced several inches of rain that helped replenish low reservoirs after a drought.
AR Cat 3: Strong	Balance of beneficial and hazardous. An atmospheric river on Oct. 14-15, 2016 lasted 36 hours at the coast, produced 5-10 inches of rain that helped refill reservoirs after a drought, but also caused some rivers to rise to just below flood stage.
AR Cat 4: Extreme	Mostly hazardous, but also beneficial. For example, an atmospheric river on Jan. 8-9, 2017 that persisted for 36 hours produced up to 14 inches of rain in the Sierra Nevada and caused at least a dozen rivers to reach flood stage.
AR Cat 5: Exceptional	Primarily hazardous. For example, a Dec. 29, 1996 to Jan. 2, 1997 atmospheric river lasted over 100 hours at the Central California coast. The associated heavy precipitation and runoff caused more than $1 billion in damages.

Source: Center for Western Weather and Water Extremes, Scripps Institution of Oceanography at UC San Diego. Scale was developed by F. Martin Ralph Director of CW3E in collaboration with Jonathan Rutz of NWS.

Figure 4-23 Atmospheric River Strength and Land Distribution, February 2018 vs. February 2019



Source: Center for Western Weather and Water Extremes, Scripps Institution of Oceanography at UC San Diego

Previous Occurrences

Heavy rains and severe storms occur in the Planning Area primarily during the late fall and winter. According to information obtained from the WRCC the majority of precipitation is produced by storms during January and other winter months. Precipitation during the summer months is in the form of rain showers and is rare. Snowstorms and ice storms occur infrequently in the District. The Storm Events Database records one snow event near the District's Planning Area in January 28, 2002 with one to two inches of snow falling in parts of Sonoma County; the Database notes this was "quite a rare event". The second event occurred on January 1, 2011 when a strong system from the Gulf of Alaska affected the San Francisco and Monterey Bay areas; the system brought strong gusty winds and heavy rain. The NCEI records 39 hail, heavy rain, lighting and dense fog events that have taken place in Sonoma County in the past 68 years (1950 –2018). Table 4-26 is a summary of the most significant severe weather events for Sonoma County.

Table 4-26: Severe Weather Events recorded in Sonoma County (1950-2020)

Hazard Type	Date	Hazard Description
Dense Fog	February 8, 2012	Dense fog is blamed in 11 crashes on Highway 37 near Skaggs Island Rd. There were 31 vehicles involved in the crashes. Two people suffered minor injuries. $100,000 in property damages were recorded.
	December 10-11, 2018	Widespread dense fog impacted the Bay Area blanketing the Bay and interior valleys. Numerous reports of dense fog with visibility less than 1/4 mile. A Dense Fog Advisory was issued for the North and East Bay Valleys as well as the San Francisco Peninsula and surrounding bay coastline.
Hail	Jan. 19, 2018	A cold front swept through the region late on the 18th. Small scattered thunderstorms were generated behind the front bringing pea sized hail (0.25 in.) to the region.
	Jan. 25, 2018	Isolated thunderstorms developed behind a cold front that passed through the area on the 25th. These thunderstorms caused minor roadway flooding and small hail (0.25 in.)
	March 14, 2018	The Press Democrat in Santa Rosa showed multiple reports of accumulating small hail in downtown Petaluma (0.25 in.); An upper level disturbance moved through the area on the afternoon of the 14th. This disturbance created scattered thunderstorms that resulted in lightning and accumulating hail in the North and East Bay areas.
Lightning	March 14, 2018	The Press Democrat in Santa Rosa reported that lightning struck a PG&E circuit at 11 am the morning of the 14th causing a power outage for 25 Petaluma residents lasting through the evening. An upper level disturbance moved through the area on the afternoon of the 14th. This disturbance created scattered thunderstorms that resulted in lightning and accumulating hail in the North and East Bay areas.
Heavy Rain	December 15, 2008	Heavy rain caused a fatality of a 32-year-old man when his vehicle collided with another vehicle. Highways 116 and 121 were closed for about three hours after the collision. A cold core low pressure system produced winter storm conditions causing low elevation snow, minor flooding and isolated strong wind through the period December 15 through 17, 2009. $25,000 in property damages is recorded.
	December 22, 2012	A series of storm systems, part of a large Atmospheric River type of pattern, impacted the area during late December 2012. From the 21st through 26th of December, heavy rain, gusty winds, flooding, and mudslides occurred across the Bay Area in these consecutive events. Downed trees, powerlines, and flooded roadways impacted residents over

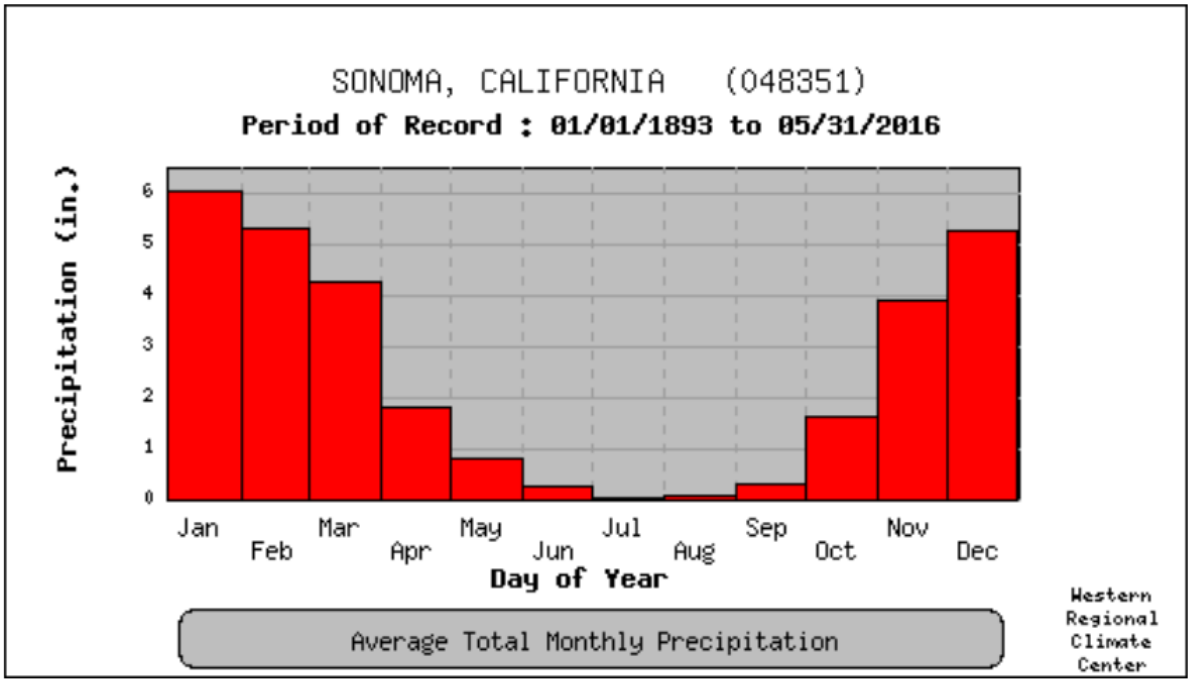
Hazard Type	Date	Hazard Description
		the Christmas holiday season. $30,000 in property damages were recorded.
	December 11, 2014	An Atmospheric River event brought heavy rain and gusty winds with a strong winter storm that impacted the Bay Area for several days in mid-December. Many locations around the entire Bay Area had flooding: urban flooding of streets and highways, flooding of creeks and even one large river in the North Bay. Eventually the NCFR (narrow cold frontal rainband) slowed around the Big Sur Coast. The stalling was likely due to another 'wave' in the atmosphere, farther to the southwest, riding along the boundary. The end result was to have the weakened NCFR lift back northward, almost like a quasi-warm front, producing another round of moderate to locally heavy rainfall around the Bay Area, compounding flooding concerns. The event was followed by several weaker storm systems that week that brought additional rainfall, continued flooding and mudslide concerns to the area.
	January 16, 2019	A moderate to strong atmospheric river impacted much of California in the middle of the month. A weak surface low developed off the coast on January 15th bringing moderate to heavy rainfall to portions of the region. Over the next 24 to 36 hours a second strong low-pressure system moved to the north and east bringing heavy rain, destructive winds, high surf, flooding, and thunderstorms to the Bay Area. Numerous reports were received of downed trees and power lines. Winds were recorded between 60 and 100 mph. Downed trees resulted in two fatalities.

Source: National Centers for Environmental Information, Strom Events Database.

El Verano – Sonoma Weather Station (Period of Record 1893 to 2016)

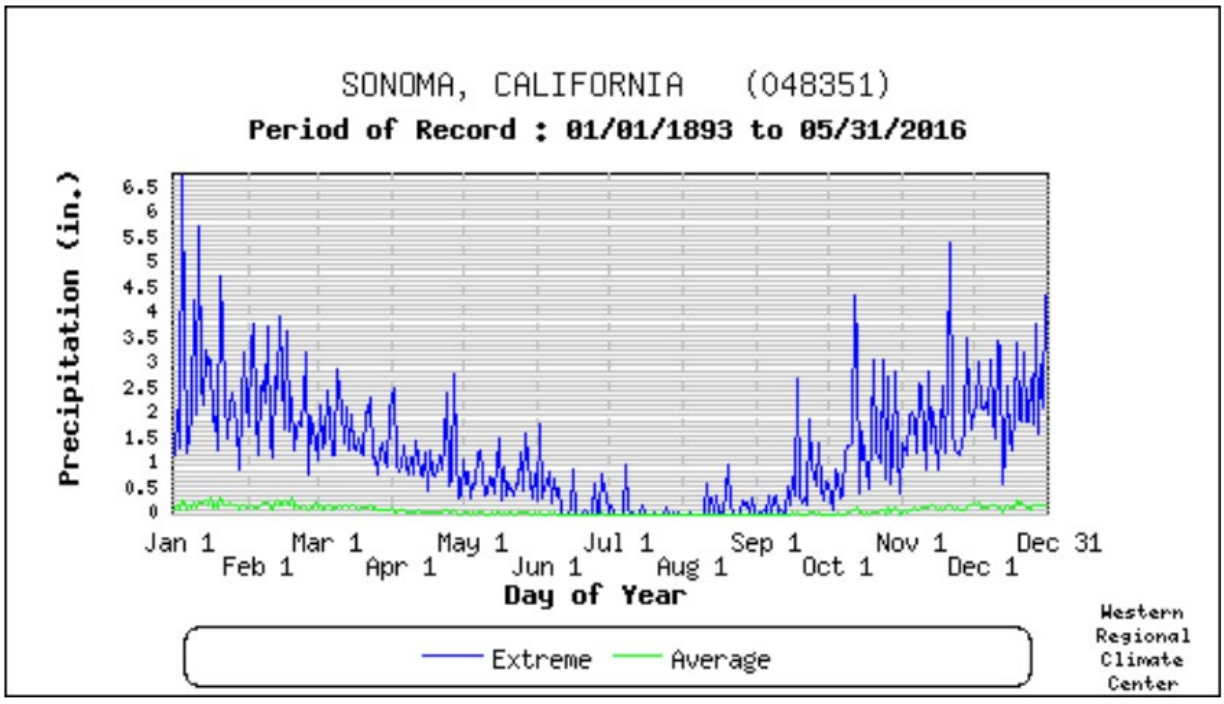
Information from the closest weather station with the most comprehensive data, Sonoma Weather Station, is summarized below in Figure 4-24 and Figure 4-25. Average annual precipitation in the Planning Area is 29.43 inches per year. The highest recorded annual precipitation was 63.45 inches in 1983; the highest recorded precipitation for a 24-hour period is 6.75 inches on January 4, 1982. The lowest recorded annual precipitation was 11.34 inches in 1976.

Figure 4-24 City of Sonoma's Monthly Average Total Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Figure 4-25 City of Sonoma's Daily Average and Extreme Precipitation



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Probability of Future Occurrences

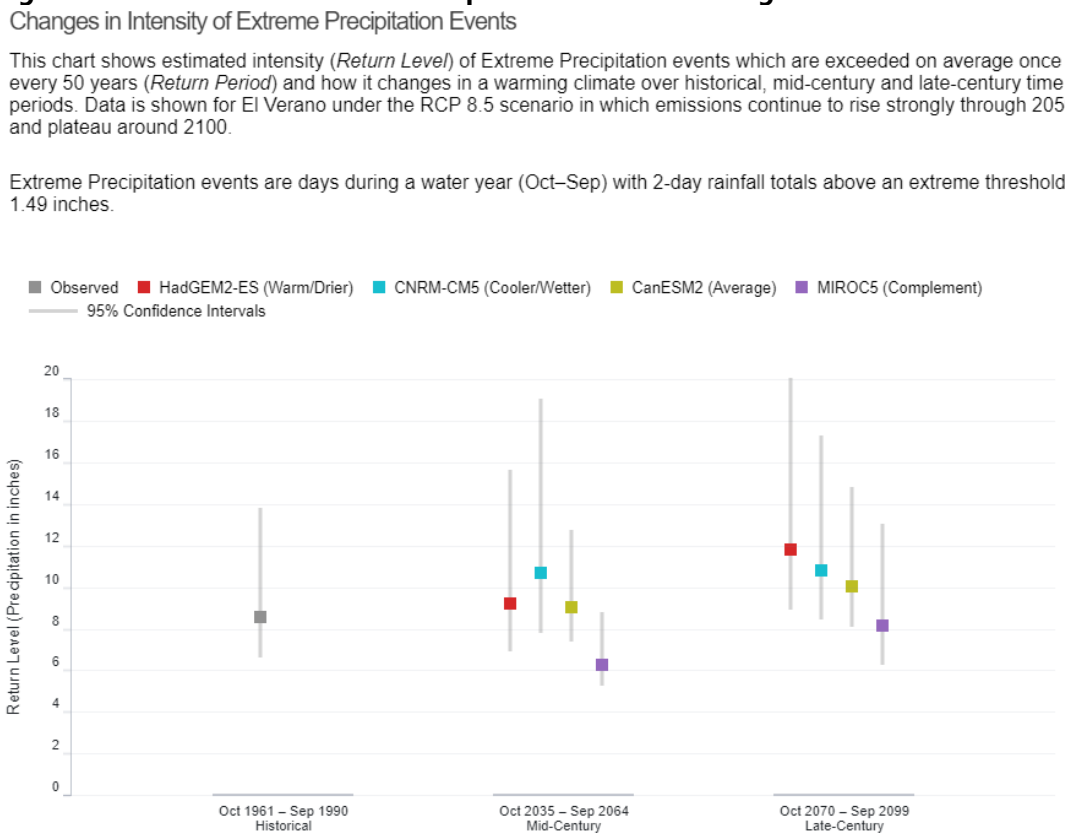
Likely – Heavy rain, thunderstorms, hail, and lightning wind and fog events are well-documented seasonal occurrences that will continue to occur annually in the Planning Area.

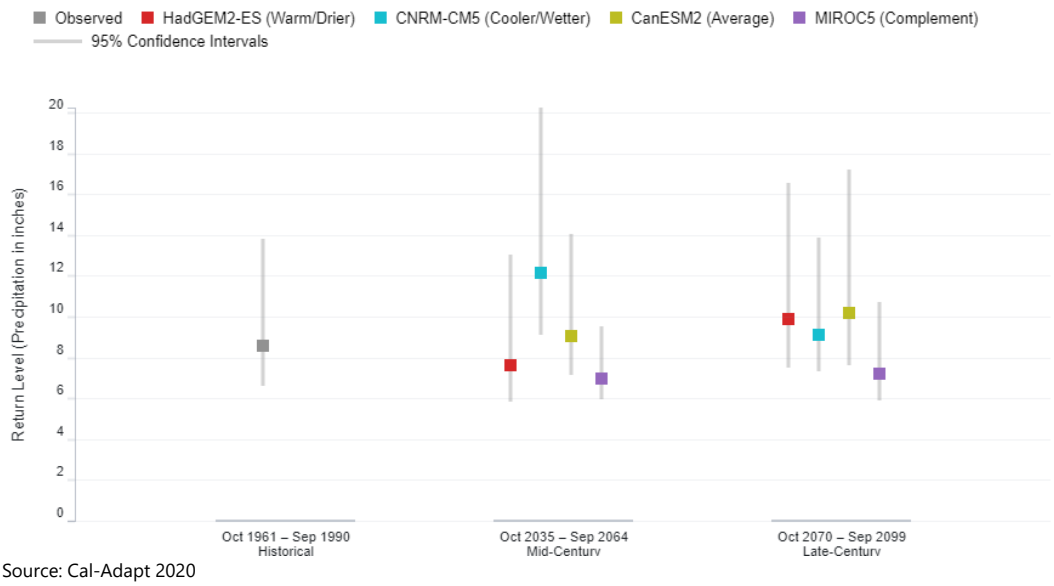
Climate Change Considerations

As average temperatures increase over time, this generally will result in higher extreme temperatures and more warming in the atmosphere can trigger climate changes, which could result in more frequent extreme weather events. According to California's Fourth Climate Change Assessment, the number of days each year on which the atmospheric rivers bring "extreme" amounts of rain and snow to the region are expected to increase under the projected climate change for the state, possibly increasing more than a quarter. Pacific Northwest National Laboratory researchers found that atmospheric rivers will reach the West Coast more frequently if GHG emissions continue to rise under business as usual conditions. Currently, the West receives rain or snow from these atmospheric rivers between 25 and 40 days each year. By the end of this century, days on which the atmospheric rivers reach the coast could increase by a third this century, between 35 and 55 days a year. Meanwhile, the number of days each year on which the atmospheric rivers bring "extreme" amounts of rain and snow to the region could increase by more than a quarter.

Cal-Adapt indicates that on average, projections show little change in total annual precipitation in California; however, the Mediterranean seasonal precipitation pattern is expected to continue, with most precipitation falling during the winter months from North Pacific storms. Cal-Adapt provides extreme future precipitation estimates that summarize the intensity and frequency of events. Future extreme precipitation estimates for the community of El Verano are shown in Figure 4-26. The upper chart shows estimated intensity of extreme precipitation events under the RCP 8.5 scenario that are exceeded on average every 50 years and how it changes in a warming climate over historical, mid-century, and late-century time periods. This chart shows that emissions rise strongly through 2050 and plateau by 2100 and that extreme precipitation events are days during a water year (October – September) with 2-day rainfall totals above an extreme threshold of 1.49 inches. The lower chart also shows estimated intensity of extreme precipitation events but under the RCP 4.5 scenario that are exceeded on average every 50 years. This chart shows that emissions peak by 2040 and then decline and that extreme precipitation events are days during a water year (October – September) with 2-day rainfall totals above an extreme threshold of 1.49 inches.

Figure 4-26 El Verano Future Precipitation Estimates in High and Low Emission Scenarios





Source: Cal-Adapt 2020

It is difficult at this point in time to predict the effects climate change will have on these hazards. However, as average temperatures increase over time, this generally will result in higher extreme temperatures. More warming in the atmosphere will trigger climate changes, which will result in more frequent extreme weather events. Much of the U.S. has already experienced prolonged periods of heavy downpours and severe flooding as a result of more extreme heavy rain and thunderstorm events. For these reasons, climate change would have a "high" influence on severe weather, specifically more heavy rainfall and precipitation events.

Vulnerability Assessment

Based on historic information, these storms have not directly resulted in significant injury or damages to people and property, or the losses are typically covered by insurance. It is the secondary hazards caused by weather, such as floods, that have had the greatest impact on the District's Planning Area. But while the primary effects may not result in significant injury or property damage, all property is vulnerable during severe weather events; properties in poor condition or closer to overhead power lines and large trees may be more vulnerable to damage.

Customers

Exposure is the greatest danger to people and District customers from severe thunderstorms. People can be hit by lightning, pelted by hail, and caught in rising waters. However, serious injury and loss of human life is rarely associated with hailstorms. Reduced visibility is the greatest risk to people when heavy fog is prevalent. Particularly when fog is dense, it can be hazardous to drivers, mariners, aviators, and District operational staff and contributes to numerous accidents each year. To reduce injury and harm, people should avoid driving when dense fog is prevalent, if possible. If driving is pertinent, emergency services advise driving with lights on low beam, avoiding stopping on highways, and avoiding crossing traffic lanes.

While national data shows that lightning causes more injuries and deaths than any other natural hazard except extreme heat, there does not seem to be any trend in the data to indicate that one segment of the population is at a disproportionately high risk of being directly affected. Anyone who is outside during a thunderstorm is at risk of being struck by lightning. Aspects of the population who rely on constant, uninterrupted electrical supplies may have a greater, indirect vulnerability to lightning. As a group, the elderly or disabled, especially those with home health care services rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, residential facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. If they do not have a back-up power source, rural residents and agricultural operations reliant on electricity for heating, cooling, and water supplies are also vulnerable to power outages. Thunderstorms have the potential energy and strong winds to topple dead trees and injure people. As a result, power outages that occur from severe weather can be life threatening and these populations could face more exposure and could experience greater secondary effects of the hazard. Refer to the Vulnerability Assessment for Severe Weather: High Winds hazards below for analysis related to electricity dependent populations in the District's Planning Area.

Critical Water Facilities and Infrastructure

Due to the unpredictability of severe thunderstorm strength and path, most critical infrastructure that is above ground, such as the District's water tanks and BPSs are equally exposed to the storm's impacts. According to historical data the Planning Area has experienced power outages in the past due to severe storms, but due to the random nature of these hazards, a more specific risk assessment was not conducted for this plan. Heavy rain and thunderstorms, particularly those that result in hail could significantly impact motorists travelling along U.S. Highway 101 and State Highway 116. Depending on

the severity of the storm, these events could slow traffic, reduce visibility, and increase the likelihood of vehicle accidents along the highway, which may result in greater traffic delays. These effects are also likely to occur along highway segments in adjacent counties.

Fog can have devastating effects on transportation corridors and traffic patterns in Sonoma Valley and throughout the County. Dense fog may increase the potential for transportation accidents along State Highway 12 which could in turn cause longer traffic delays and timely movement of goods and services. Multi-car pileups have resulted from drivers using excessive speed for the conditions and visibility.

These accidents can cause multiple injuries and deaths and could have serious implications for human health and the environment if a hazardous or nuclear waste shipment were involved. Other disruptions from fog include delayed emergency response vehicles and school closures. While dense fog can negatively impact traffic due to reduced visibility, it has limited impacts on the operation of water facilities and infrastructure. Therefore, the District does not have dense fog mitigation action proposed in this plan.

Historic, Cultural, and Natural Resources

Severe thunderstorms are a natural environmental process. Environmental impacts include the sparking of potentially destructive wildfires by lightning and localized flattening of plants by hail. As a natural process, the impacts of most severe thunderstorms by themselves are part of the overall natural cycle and do not cause long-term consequential damage.

Future Development

New critical facilities, such as steel water tanks should be built to withstand heavy rain, lighting, and hail damage. Population and commercial growth in the District's Planning Area will increase the potential for complications with traffic accidents and commerce interruptions associated with dense fog. Future development projects for new District infrastructure should also consider severe weather hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Future development in the District's Planning Area is not expected to be vulnerable to the hazard, but all development will be affected by severe weather and storm events and population growth will increase potential exposure to hazards such as lightning and hail.

Risk Summary

- Sonoma County has experienced 39 hail, heavy rain, lighting, and dense fog events in past 68 years.
- The average annual precipitation in the City of Sonoma, the closest City to the District is 29.43 inches.
- The highest recorded annual precipitation was 63.45 inches in 1998.
- The highest recorded precipitation for a 24-hour period was 6.75 inches on January 4, 1992.
- While dense fog results in limited visibility and can affect traffic flow in the southern portion of Sonoma Valley, it rarely has a direct effect on water utility infrastructure. For this reason, dense fog is a low priority hazard and the District does not have dense fog mitigation actions in this plan.
- Overall significance for other severe weather hazards such as heavy rain, thunderstorms, hail, and lightning is **Medium.**

4.3.8 Severe Weather: High Winds

Hazard Description

High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. The predominant wind pattern in Sonoma Valley is out of the northwest and tends to be light in the morning

and windier in the afternoon, but compared to the coastal portion of the County, Sonoma Valley is drier and less windy.

Windstorms in the District are typically straight-line winds. Straight-line winds are generally any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). These winds can exceed 100 miles per hour (mph) and are responsible for most wind damage related to thunderstorms. These winds can overturn mobile homes, tear roofs off houses, topple trees, snap power lines, shatter windows, and sandblast paint from cars. Other associated hazards include utility outages, arcing power lines, debris blocking streets, dust storms, and an occasional structure fire. Table 4-27 outlines the Beaufort scale, describing the damaging effects of wind speed.

Table 4-27: Beaufort Wind Scale

Wind Speed (mph)	Description—Visible Condition
0	Calm; smoke rises vertically
1-4	Light air; direction of wind shown by smoke but not by wind vanes
4-7	Light breeze; wind felt on face; leaves rustle; ordinary wind vane moved by wind
8-12	Gentle breeze; leaves and small twigs in constant motion; wind extends light flag
13-18	Moderate breeze; raises dust and loose paper; small branches are moved
19-24	Fresh breeze; small trees in leaf begin to sway; crested wavelets form on inland water
25-31	Strong breeze; large branches in motion; telephone wires whistle; umbrellas used with difficulty
32-38	Moderate gale whole trees in motion; inconvenience in walking against wind
39-46	Fresh gale breaks twigs off trees; generally, impedes progress
47-54	Strong gale slight structural damage occurs; chimney pots and slates removed
55-63	Whole gale trees uprooted; considerable structural damage occurs
64-72	Storm very rarely experienced; accompanied by widespread damage
73+	Hurricane devastation occurs

Source: NWS

High winds and tornadoes can cause damage to property and loss of life. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response.

Geographic Location

Extensive – Strong winds have the potential to happen anywhere in the District's Planning Area. The resulting damage from wind events may be most severe in the downtown area of the District where there are more large trees, infrastructure, and higher density development.

Magnitude/Severity

Significant – The prevailing winds in Sonoma Valley come from the northwest. Winds tends to be lighter in the morning and windier in the afternoon as the ocean air arrives over the Sonoma Mountains. Based on NCEI records between 1950 and September 14, 2020 there have been 253 high and strong wind events in Sonoma County, causing a total of $3,854,700 in property damage. The most damaging event took place on December 27, 2006 and was a 30 mph wind event that resulted in over $1 million of property

damage to both commercial and residential structures. The highest magnitude event recorded occurred on October 27, 2019 and was in association with a series of offshore wind events that occurred in most of California. Strong surface high pressure built up over the Great Basin and a trough along the California coast provided the set up for one of the strongest dry offshore winds over the greater Bay Area since the 2017 North Bay Fires. Winds remained elevated for at least 24 hours with gusts in the hills that ranged from 60 to 80 miles per hour. A peak gust of 102 miles per hour was recorded near the Kincade Fire. These winds promoted rapid growth of the Kincade Fire and along with very dry conditions allowed for multiple new wildfires to spare in the Bay Area. Because of these high winds, a large portion of Sonoma County responded by evacuating downwind of the Kincade Fire. Further, prior to the high winds, PG&E shut off power to over two million people across the State.

High wind events in the County have led to five recorded fatalities and seven injuries. High wind event impacts would likely be limited, with a majority of impacts being related to property damages caused by down trees as well as power outages. Overall, impacts from high wind events would likely be limited, with 10 to 25 percent of property severely damaged.

Previous Occurrences

Despite being nearly 30 miles from the coast of the Pacific Ocean, Sonoma Valley's climate tends to be similar to inland coastal communities and drier and warmer. However, high wind events Sonoma Valley have also led to downed trees and power outages throughout Sonoma Valley. The following events are recorded in the NCEI Storm Events Database that are specific to the District's Planning Area.

January 10, 2010 – The third in a series of significant storms brought strong winds and heavy rain to the San Francisco and Monterey Bay areas. This storm, the strongest of the week, developed over the Pacific Ocean with strong low pressure based in the Gulf of Alaska. Around 159,000 customers lost power across the San Francisco Bay area with nearly 22,000 customers without power in the Monterey Bay area. Numerous power lines and trees were knocked down when strong wind combined with saturated soil. Also, areas of flooding occurred causing mainly problems for vehicles. In Sonoma, a fallen tree smashed a home. Along State Route 12, a tree fell onto a moving vehicle just east of Glen Ellen causing closure of the roadway. In Sonoma, a redwood tree fell through the roof of the K building at Sonoma Valley High School. In Healdsburg, power lines fell along Alexander Valley Road. The event resulted in $435,000 in damages.

January 20, 2012 – A storm system from the Gulf of Alaska brought gusty wind and periods of heavy rain across San Francisco and the Bay Area from January 19, 2012 through January 23, 2012. A large dead tree fell at a residence on Robin Drive and Arnold Drive in El Verano. The high wind event resulted in $4,500 in damages.

October 23, 2019 - A series of offshore wind events plagued much of California towards the end of October 2019. Cut off lows (also known as insider sliders) moved into the Great Basin as an upper ridge sat over the eastern Pacific. Strong surface high pressure also building over the Great Basin and a trough along the California coast provided the set up for strong and dry offshore winds over the greater Bay Area. Two more events would go on to occur before the end of the month providing what would be historic critical fire weather conditions for the region. The first event brought strong north to northeast winds to the region, particularly the North Bay, where gusts of 50 to 70 mph were observed. Healdsburg Hills North Station had a peak gust of 76 mph the night of October 23, 2020. These conditions fed the rapid growth of the Kincade Fire that broke out late in the evening of October 23, 2020 and at the end of the month the Kincade Fire was still burning. Additionally, near record breaking high temperatures were observed in parts of the area on the 24th and 25th. Prior to the event on October 9th PG&E shut off power to roughly 1 million people across the state of California.

November 26, 2019 – A rapidly intensifying and ultimately record setting low pressure system moved into northern California and the Pacific Northwest in late November. A strong cold front associated with this system swept through the Bay Area bringing heavy rain, roadway flooding, strong winds, low elevation snow, small hail, and large waves to the region. The event occurred 1.7 miles south of the community of Temelec in Sonoma Valley.

February 9, 2020 - An offshore wind event impacted the region from February 8, 2020 through February 9, 2020 when an upper trough moved through the Great Basin. Widespread wind gusts of 45 to 60 mph were observed with gusts of 87 mph recorded on Mt St. Helena. Trees and power lines were knocked down causing scattered power outages and property damage. Around 80,000 customers were without power across the Bay Area according to PG&E. A large oak tree crashed into a home and crushed two vans as well as damaged two additional cars on Riverside Dr. in Sonoma Valley. No one was injured.

Probability of Future Occurrences

Likely – A total of 258 combined high and strong wind events have occurred in Sonoma County over 70 years of record keeping, which equates to an average of 3.7 events in a typical year. Historical wind activity within the Planning Area indicates that the area will likely continue to experience high wind events during adverse weather conditions. The actual risk of a wind event to the District is dependent on the nature and location and the magnitude of a high wind event.

Climate Change Considerations

There presently is not enough data or research to quantify the magnitude of change that climate change may have related to wind frequency and intensity. Studies referenced in California's Fourth Climate Assessment indicated that extreme fire weather, particularly in the form of hot and dry winds, can strongly influence shrub-land fire regimes. Strong winds have also been associated with severe forest fires in California, meaning climate change impacts on wind patterns may also affect forest health and wildfire susceptibility. Lastly, other ongoing research compiled in the recent climate assessment has resulted in different conclusions on the effect of climate change on wind regimes, particularly extreme wind events, such as the Santa Ana and Diablo winds that created some of the most devastating wildfires (California Natural Resources Agency 2018a). At this time, these changing factors are not well understood and are still being incorporated into state and regional research and risk analysis.

Vulnerability Assessment

General damages from high wind events can be both direct and indirect impacts. Direct impacts refer to what the wind physically destroys, while indirect impacts include additional costs, damages and losses attributed to secondary hazards spawned by the event or resulting from the direct damages caused by the wind event. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary or indirect impacts of damage caused by wind events often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a wind event put tremendous strain on a community.

Customers

District customers are the most vulnerable to high wind events, particularly when they result in power outages that could in turn impact the delivery of drinking water. There are also segments of the population that are especially exposed to the indirect impacts of high winds, particularly the loss of electrical power. These populations include the elderly or disabled, especially those with medical needs

and treatments dependent on electricity. Nursing homes, community-based residential facilities, other special needs housing facilities, and other socially susceptible populations are vulnerable if electrical outages are prolonged, since backup power generally operates only minimal functions for a short period of time.

The U.S. Department of Health and Human Services (HHS) ePOWER Mapping 3.0 tool provides information on Medicare beneficiaries who rely on electricity-dependent medical equipment such as ventilators to live independently in their homes. According to the HHS ePOWER Mapping 3.0 tool there are 11,677 Medicare beneficiaries located in the unincorporated communities of El Verano, Boyes Hot Springs, Fetter Hot Springs, Eldridge, and Glen Ellen (within the zip codes of 95431, 95476, and 95442). Of these individuals, 249 are considered electricity dependent and are highly vulnerable to power outages as a result a high wind event.

Following the unprecedented 2018 wildfire season in California, PG&E announced it will be conducting PSPS when there are high winds and dry conditions and generally a heightened fire risk forecasted. The outages could last several days, and PG&E has suggested customers be prepared for outages that could last longer than 48 hours. A majority of Sonoma County could be affected by the power outages including almost the entirety of the Sonoma Valley. PG&E has a plan to install a resource area at the Sonoma-Marin Fairgrounds within 24 hours of a PSPS, and will offer power, air conditions and updates for local residents. Overall, the most common problems associated with high winds are loss of utilities. Downed power lines can cause power outages, leaving large parts of the District's Planning Area isolated, and without electricity, water, and communication.

In the event of a PSPS during red flag warnings, as described above, large portions of the District's Planning Area could be without power including several businesses. The economic impacts due to the PSPS depend on the length of the shutoff, and the subsequent downtime of specific power sources that do not have back-up supplies. Given the recent planned PSPS in October 2019 and in August 2020, economic impacts were reported across northern California as many businesses and restaurants and other tourism-based operations had to close due to limited to no power supply. In 2018, PG&E abruptly shut down the power in the Napa Valley region and the City of Calistoga reported that numerous small business lost tens of thousands of dollars in missed revenue and inventory (Argus-Courier 2019).

Critical Water Facilities and Infrastructure

High wind events have the potential to impact all of the District's critical water facilities and infrastructure, but direct impacts are anticipated to be limited. Secondary impacts, due to the temporary loss of power, or from PSPS are expected to have longer-term effects if there are not adequate back-up power supplies to pump stations and other infrastructure that rely on electricity.

Historic, Cultural, and Natural Resources

High winds can cause massive damage to the natural environment, uprooting trees and other debris. This is part of a natural process, however, and the environment will return to its original state over time. Wind damage to historic or cultural resources on the other hand may result in more severe temporary and permanent damage that could temporarily impact the historic aesthetic of downtown Sonoma or the surrounding areas or require extensive restoration and rehabilitation of certain structures.

Future Development

As the District's Planning Area increases in population, the number of people and housing developments exposed to the hazard increases. Proper education on building techniques and the use of sturdy building materials, basements, attached foundations, and other structural techniques may minimize the property

vulnerabilities, as well as the vulnerability of District infrastructure. Public shelters at parks and open spaces may help reduce the impacts of high wind events on the recreational populations exposed to storms.

Risk Summary

- Increase in post-failure or secondary hazards such as flooding, mudslides, landslides, and long-term power outages can occur.
- The U.S. Department of Health and Human Services lists 249 individuals in the District's Planning Area as electricity dependent, and highly vulnerable to power outages due to high wind events.
- Damage to natural resource habitats and other resources may result from severe weather associated wind.
- Severe wind events could result in the loss of water, communication lines, or power; closures to roads and transportation lifelines, which could impact, strand, and/or impair mobility for emergency responders and/or area residents.
- Severe wind hazards could result in loss or damages to historic and cultural resources, which could severely impact the social fabric and rural character of Sonoma Valley;
- Timely removal of debris, specifically downed trees must be addressed, as this can impact the severity of the severe weather events and the secondary impacts (e.g. localized flooding, loss of power).
- Overall, the significance of severe weather associated with high winds is **Medium.**

4.3.9 Landslides

Hazard Description

A landslide is a geologic hazard where the force of gravity combines with other factors to cause earth material to move or slide down an incline. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Slopes with the greatest potential for sliding are between 34 degrees and 37 degrees. Although steep slopes are commonly present where landslides occur, it is not necessary for the slopes to be long.

Debris flows are a mixture of rock fragments, soil, vegetation, water and, in some cases, entrained air that flows downhill as a fluid. Debris flows can range in consistency from that of freshly mixed concrete to running water. Debris flows can be further classified as mudflows and earth flows depending on the ratio of water to soil and rock debris.

Landslides, rockslides, and debris flows occur continuously on all slopes; some processes act very slowly, while others occur very suddenly, often with disastrous results. Landslide and debris flow problems can be caused by land mismanagement, particularly in mountain, canyon, and coastal regions. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides and debris flows. As human populations expand over more of the land surface, these processes become an increasing concern.

There are predictable relationships between local geology and landslides, rockslides, and debris flows. The down-slope movement of earth material, either as a landslide, debris flow, mudslide, or rockslide, is part of the continuous, natural process of erosion. This process, however, can be influenced by a variety of causes that change the stability of the slope. Slope instability may result from natural processes, such as the erosion of the toe of a slope by a stream, or by ground shaking caused by an earthquake. Slopes can also be modified artificially by grading, or by the addition of water or structures to a slope. Development that occurs on a slope can substantially increase the frequency and extent of potential slope stability hazards. Knowledge of these relationships can improve planning and reduce vulnerability. Slope stability is dependent on many factors and their interrelationships, including rock type (unconsolidated soil or soft

rock and sediments), moisture content, slope steepness, lack of vegetation, previous wildfires or other forest disturbances, and natural or man-made undercutting.

Geographic Location

Limited – In Sonoma County, there are several geologic formations commonly associated with slope stability problems. Figure 4-27, which is based on the California Geological Survey data, indicates that the central portion of the District has a low landslide susceptibility, but the surrounding areas to the north, east, and west have moderate to high landslide susceptibility. They are most expected in areas with steep slopes and weak soils. While there are few areas with very steep slopes in the District, steep slopes surround the District and cover large portions of Sonoma County where other water supply infrastructure is located. Post-wildfire areas are also locations where heavy rains can cause erosion, and in turn landslides or debris flows.

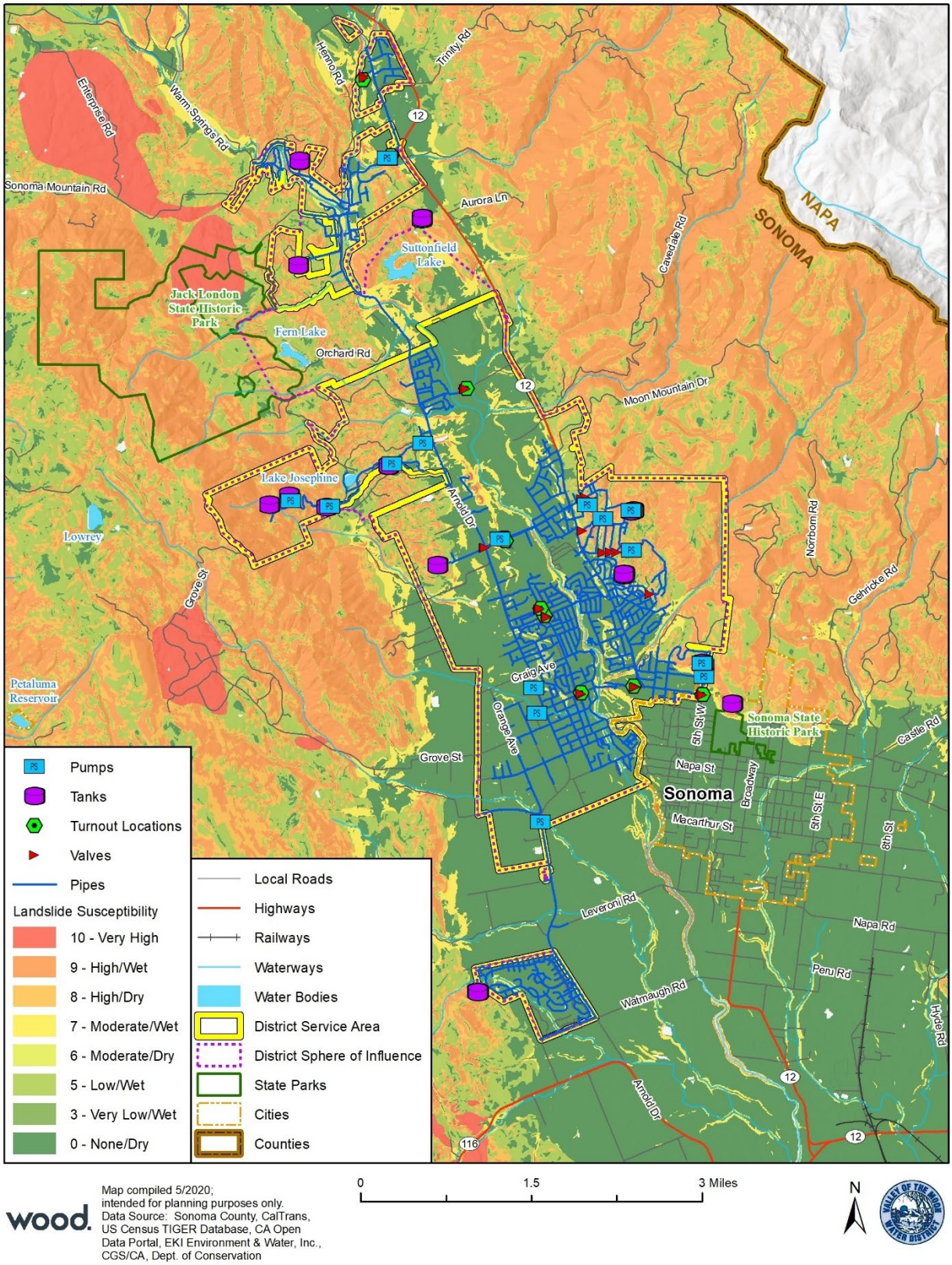
Extent (Magnitude/Severity)

Negligible –The extent of landslides and debris flow events within the County range from negligible to significant but is considered to mostly be negligible for the District. Landslides and rockslides can result in damage to infrastructure such as water and sewer lines, electrical and telecommunications utilities and drainage.

Previous Occurrences

There have been one disaster declarations associated with landslides in Sonoma County. This federal disaster declaration occurred in 2019 and was associated with severe winter storms, flooding, and mudslides. There were also two disaster declarations that occurred in 2017 associated with mudslides. None of these past landslide events affected District property.

Figure 4-27 Landslide Potential in the Valley of the Moon Water District Planning Area



Map compiled 5/2020;
intended for planning purposes only.
Data Source: Sonoma County, CalTrans, US Census TIGER Database, CA Open Data Portal, EKI Environment & Water, Inc., CGS/CA, Dept. of Conservation

Probability of Future Occurrences

Likely – Based on historical data and given the presence of landslide-susceptible geology and steep slopes in the District's Planning Area, landslides hazards are likely to continue on an annual basis, with damaging landslides less frequently. Landslides are usually a cascading effect of severe weather. The probability for more severe and damaging landslides increases during El Nino years or severe winter storms. The potential for debris flows dramatically increases following a wildfire.

Climate Change Considerations

Landslides can result from intense rainfall and runoff events. Projected climate change-associated variance in rainfall events may result in more high-intensity events, which may increase landslide frequency. In addition, the increased potential of wildfire occurrence also escalates the risk of landslide and debris flows in the period following a fire, when slopes lack vegetation to stabilize soils and burned soil surfaces create more rainfall runoff. As climate change affects the length of the wildfire season, it is possible that a higher frequency of large fires may occur into late fall, when conditions remain dry, and then be followed immediately by intense rains early in the winter.

Vulnerability Assessment

Landslides directly damage engineered structures in two general ways: 1) disruption of structural foundations caused by differential movement and deformation of the ground upon which the structure sits, and 2) physical impact of debris moving downslope against structures located in the travel path.

Customers

People could be susceptible if they are caught in a landslide or debris flow, potentially leading to injury or death, but this risk is considered low in the District. There is also a danger to drivers operating vehicles, as rocks and debris can strike vehicles passing through the hazard area or cause dangerous shifts in roadways. Also, since landslide occurrence can be linked to earthquake and general seismic activity, it is possible that landslide and debris flow hazards may cause similar risks as those tied to earthquake (e.g. inability for disabled or vulnerable populations to evacuate in a timely manner, inability to communicate critical information to those who may not speak English, potential for populations to lose access to key resources such as life support technology).

Critical Water Facilities and Infrastructure

Water facilities and infrastructure is vulnerable to the impact and ground deformation caused by slope failures. They present a particular vulnerability because of their geographic extent and susceptibility to physical distress. Critical water facility lifelines are generally linear structures like the Sonoma Aqueduct that, because of their geographic extent, have a greater chance of being affected by ground failure due to greater hazard exposure over larger geographical areas.

Extension, bending, and compression caused by ground deformation can break linear water facility lifelines. Failure of any component along the lifeline can result in failure to deliver service over a large region. Once broken, transmission of the commodity through the lifeline ceases, which can have catastrophic repercussions down the line: loss of water supply to critical facilities such as hospitals, contamination of water supplies, disruption of all forms of transportation, and even release of flammable fuels. Therefore, the overall impact of critical water facility lifeline failures, including secondary failure of systems that depend on lifelines, can be much greater than the impact of individual building failures.

Table 4-28 summarizes the results of the GIS analysis, which indicate the types of the District's critical water facilities that are located in areas of landslide potential (see Figure 4-). Based on this analysis a

considerable number of District facilities are located in areas of high landslide potential. District pipelines also traverse areas of landslide potential. A site-specific analysis would need to be done to refine vulnerability further.

Table 4-28: Water Facilities within Landslide Potential Areas by Potential Category

Landslide Potential	Asset Type	Count	Replacement Value
High/Dry	Pump	1	$1,700,000
	Tank	8	$17,000,000
	Valve	1	$50,000
	Total	**10**	**$18,750,000**
High/Wet	Pump	9	$16,300,000
	Tank	2	$4,000,000
	Valve	1	$50,000
	Total	**12**	**$20,350,000**
Moderate/Wet	Pump	2	$3,200,000
	Valve	2	$75,000
	Total	**4**	**$3,275,000**
Low/Wet	Pump	2	$3,200,000
	Tank	7	$15,500,000
	Valve	5	$250,000
	Total	**14**	**$18,950,000**
None/Dry	Pump	6	$10,800,000
	Tank	1	$4,000,000
	Turnout Location	10	$2,500,000
	Valve	32	$685,000
	Total	**49**	**$17,985,000**

Source: VOMWD 2019, Wood GIS analysis

According to the HMPC, there has also been one small landslide event that occurred impacted Donald Tank in 2018. A small landslide occurred above the tank and damaged the perimeter fence, but it did not affect the facility. Future landslides in the vicinity have the potential to impact the pumping and power generation equipment.

Historic, Cultural, and Natural Resources

As primarily a natural process, landslides and debris flows can have varying impacts to the natural environment. Landslides and debris flows also have the potential to permanently alter the natural landscape.

Future Development

The severity of landslide problems is directly related to the extent of human activity in hazard areas. Human activities such as property development and road construction can also exacerbate the occurrence of landslides. Future development should take place carefully to prevent landslide damage to property or

people. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas or by corrective engineering. Improving mapping and information on landslide hazards and incorporating this information into the development review process could prevent siting of structures and infrastructure in identified hazard areas.

Risk Summary

- The overall significance of landslides and debris flows in the District's Planning Area is **Medium.** These events are recurring in nature and could disrupt critical elements of District's infrastructure.
- Landslides and debris flows can result in the destruction of critical water facilities and distribution infrastructure such as water pipelines.
- Based on GIS analysis, there are 10 critical water assets found within high/dry landslide susceptibility zone, 12 water assets in the high/wet landslide susceptibility zone, and 4 water assets in the moderate/wet landslide zones for a total of 26 water assets at risk of this hazard.

4.3.10 Dam Incidents

Hazard Description

Dams are manmade structures built for a variety of uses, including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they usually are engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped and fail. Overtopping is the primary cause of earthen dam incidents and failure in the United States. Dam incidents can also result from any one or a combination of the following causes:

- Earthquake
- Inadequate spillway capacity resulting in excess overtopping flows
- Internal erosion caused by embankment or foundation leakage or piping or rodent activity
- Improper design
- Improper maintenance
- Negligent operation
- Failure of upstream dams on the same waterway

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam incident or failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result as well as potentially catastrophic effects to roads, bridges, and homes. Associated water quality and health concerns could also be issues. Factors that influence the potential severity of a full or partial dam failure or dam incident are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

Controlled release or spillway flooding: inadequate spillway capacity often results in excess overtopping flows, though the potential for flooding as a result of discharge from dam outlet structures or spillways could be expected during excessive rain events. However, controlled releases of water from dams is a measure that can prevent or minimize spillway flooding or structure failure, by regulating capacity in a managed way. Even controlled releases can lead to unwanted or unpredicted flooding, depending on environmental and weather conditions, or even human error.

In general, there are three types of dams: concrete arch or hydraulic fill, earth-rockfill, and concrete gravity. Each type of dam has different failure characteristics. A concrete arch or hydraulic fill dam can fail almost instantaneously: the flood wave builds up rapidly to a peak then gradually declines. An earth-rockfill dam fails gradually due to erosion of the breach: a flood wave will build gradually to a peak and then decline until the reservoir is empty. A concrete gravity dam can fail instantaneously or gradually with a corresponding buildup and decline of the flood wave.

The California Department of Water Resources (California DWR) Division of Safety of Dams (DSOD) has jurisdiction over impoundments that meet certain capacity and height criteria. Embankments that are less than six feet high and impoundments that can store less than 15 acre-feet are non-jurisdictional. Additionally, dams that are less than 25 feet high can impound up to 50 acre-feet without being jurisdictional. The California DWR DOSD assigns hazard ratings to large dams within the State. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. Dams are classified in four categories that identify the potential hazard to life and property:

- **Extremely High Hazard** – Expected to cause considerable loss of human life or would result in an inundation area with a population of 1,000 or more
- **High Hazard** – Expected to cause loss of at least one human life.
- **Significant Hazard** – No probable loss of human life but can cause economic loss, environmental damage, impacts to critical facilities, or other significant impacts.
- **Low Hazard** – No probable loss of human life and low economic and environmental losses. Losses are expected to be principally limited to the owner's property.

Geographic Location

Limited – According to the U.S. Army Corps of Engineers' (Corps) National Inventory of Dams (NID) database, last updated in 2018 and the California DWR there are two potential dams of concern in the District's Planning Area. There are also three potential dams of concern upstream of the District's Planning Area. These and other nearby dams have been constructed for flood control, water and irrigation storage, water treatment impoundment, and recreation purposes. Of these dams, two are rated as High Hazard and two are rated as Significant Hazard.

Table 4-29 below details the upstream dams that could potentially affect the District's Planning Area given their close proximity and potential to inundate if either were to fail. Figure 4-28 illustrates the locations of the identified dams of concern near the District's Planning Area.

Table 4-29: Characteristics of the Dams of Concern Upstream of the District's Planning Area

Hazard Rating	Dam Name	River Drainage	Downstream Community	Dam Type	Dam Height (in Feet)	Storage Capacity (Acre-Feet)	Emergency Operations Plan	Dam Owner
Significant	Ski	Calabazas Creek	Glen Ellen	Earth	24	55	No	Kunde Estate Winery and Vineyards
High	Suttonfield	Sonoma Creek	El Verano, Boyes Hot Springs, Sonoma	Earth	76	600	Yes	Sonoma Developmental Center

Hazard Rating	Dam Name	River Drainage	Downstream Community	Dam Type	Dam Height (in Feet)	Storage Capacity (Acre-Feet)	Emergency Operations Plan	Dam Owner
High	Fern	Tributary to Mill Creek	El Verano, Boyes Hot Springs, Sonoma	Earth	40	241	Yes	Sonoma Developmental Center
Significant	Lowrey No. 1	Tributary to Carriger Creek	Sonoma	Earth	19	82	No	Private Entity

Source: U.S. Army Corps of Engineers' NID, 2018
Note: 1 acre-foot = 325,851 gallons

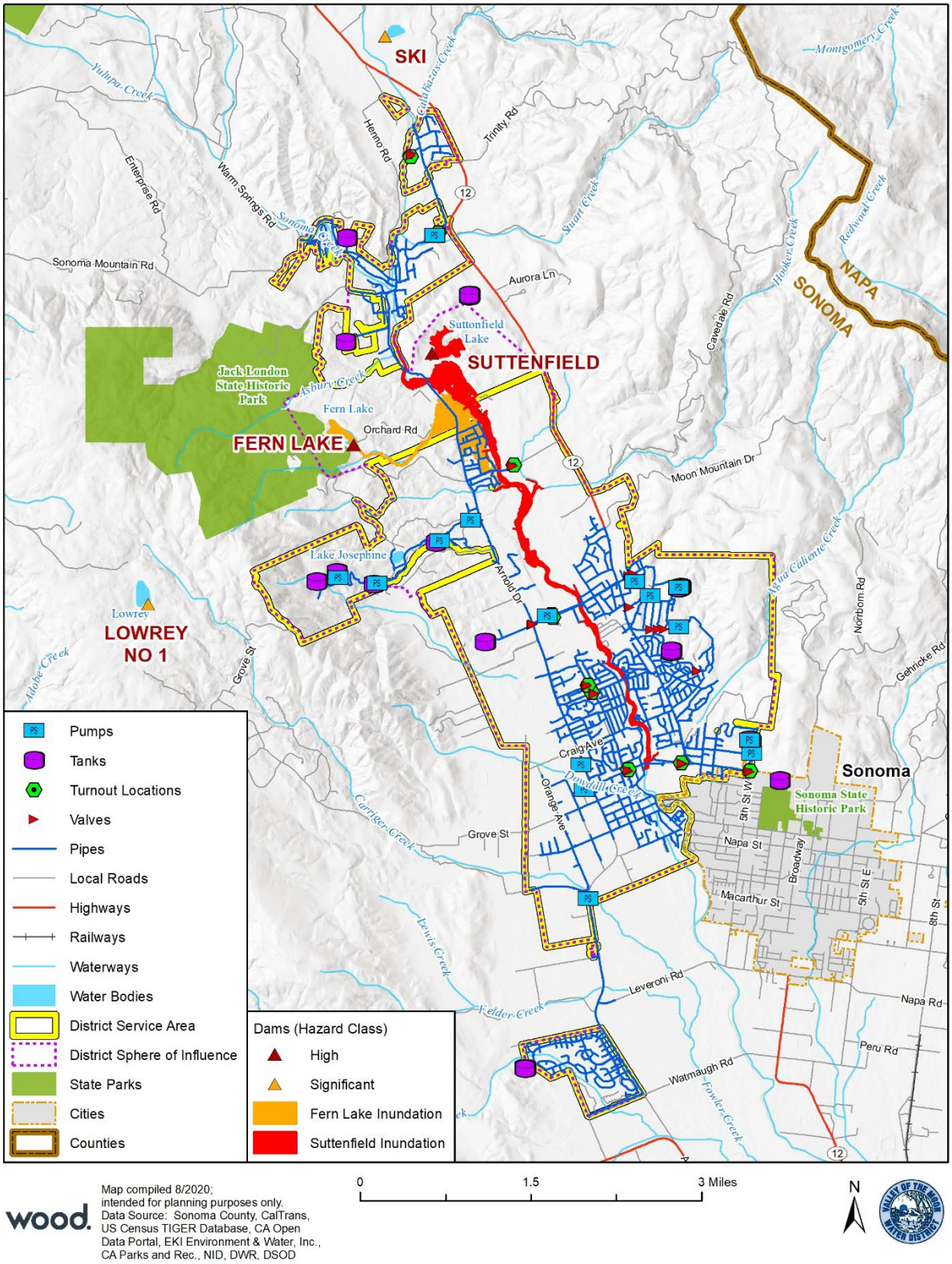
The Ski Dam is an earth-material structure located along Calabazas Creek outside and to the north of the District's Planning Area. The dam storage capacity is 55 acre-feet. This is a significant hazard dam owned by Kunde Estate Winery and Vineyards, with no active Emergency Operations Plan (EOP), or Emergency Action Plan (EAP) in place. The Suttonfield Dam is a high hazard dam located within the District's Planning Area. It was built in 1938 and it is owned by Sonoma Developmental Center (now the California Department of General Services) and is located north of El Verano along Sonoma Creek. Suttonfield Lake has a storage capacity of 600 acre-feet; this dam also has an EAP in place. Fern Lake Dam is also a high hazard man located to the west of Suttonfield Dam within the District's Planning Area. It was built in 1921 and is also owned by the Sonoma Development Center (now the California Department of General Services). Fern Lake has a storage capacity of 241 acre-feet; this dam has an EAP in place. Finally, Lowrey No. 1 Dam is located outside the District's Planning Area along a tributary to Carriger Creek, about five miles east of the City of Sonoma. This is a significant hazard dam owned by a private entity, built in with a primary use of providing water supply. It has a storage capacity of 82 acre-feet.

Magnitude/Severity

Limited – Standard practice among federal and state dam safety offices is to classify a dam according to the potential impact a dam failure (breach) or mis-operation (unscheduled release) would have on downstream areas. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline facilities.

Since there are four potentially hazardous dams upstream of the District's Planning Area (two significant- and two high hazard dams), there is some, though limited, potential for loss of life and/or property and water infrastructure damage. Adjacent unincorporated portions of Sonoma County and portions of the City of Sonoma could also be affected by a dam failure upstream of the District's Planning Area and the City of Sonoma, although the specific extent of impacts would depend on the nature of the failure, local emergency response capabilities, people and property found in the path of the dam inundation areas, and other such factors.

Figure 4-28 Dams of Interest Upstream of the District's Planning Area



Map compiled 8/2020;
intended for planning purposes only.
Data Source: Sonoma County, CalTrans, US Census TIGER Database, CA Open Data Portal, EKI Environment & Water, Inc., CA Parks and Rec., NID, DWR, DSOD

Based on the dam capacities of the two dams upstream of the Planning Area with EAPs and dam inundation mapping data, the extent of dam inundation for both Fern Lake and Suttonfield Lake affects discrete areas of the District south towards Arnold Drive along Sonoma Creek and Mill Creek, respectively. GIS analysis was conducted and determined that approximately 1.6 percent (92.6 acres) of the District would be inundated by the failure the Fern Lake Dam and approximately 1.3 percent (97.1 acres) of the District would be inundated by the failure of the Suttonfield Lake Dam. The time for flooding to reach the Harney/Redwood Drive intersection southeast of Fern Lake is 5 to 10 minutes. The time for flooding to reach the Railroad/Sunrise intersection south of Suttonfield Lake is 5 to 10 minutes. The extent of the two inundation areas covers a portion of the community of Eldridge and a small portion of the community of El Verano, but most of the inundation area around E Verano is confined to Sonoma Creek.

For the significant dams upstream of the District's Planning Area that lack EAPs and inundation mapping, it is unlikely that much risk would be imposed on those areas near the District's Planning Area, nor their water infrastructure given the smaller size of each water supply reservoir and the distance of the water bodies to the downstream communities. Additionally, because the dam inundation maps are not currently available for the Ski and Lowrey No. 1 dams, it is difficult to determine the particular customers or populations at risk, or the District's water facilities at risk of a potential dam incident event.

Previous Occurrences

There is no history of dam incidents or failures affecting the District.

Probability of Future Occurrences

Unlikely – The District remains at risk to upstream dam failures or incidents, particularly from the two dams that are classified as high hazard structures that are within the District Planning Area. However, based on the lack of previous dam inundation events, HMPC input, two active EAPs in place, and the rigorous monitoring and inspection requirements for dams, dam failure and dam incidents are unlikely in the area. Nevertheless, the potential exists for future dam incidents in the Planning Area or portions of it, but the likelihood of this is low. Uncontrolled or controlled release flooding as well as spillway flooding below dams due to excessive rain or runoff are more likely to occur than failures.

Climate Change Considerations

The potential for climate change to affect the likelihood of dam failure and incidents is not fully understood at this point in time. With a potential for more extreme precipitation events a result of climate change, this could result in large inflows to reservoirs. However, nearby water diversions limit the amount of water currently stored at both Suttonfield Lake and Fern Lake. Further, this potential inflow of water to the reservoirs could also be offset by generally lower reservoir levels if storage water resources become more limited or stretched in the future due to drought or population growth. For these reasons, climate change would have a "low" influence on dam incidents.

Vulnerability Assessment

Vulnerability—Low

The District's main four water waterways, Sonoma Creek, Calabazas Creek, Carriger Creek, and a tributary to Mill Creek, have dams and large reservoirs. These dams are used mainly for downstream flood control and water storage. Dam incidents and failure can occur independently from flooding events. Dam failure can also occur from earthquakes, internal erosion caused by embankment and foundation leakage, and from inadequate spillway capacity that can lead to overtopping of the dam and erosion.

A dam incident can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to dam failures is also confined to the areas and populations subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the dam itself and associated revenues that accompany those functions, including potential lifeline utilities, such as potable water uses or critical irrigation for crops.

Customers

Communities located below a high or significant hazard dam and along a waterway are potentially exposed to the impacts of a dam failure. For reference, high hazard dams threaten lives and property, significant hazard dams threaten property only. Inundation maps that identify anticipated flooded areas (which may not coincide with known floodplains) are often produced for all high hazard dams and are contained in the EAP required for each dam. The potential magnitude of a dam incident depends on the time of year and the base flow of the river when the incident or failure occurs. During the winter months, when the river flows are higher, the impact to the area would be much greater and evacuation times even shorter.

Persons located underneath or downstream of a dam are at risk of a dam failure, though the level of risk can be tempered by topography (specifically where populations are located within the inundation path of a dam but at higher elevations), amount of water in the reservoir/damming structure, and time of day of the breach. Injuries and fatalities can occur from debris, bodily injury, and drowning. Once a dam has breached, standing water presents all the same hazards to people as floodwater from other sources. People in the inundation area may need to be evacuated, cared for, and possibly permanently relocated. Impacts could include hundreds or thousands of evacuations and likely casualties, depending on the dam involved.

Based on the location of the two high hazard dams in the District and within the SDC Campus and near a relatively populated area within the communities of Eldridge and El Verano, should a dam failure occur, those that reside in the dam inundation area would be at risk, including socially vulnerable or sensitive populations that reside in the inundation area. Approximately 183.4 acres (2.4 percent of the Planning Area) is within the Suttonfield Dam inundation area and approximately 97.1 acres (1.4 percent of Planning Area) is within the Fern Dam inundation area. Both these areas cover residential area, which may result in the loss of homes in the District's Planning Area, and in turn a loss of customers and revenue for the District. Dam incidents and loss of water from the associate reservoir could also include direct business and industry damages, the inability for the District to provide water to customers, and indirect disruption of the local economy, including the disruption of irrigation water for crops or even water for livestock which may be key components of Sonoma Valley's agricultural economy.

Critical Water Facilities and Infrastructure

A total dam failure can cause catastrophic impacts to areas downstream of the water body, including critical infrastructure and essential facilities. Dam incidents may result is less severe downstream impacts, depending on the severity of the incident. Any critical asset located under the dam in an inundation area would be susceptible to the impacts of a dam incident. Of particular risk would be roads and bridges that could be vulnerable to washouts, complicating response and recovery by cutting off impacted areas. Risk to specific facilities could be considered sensitive information, especially those such as water treatment facilities or water delivery systems which may provide potable water for the local population.

The District's critical water facilities and infrastructure assets were intersected with the dam inundation mapping data for both the Suttonfield Dam and Fern Dam to determine if any of the assets occurred in the dam inundation area. Based on the GIS analysis, none of the District's critical water facilities and infrastructure assets were within the two dam inundation areas.

Due to the lack of dam inundation mapping for the other two significant dams upstream of the District, and the lack of EAPs, it is not well known the extent to which a potential dam failure could affect the District's water facilities and infrastructure. Based on location alone it does appear that the failure or a major incident at the Ski Dam or the Lowrey No. 1 Dam could potentially impact the District's infrastructure located downstream, but the actual risk is unknown due to data limitations.

Major dam incidents that affect Sonoma Water's two main reservoirs, Lake Mendocino and Lake Sonoma would result in secondary, but direct impacts on the District's water supply if impacts limit Sonoma's Water's ability to convey surface water supplies via the Sonoma Aqueduct to the District. Sonoma Water maintains these two reservoirs. Lake Mendocino is impounded by Coyote Valley Dam and Lake Sonoma is impounded by Warm Springs Dam. If there is an uncontrolled release of water from the reservoir it could impose excessive demands on Sonoma Water's distribution system. Also, while Sonoma Water and the Mendocino County Russian River Flood Control and Water Conservation Improvement District share permits from the State to store and release water, Corps assumes control of releases when water rises above the supply pool. Similarly, Sonoma Water has exclusive rights to control the water level in Lake Sonoma, but the Corps assumes control when the water level exceeds a certain elevation (i.e., 451 feet) and goes into the flood control pool. The Corps is also responsible for dam safety for both dams. Therefore, any vulnerabilities to this regional water agency's critical facilities must be coordinated with responsible federal and state agencies, such as the Corps and DWR DSOD.

Historic, Cultural, and Natural Resources

Dam failure effects on the environment would be similar to those caused by flooding from other causes. Water could erode stream channels and topsoil and cover the environment with debris. For the most part the environment is resilient and would be able to rebound from whatever damages occur, though this process could take years. Historic and cultural resources could be affected just as housing or critical infrastructure would be affected, were a dam to fail and cause downstream inundation that could further erode surfaces or cause scouring of structural foundations. Given the two high hazard dams within the District's Planning Area, historic and cultural resources within the community of El Verano, a portion of Glen Ellen would be most impacted. Given there is no inundation mapping or EAPs in place for the two significant hazard dams, risks to historical and cultural resources associated with the failure of either the Ski Dam or Lowrey No. 1 Dam are unknown.

Future Development

Areas slated for future development should take into consideration potential impacts from dam failure risk upstream and should overlay the existing dam inundation maps (for those available, such as the Suttonfield Dam and Fern Dam) with proposed future development, such as the redevelopment of the SDC campus, which is located adjacent to Fern Lake.

If the District becomes responsible for operating the reservoirs within the SDC Campus within the future, each dam would result in direct impacts associated with a dam breach or overtopping, and related significant erosion and sedimentation impacts in the area immediately surrounding the dam near the SDC campus. A small portion of flood inundation also spreads slightly upstream along Sonoma Creek if Suttonfield Dam fails, and along a tributary of Mill Creek if Fern Dam fails.

In the case of a dam failure, inundation would likely follow existing FEMA mapped floodplains, which contains development restrictions for areas in the 1 percent annual chance floodplain, but it could exceed those floodplains and affect areas that are not regulated for flood hazards. Also, development below a hazard dam could increase its hazard rating. Finally, added development could compromise dams and reservoir resources if populations depend on them for critical needs such as potable water during or after a dam failure event.

Risk Summary

- The overall significance of dam inundation in the District is **Low**.
- Four dams of concern fall upstream of the District: Suttonfield Dam, Fern Dam, Ski Dam, and Lowrey No. 1 Dam.
- Suttonfield Dam is a high hazard earthen dam and owned by the State of California, Department of General Services (DGS) (it was formerly owned by the SDC). It is located south of the community of Glen Ellen along Sonoma Creek and has a storage capacity of 600 acre-feet. This dam has an active EAP and dam inundation mapping.
- The second dam of concern is the Fern Dam, another high hazard earthen dam owned by the State of California, DGS. Fern Dam is located just over 2 miles west of Suttonfield Dam along a tributary of Mill Creek. This significant hazard dam has a storage capacity of 241 acre-feet and an EAP and dam inundation mapping.
- The two other upstream dams near the District include Ski Dam and Lowrey No. 1 Dam, both which are located outside the District's Planning Area. Ski Dam is a significant hazard earthen dam with 55 acre-feet of capacity used for water supply by the Kunde Estate Winery and Vineyards. This dam has no EAP in place and no available dam inundation mapping. The Lowrey No. 1 dam is a significant hazard earthen dam with 82 acre-feet of capacity for water supply. It is owned by a private entity and lacks an EAP and available dam inundation mapping.
- Due to the lack of historic occurrence data on dam inundation, and no dam inundation mapping available, and lack of EAPs for the two significant hazard dams, it is not well known how a potential failure of any of these dams could affect the District's customers or populations and water facilities and infrastructure.
- None of the District's critical water facilities or infrastructure fall within the Suttonfield Lake Dam or Fern Lake Dam inundation areas.

4.4 Human-Caused and Human-Health Hazard Profiles and Risk Assessment

The DMA does not require an assessment of human-caused or human-health hazards, but the District and HMPC decided to include public health hazards in this LHMP for several reasons. First, the District wants to inform the public about all hazards, including both natural and human-health hazards given the recent novel COVID-19 pandemic. The District also intends to take a proactive approach to disaster preparedness, and the HMPC feels that preparation for and response to a major human-health event involves the same training and commitment of District resources as a natural hazard.

The District also recognizes that while Sonoma County has several public health programs in place, as a major water utility it is equally important to highlight the potential public health hazards present in the District's Planning Area in this plan for the purpose of public education and awareness. The District wants to ensure that human health hazards do not exacerbate secondary impacts associated with natural hazard events.

The following human-caused and human-health hazards are discussed in this plan:

- Cyber Threats/Cyber Security
- Public Health Hazards

Other potential human-caused hazards, such as hazardous materials, cyber threats, and terrorism threats were dismissed from further study. The District and HMPC noted that most human-caused hazards are adequately covered by the planning mechanisms administered by Sonoma County's Fire Prevention Division and Environmental Health Department.

4.4.1 Cyber Threats

Hazard Description

The California SHMP identifies cyber threats as "attempts by cyber criminals to attack a government, organization, or private party by damaging or disrupting a computer or computer network, or by stealing data from a computer or computer network for malicious use." A recent survey by the United States Government Accountability Office (GAO) found that "agencies having high-impact systems identified cyber-attacks from nation-states as the most serious and most frequently-occurring threat to the security of their systems."

There are many types of cyber-attacks. Among the most common is a direct denial of service, or DDoS attack. This is when a server or website will be queried or pinged rapidly with information requests, overloading the system and causing it to crash.

Cyber-attacks and threats use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks.

Malware, or malicious software, can cause numerous problems once on a computer or network, from taking control of users' machines to discreetly sending out confidential information. Ransomware is a specific type of malware that blocks access to digital files and demands a payment to release them. Hospitals, school districts, state and local governments, law enforcement agencies, businesses, and even individuals can be targeted by ransomware. A 2017 study found ransomware payments over a two-year period totalled more than $16 million. Even if a victim is perfectly prepared with full offline data backups, recovery from a sophisticated ransomware attack typically costs far more than the demanded ransom. However according to a 2016 study by Kaspersky Lab, roughly one in five ransomware victims who pay their attackers are still not able to retrieve their data.

Cyber spying or espionage is the act of illicitly obtaining intellectual property, government secrets, or other confidential digital information, and often is associated with attacks carried out by professional agents working on behalf of a foreign government or corporation. According to cybersecurity firm Symantec, in 2016 "…the world of cyber espionage experienced a notable shift towards more overt activity, designed to destabilize and disrupt targeted organizations and countries."

Major data breaches - when hackers gain access to large amounts of personal, sensitive, or confidential information - have become increasingly common. The Symantec report says more than seven billion identities have been exposed in data breaches over the last eight years. In addition to networked systems, data breaches can occur due to the mishandling of external drives, as has been the case with losses of some state employee data.

Cybercrime can refer to any of the above incidents when motivated primarily by financial gain or other criminal intent. The most severe type of attack is cyber terrorism, which aims to disrupt or damage systems in order to cause fear, injury, and loss to advance a political agenda. The District's water utilities use Supervisory Control and Data Acquisition systems (SCADA). These systems operate over telecommunication lines or radio systems, which are vulnerable to cyber security breaches, thereby leaving water utilities like the District susceptible to such activity.

Location

Cyber disruption events can occur or impact virtually any location where computing devices are used. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the state can still impact people, businesses, and institutions within the District's Planning Area.

Magnitude/Severity

Critical –The extent of a cyber disruption event is variable depending on the nature of the event. A disruption affecting a small, isolated system could impact only a few functions and processes. Disruptions of large, integrated systems could impact many functions and processes, as well as many individuals that rely on those systems.

There is no universally accepted scale to quantify the severity of cyber-attacks. The strength of a DDoS attack is sometimes explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, which brought down some of the internet's most popular sites on October 21, 2016, peaked at 1.2 terabytes per second.

Data breaches are often described in terms of the number of records or identities exposed. Cyber threats and data breaches can also occur on municipal water systems if computer and system infrastructure and software is underfunded.

Previous Occurrences

The District noted there are potential ransomware attacks on the District's IT system on a daily basis. Specific cyber incidents were not discussed.

Symantec reports there were a total of 1,209 data breaches worldwide in 2016, 15 of which involved the theft of more than 10 million identities. While the number of breaches has remained relatively steady, the average number of identities stolen has increased to almost one million per incident. The report also found that one in every 131 emails contains malware, and the company's software blocked an average of 229,000 web attacks every day.

The Privacy Rights Clearinghouse, a non-profit organization based in San Diego, maintains a timeline of 2,631 data breaches resulting from computer hacking incidents in the United States from 2005-2019. The database lists 522 data breaches in California during this timeframe, including attacks on private sector facilities, government agencies, schools and media entities. While none of those security breaches were specifically targeted at systems at the District, some of them included information on individuals who live in the community. Similarly, District customer were likely affected by national and international data breaches.

While the District itself has not been the victim of major cyber or ransomware attacks, examples from across the country show both the prevalence of cyber-attacks and potential impacts. DDos cyber disruptions also happen to water districts. On February 5, 2021, a cyber-attack occurred on a water system in Florida that briefly impacted a water treatment facility, but the cyber attempt was quickly identified and stopped. The City of Atlanta was also hit by a major ransomware attack in 2018, recovery from which cost a reported $2.6M, significantly more than the $52,000 ransom demand. A similar attack against the City of Baltimore in 2019 affected the city government's email, voicemail, property tax portal, water bill and parking ticket payment systems, and delayed more than 1,000 pending home sales.

Probability of Future Occurrences

Occasional – Cyber-attacks occur daily, but most have negligible impacts at District-level and are blocked by the District's existing cyber security systems, emergency planning programs, and redundant protocols to ensure the viability of the critical infrastructure that provides water distribution and delivery and the safety and quality of the District's water supply. The possibility of a larger disruption affecting the District exists at all times, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Minor attacks against business and government systems have become commonplace occurrences but are usually stopped with minimal impact. Similar data breaches impacting the information of residents are almost certain to happen in coming years. Major attacks or breaches specifically targeting systems in the county are less likely but cannot be ruled out.

Climate Change Considerations

Climate change is not expected to have any direct impacts on the vulnerability of the District's cyber security systems to an attack.

Vulnerability Assessment

Customers

Cyber-attacks can have a significant cumulative economic impact. Symantec reports that in the last three years, businesses have lost $3 billion due to spear-phishing email scams alone. A major cyber-attack has the potential to undermine public confidence and build doubt in their government's ability to protect them from harm.

Injuries or fatalities from cyber-attacks would generally be a cascading result of specific system failure (i.e. injuries or fatalities caused by secondary incidents due to a compromised traffic light system) or a compromised electrical grid. Refer to the Vulnerability Assessment under Section 4.3.8 High Winds for details on the number of Medicare beneficiaries that are electricity dependent in Sonoma Valley.

Critical Facilities and Infrastructure

Critical facilities, infrastructure and systems can make inviting targets for cyber threats, with the potential to cause widespread and damaging impacts. Ultimate impacts of a cyber-attack depend on both the method and success of the cyber-attack, as well as the type of critical asset affected. Most attacks affect only data and computer systems. Sabotage of utilities and infrastructure from a major cyber terrorist attacks could potentially result in system failures that damage property on a scale equal with natural disasters. Facilities and infrastructure may become unusable as a result of a cyber-attack.

Historic, Cultural, and Natural Resources

Cyber threats are not expected to have any direct or indirect impacts on the vulnerability of cultural or natural resources.

Future Development

Traditionally, cyber threats should not have any bearing on future development. The prevalence and evolution of cyber threats does require continued District efforts to upgrade security systems and integrate redundant programs and protocols to meet evolving threats and safeguard the community's water supply.

Risk Summary

- District systems are attacked multiple times a day; most attacks thwarted by existing security systems

- The District is proactive in cybersecurity and cyber prevention measures.
- Evolving cyber threats require a matching evolution in protection and deterrence techniques to match the threat.
- While the District hasn't suffered a specific, large-scale cyber infiltration, examples from around the world show how devastating these types of attacks can be on communities.
- Successful cyber incidents can have a variety of impacts, based on the targeted system(s), attack type, attack goals, and ultimate success of the attack.
- Overall, the significance of cyber threats is **High.**

4.4.2 Public Health Hazards: Disease/Pandemic/Epidemic

Hazard Description

A public health emergency is defined as an emergency need for health care [medical] services to respond to a disaster, significant outbreak of an infectious disease, bioterrorist attack or other significant or catastrophic event. Public health emergencies can occur as primary events by themselves, or they may be secondary to another disaster or emergency, such as tornado, flood, or hazardous material incident.

Public health emergencies have the potential to cause serious illness and death, especially among those who have compromised immune systems due to age or underlying medical conditions. There are several contagious and infectious diseases present in Sonoma County that constitute a public health risk. The Sonoma County Emergency Operations Plan (EOP) provides an organizational framework for public health and medical service preparedness, response, and recovery efforts for various emergency epidemics.

Unlike influenza viruses that have achieved ongoing transmission in humans, the sporadic human infections with avian A (H5N1) viruses are far more severe with high mortality. Initial symptoms include high fever and other influenza-like symptoms. It also appears that the incubation period in humans may be longer for avian (H5N1) viruses, ranging from 2 to 8 days, and possibly as long as 17 days. Diarrhea, vomiting, abdominal pain, chest pain, and bleeding from the nose and gums have also been reported. The disease often manifests as a rapid progression of pneumonia with respiratory failure ensuing over several days.

A pandemic can be defined as a disease that attacks a large population across great geographic distances. Pandemics are larger than epidemics in terms of geographic area and number of people affected. Epidemics tend to occur seasonally and affect much smaller areas. Pandemics, on the other hand, are most often caused by new subtypes of viruses or bacteria for which humans have little or no natural resistance. Consequently, pandemics typically result in more deaths, social disruption, and economic loss than epidemics.

There are three conditions that must be met before an influenza pandemic begins:

1. A new virus subtype must emerge that has not previously circulated in humans (and therefore there is no pre-existing immunity),
2. This new subtype must be able to cause disease in humans, and
3. The virus must be easily transmissible from human to human.

As of September 2020, Sonoma County and the nation are dealing with the COVID-19 coronavirus pandemic, confirming that pandemics can have a significant impact on the County. This hazard risk assessment includes an analysis of pandemic flu risk in Sonoma County and an analysis of the impacts of the hazards profiled in this plan on public health.

Geographic Location

Extensive – Pandemics occur not only on a county or state level, but on a national and global scale. It is likely that most communities in Sonoma County would be affected, either directly or by secondary impacts. More highly-populated areas may be affected sooner and may experience higher infection rates. The current COVID-19 pandemic has impacted all 58 California counties, as of September 16, 2020. Sonoma County has reported 1,786 active cases; 110 people have died and 4,881 recovered as of September 16, 2020 and is currently noted as having a sustained decline in new cases per 100,000 residents within the past two weeks. All communities in the County, including the District's Planning Area in Sonoma Valley are likely to be impacted, either directly or indirectly. Some indirect consequences may be the diversion of resources that may be otherwise available.

Magnitude/Severity

Critical – The magnitude of a public health emergency will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is more easily transmitted from person-to-person but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could literally be spread around the globe within hours. Under such conditions, there may be very little warning time. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster. Pandemics typically last for several months to 1-2 years.

The Pandemic Intervals Framework (PIF) is a six-phased approach to defining the progression of an influenza pandemic. This framework is used to guide influenza pandemic planning and provides recommendations for risk assessment, decision-making, and action. These intervals provide a common method to describe pandemic activity which can inform public health actions. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response. The six-phase approach was designed for the easy incorporation of recommendations into existing national and local preparedness and response plans. Phases 1 through 3 correlates with preparedness in the **pre-pandemic interval**, including capacity development and response planning activities, while Phases 4 through 6 signal the need for response and mitigation efforts during the **pandemic interval**.

Pre-Pandemic Interval
In nature, influenza viruses circulate continuously among animals (primarily birds). Even though such viruses might develop into pandemic viruses, in Phase 1 no viruses circulating among animals have been reported to cause infections in humans.

- **Phase 1** is the natural state in which influenza viruses circulate continuously among animals but do not affect humans.

In Phase 2 an animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is thus considered a potential pandemic threat.

- **Phase 2** involves cases of animal influenza that have circulated among domesticated or wild animals and have caused specific cases of infection among humans.

In Phase 3 an animal or human-animal influenza virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for examples, when there is close contact between an infected person and an unprotected caregiver. Limited transmission under these circumstances does not indicate that the virus has gained the level of transmissibility among humans necessary to cause a pandemic.

- **Phase 3** represents the mutation of the animal influenza virus in humans so that it can be transmitted to other humans under certain circumstances (usually very close contact between individuals). At this point, small clusters of infection have occurred.

Pandemic Interval
Phase 4 is characterized by verified human to human transmission of the virus able to cause "community-level outbreaks." The ability to cause sustained disease outbreaks in a community marks a significant upward shift in the risk for a pandemic.

- **Phase 4** involves community-wide outbreaks as the virus continues to mutate and become more easily transmitted between people (for example, transmission through the air)

Phase 5 is characterized by verified human to human spread of the virus into at least two countries in one World Health Organization (WHO) region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.

- **Phase 5** represents human-to-human transmission of the virus in at least two countries

Phase 6, the pandemic phase, is characterized by community-level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is underway.

- **Phase 6** is the pandemic phase, characterized by community-level influenza outbreaks.

Previous Occurrences

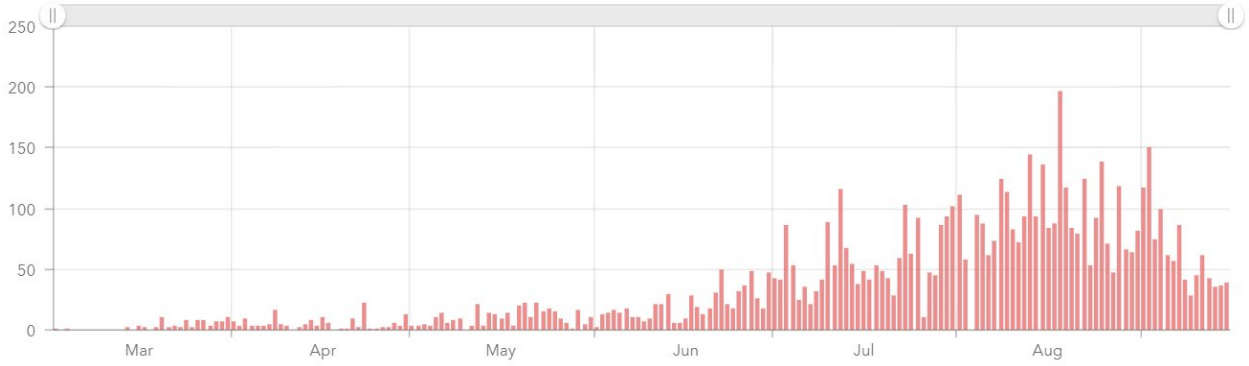
Since the early 1900s, five lethal pandemics have swept the globe:

- **1918-1919 Spanish Flu:** The Spanish Flu was the most severe pandemic in recent history. The number of deaths was estimated to be 50-100 million worldwide and 675,000 in the United States. Its primary victims were mostly young, healthy adults. At one point, more than 10 percent of the American workforce was bedridden.
- **1957-1958 Asian Flu:** The 1957 Asian Flu pandemic killed 1-2 million people worldwide, including about 70,000 people in the United States, mostly the elderly and chronically ill. Fortunately, the virus was quickly identified, and vaccine production began in May 1957.
- **1968-1969 H3N2 Hong Kong Flu:** The 1968 Hong Kong Flu pandemic killed 34,000 Americans. Again, the elderly were more severely affected. This pandemic peaked during school holidays in December, limiting student-related infections, which may have kept the number of infections down. Also, people infected by the Asian Flu ten years earlier may have gained some resistance to the new virus.
- **2009-2010 H1N1 Swine Flu:** This influenza pandemic emerged from Mexico in early 2009 and was declared a public health emergency in the U.S. on April 26. By June, approximately 18,000 cases had been reported in the U.S. and the virus had spread to 74 countries. Most cases were fairly mild, with symptoms similar to the seasonal flu, but there were cases of severe disease requiring hospitalization and a number of deaths. The Center for Disease Control (CDC) estimates that 43-89 million people

were infected worldwide, with an estimated 8,870 to 18,300 H1N1 related deaths, including 12,469 deaths in the United States.

- **2020-Ongoing COVID-19:** The COVID-19 or novel coronavirus pandemic began in December 2019 and was declared a pandemic in March of 2020. As of August 25, 2020, it has killed more than 800,000 people worldwide and more than 175,000 Americans. It is expected to last through the remainder of 2020 and into 2021 Figure 4-29 illustrates the number of new cases reported in the County since March 2020 through September 2020.

Figure 4-29 Sonoma County New COVID-19 Cases by Date



Source: Sonoma County Emergency Management 2020.

The California Department of Public Health and Environment releases an annual reportable disease summary for each county. The diagnoses with the highest incidences in Sonoma County for 2016 through 2018 are summarized in Table 4-30.

Table 4-30: Annual Cases of Communicable Diseases in Sonoma County: 2015 – 2018

Disease	Year of Reported Cases			
	2015	2016	2017	2018
Ambeiasis	3	9	9	0
Anaplasmosis	--	1	2	0
Babesiosis	0	0	0	0
Botulism (Food-borne)	0	0	0	0
Botulism (Wound)	--	0	0	0
Brucellosis	1	0	1	1
Campylobacteriosis	52	60	184	191
Chikungunya Virus	0	0	0	0
Cholera	0	0	0	0
Vibrio Infection	2	0	2	2
Ciguatera (Fish Poisoning)	0	0	0	0
Coccidioidomycosis	1	2	3	3
Creutzfeldt Jakob	0	1	1	0
Cryptosporidiosis	5	3	7	6
Cyclosporiasis	0	0	0	1
Cysticercosis	1	0	0	0
Dengue Virus	0	2	1	0
Ehrilichiosis	0	0	0	0
Flavivirus	0	0	0	0
Giardiasis	50	32	43	49
Hantavirus	0	0	0	0

Disease	Year of Reported Cases			
	2015	2016	2017	2018
Hepatitis E	1	2	3	1
Legionellosis	1	7	6	5
Leprosy (Hansen's Disease)	0	0	0	0
Leptospirosis	0	0	1	0
Listeriosis	1	3	1	2
Lyme Disease	13	14	18	11
Malaria	0	0	3	0
Paralytic – Shellfish Poisoning	0	0	0	1
Parathyroid Fever	0	0	0	0
Plague – Human	0	0	0	0
Psittacosis	0	0	0	0
Q Fever	3	1	0	1
Rabies (Animal)	5	5	3	5
Rabies (Human)	0	0	0	0
Relapsing Fever	0	0	1	0
Salmonellosis	58	60	80	83
Scrombroid Fish Poisoning	0	00	0	0
Shiga Toxin-producing E.Coli	27	25	35	50
Hemolytic Uremic Syndrome	0	1	0	0
Shigellosis	0	12	35	71
Spotted Fever Rickettsiosis	0	1	0	0
Streptococcal Infection	0	0	0	0
Trichinosis	0	0	0	0
Tularmia	1	0	0	0
Typhoid Fever	0	1	1	0
Typhus Fever	0	0	0	0
Yersiniosis	0	3	1	2
Zika Virus	--	10	7	1

Source: California Department of Public Health 2018.

As shown in Table 4-30 above, common communicable diseases in Sonoma County include Campylobacteriosis, Giardiasis, Lyme Disease, and Salmonellosis. Campylobacteriosis is a common bacteria infection in humans; it is often a food-borne illness. Giardiasis is a diarrheal disease caused by the microscopic parasite Giardia. Once a person has been infected with Giardia, the parasite lives in the intestines and is passed in feces. Lyme disease is a bacterial infection you get from the bite of an infected tick. Salmonellosis is also a common bacterial disease that affects the intestinal tract; humans become infected through contaminated food and water.

The CDPH obtains data on laboratory-confirmed influenza and other respiratory viruses from a number of laboratories throughout the state. These laboratories include the CDPH Viral and Rickettsial Disease Laboratory (VRDL) and 24 local public health laboratories, collectively known as the Respiratory Laboratory Network (RLN), and 16 clinical, academic, and hospital laboratories. At a national level, the 2018–2019 influenza season (September 30, 2018–May 18, 2019) was a moderate severity season. Influenza-like illness activity in the United States began increasing in November, peaked during mid-February, and returned to baseline in mid-April; the season lasted 21 weeks, making it the longest season in 10 years (CDPH 2019). Illness attributed to influenza A viruses predominated, with very little influenza B activity. Two waves of influenza A were notable during the prolonged season: influenza A(H1N1) viruses from October 2018 to mid-February 2019 and influenza A(H3N2) viruses from February through May 2019. From September 30, 2018 through May 18, 2019, 2,502 specimens were tested for influenza and

respiratory syncytial virus (RSV). Of the 2,502 specimens, 1,198 (47.9 percent) were positive. Of the positive cases, 1,183 (98.7 percent) were Influenza A, 780 (65.9 percent) were Influenza A (H1N1), and 370 were Influenza A (H3N2). During the same period, 775 specimens were tested for RSV and 119 were positive (15.4 percent).

Probability of Future Occurrences

Occasional – Even before the COVID-19 pandemic began, the California Department of Public Health (CDPH) considered a pandemic to be inevitable. However, there is no definite way to predict when the next pandemic might happen. Some indicators will be present, but not every new virus turns into a pandemic. Based on the five pandemics that have affected the United States in roughly the last 100 years, a pandemic occurs on average roughly every 20 years.

Climate Change Considerations

There is no direct evidence that climate change is influencing the spread of public health hazards, or the spread of COVID-19. Climate change does alter how we relate to other species and that can affect human health and risk for infections. Many of the root causes of climate change can also increase the risk of pandemics (Bernstein 2020). Deforestation is the largest loss of habitat worldwide and this loss forces animals to migrate and potentially contact other animals or people and spread germs. Large livestock can serve as a source for spillover infections from animals to people (Bernstein 2020). Climate change has also made conditions more favorable to the spread of some infectious diseases, including Lyme disease, waterborne diseases, and mosquito-borne diseases, such as malaria and dengue fever. In summary, future risks associated with climate change are difficult to predict, but it impacts when and where pathogens appear, particularly related to temperature and rainfall patterns. As a result, climate change is expected to have a low influence on public health hazards.

Vulnerability Assessment

Although The District's water facilities and infrastructure would not be directly affected by a public health hazard, or a pandemic, access to facilities and infrastructure in the area of the incident may be restricted or denied until decontamination and disinfection is complete and it is safe to access the area.

Customers

Impacts on customers in the District's Planning Area are expected to be severe for unprotected people and moderate for people protected from human-health hazards, such as people with jobs that have less exposure to people and possible sources of transmission. For example, people with jobs in education or the medical field may be more frequently exposed to different groups of people (students, patients) that can transmit diseases. Medications may be limited to help prevent or treat the disease. It can also take years to manufacture a vaccine and would likely become available in small quantities at first. It may become necessary to ration limited amounts of medications, vaccinations, and other health care supplies. Risk groups also cannot be predicted with certainty; the elderly, people with underlying medical conditions, and young children are usually at higher risk, but as discussed above this is not always true for all influenza strains. People without health coverage or access to good medical care are also likely to be more adversely affected.

Critical Facilities and Infrastructure

When disruptions related to public health hazards impact key water supply and distribution facilities and result in critical facilities being temporarily offline due to increased water testing or other precautionary water monitoring, they may postpone the delivery of essential services, such as water supply. Public health incidents and disease outbreaks may cause restricted access or delays in the use of some communities,

work areas, or sites where incidents may be tied to environmental factors (e.g. water-borne diseases transmitted through contaminated water). Such work areas or sites may not be accessible again until there are safety protocols in place. In these cases, remediation, sanitization, and good hygiene practice may be needed.

Historic, Cultural, and Natural Resources

Public health hazards are not expected to result in any direct impacts to historic or cultural resources. Some preliminary studies did indicate that shelter-in-place restrictions during the early stages of the pandemic may have improved habitat conditions for wildlife given there were less cars on the roads, and fewer people outside.

Future Development

Future development in Sonoma Valley has the potential to change how infectious diseases spread through the community and impact human health in both the short and long term. New development may increase the number of people and care facilities exposed to public health hazards. In general, greater population concentrations (often found in special needs facilities, businesses, school campuses) put more people at risk.

Population growth and development contribute the greatest to pandemic exposure. As populations increase and the cost of health care increases, potential losses can be expected to rise. It is also possible that infrastructure may not be able to be maintained as necessary during a pandemic because of a significantly decreased workforce.

Risk Summary

- Pandemics occur on a national and global scale and it is likely that most communities in Sonoma County would be affected, either directly or by secondary impacts. More highly-populated areas may be affected sooner and may experience higher infection rates.
- Sonoma County has reported 1,786 active cases related to the current COVID-19 pandemic; 110 people have died and 4,881 recovered as of September 16, 2020. The County noted a sustained decline in new cases per 100,000 residents in September.
- The Pandemic Intervals Framework (PIF) is a six-phased approach to defining the progression of an influenza pandemic. Phases 1 through 3 correlates with preparedness in the pre-pandemic interval, including capacity development and response planning activities, while Phases 4 through 6 signal the need for response and mitigation efforts during the pandemic interval.
- Common communicable diseases in Sonoma County include Campylobacteriosis, Giardiasis, Lyme Disease, and Salmonellosis.
- Five lethal pandemics have occurred since the early 1900s: 1918-1919 Spanish Flu, 1957-1958 Asian Flu, 1968-1969 H3N2 Hong Kong Flu, 2009-2010 H1N1 Swine Flu, and the current COVID-19 novel coronavirus. Based on the five pandemics that have affected the United States in roughly the last 100 years, a pandemic occurs on average roughly every 20 years.
- When disruptions related to public health hazards impact key water supply and distribution facilities and result in critical facilities being temporarily offline, they may postpone the delivery of essential services, such as water supply.
- Overall, the significance of public health hazards is **High.**

4.5 Hazard Summary

Table 4-31 summarizes the results of the hazard identification and hazard profiles for the Planning Area based on the hazard identification data and input from the HMPC. For each hazard profiled in Section 4.2 on natural hazards and in Section 4.3 on human-caused hazards, this table includes the likelihood of future occurrence and whether the hazard is considered a priority hazard for the Planning Area.

Table 4-31: Hazard Identification and Determination of Priority Hazard

Hazard	Priority Hazard
Natural Hazard	
Earthquake	Yes
Wildfire	Yes
Drought and Water Supply	Yes
Flood	Yes
Severe Weather: Extreme Heat	No
Severe Weather: Heavy Rain/Thunderstorm/ Hail/Lightning/Dense Fog	No
Severe Weather: High Wind	Yes
Landslide	No
Dam Incidents	No
Human-Caused and Human-Health Hazards	
Cyber Threats	Yes
Public Health Hazards: Disease/Pandemic/Epidemic	Yes

Source: HMPC 2020

The HMPC determined that dam incidents, drought and water supply, earthquake, flooding, landslide, high winds, wildfire, and public health hazards are the most significant high priority hazards in the Planning Area. These hazards have also been categorized as priority hazards for mitigation planning purposes by the HMPC. Severe weather hazards, such as heavy rain, thunderstorms, hail, and lightning are medium priority hazards and mitigation actions are proposed for these hazards. However, severe weather hazards, such as extreme heat and dense fog are not priority hazards in the District's planning area. The District's HMPC developed mitigation actions for extreme heat, but dense fog mitigation actions are not included in the plan.

5 Mitigation Strategy

44 U.S. CFR Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the process to develop the mitigation strategy and mitigation action plan for the Valley of the Moon Water District (District) Local Hazard Mitigation Plan (LHMP). It describes how the District met the requirements for the Federal Emergency Management Agency (FEMA) 9-step planning process. This chapter specifically discusses:

- Planning Step 6: Develop a Mitigation Strategy

The results of the planning process, the risk assessment, the goal setting, the identification of mitigation actions, and the participation of the Hazard Mitigation Planning Committee (HMPC) led to the action plan documented in Section 5.3 Mitigation Action Plan. Taking all the above into consideration, the HMPC developed the following overall mitigation strategy:

- **Communicate** the hazard information collected and analyzed through this planning process so that the District's customers better understand what can happen in the service area and what they can do to be better prepared.
- **Implement** the action plan recommendations of this plan.
- **Use** existing policies, water supply and capital improvement plans, and safety procedures already in existence.
- **Monitor** multi-objective management actions so that funding opportunities may be shared, projects may be packaged, and broader constituent support may be garnered among neighboring communities and entities.

5.1 Goals and Objectives

Requirement §201.6(c)(3)(i): The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Up to this point in the planning process, the HMPC has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals and mitigation actions were developed based on these tasks. The HMPC held a series of meetings and exercises designed to achieve a collaborative mitigation strategy as described further throughout this section.

During the initial goal-setting meeting, the HMPC reviewed the results of the hazard identification, vulnerability assessment, and capability assessment. This analysis of the risk assessment identified areas where improvements could be made and provided the framework for the HMPC to formulate planning goals and objectives and the ultimate mitigation strategy for the District's Planning Area.

5.1.1 Goals Development Process

Goals were defined for the purpose of this mitigation plan as broad-based public policy statements that:

- Represent basic desires of the District, water customers, and the Sonoma Valley community;

- Encompass all aspects of community, public and private;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- Are time-independent, in that they are not scheduled events.

Goals are stated without regard to implementation cost, schedule, and means. Goals are defined before considering how to accomplish them so that they are not dependent on the means or cost of achievement. The goal statements form the basis for objectives and actions that will be used as means to achieve the goals. Objectives define strategies to attain the goals and are more specific and measurable.

During the planning process, HMPC members were given a list of sample goals to consider from the California 2018 State Hazard Mitigation Plan (SHMP) and the 2018 Sonoma County Water Agency (Sonoma Water) LHMP. They were also provided a list of goal statements from neighboring city and county hazard mitigation plans (e.g. 2016 Sonoma County Operational Hazard Mitigation Plan), as well as water district plans. The HMPC also reviewed the 2019 Water System Master Plan (WMP) to look for opportunities to align the WMP with the LHMP goals and objectives. They were told that they could use, combine, or revise the statements provided or develop new ones, keeping the risk assessment in mind. Each member was asked to share a goal statement during the second HMPC meeting and write a goal statement in the meeting chat room. Goal statements were compiled and grouped into similar themes and pasted in the chat room. The goal statements from the HMPC were discussed until the team came to consensus on the top goal statements. Some of the statements were determined to be better suited as objectives or actual mitigation actions and were set aside for later use.

Next, the HMPC was asked whether they wanted to develop objectives that summarized strategies to achieve each goal. The HMPC agreed they would consider the development of objective statements as part of the goal development process but chose to revisit the development of objectives once the Draft LHMP was ready for internal review. The HMPC revisited the goal statements prepared and categorized during the second HMPC Meeting. The Wood team explained that their staff and the District Project Manager reviewed each goal, re-arranged them by theme and removed duplicate goal statements. The draft goals focused on resiliency and reliability, basic health and safety, fire suppression, reducing economic impacts associated with hazards, and enhancing collaboration among regional agencies and organizations related to hazard mitigation planning and implementation. The goals focus on the findings from risk assessment review and goal setting process. The HMPC identified the following four goals, which provide direction for reducing future hazard-related losses within the District's Planning Area.

- **Goal 1:** Increase resiliency and reliability of the District's water supply system.
- **Goal 2:** Maintain water supplies during natural, human-health, and technological hazards to provide basic public health, safety, and sanitation and fire suppression needs.
- **Goal 3:** Reduce economic impacts and asset damage from hazards and ensure the District is eligible for FEMA grant funding for mitigation projects.
- **Goal 4:** Enhance collaboration among regional agencies and organizations in regards to hazard mitigation.

5.1.2 Incorporation into Existing Planning Mechanisms

The information contained within this plan, including results from the vulnerability assessment, and the mitigation strategy will be used by the District to help inform updates and the development of local plans, programs and policies. The District may utilize the hazard information when implementing the District's 2019 WMP. The District may also incorporate information in this LHMP into future updates to the District's WMP and the Risk and Resilience Assessment (RRA) and Emergency Response Plan (ERP) update.

Information may include hazard profile information on climate change impacts and the incorporation of climate change adaptation strategies into other local and regional plans and outreach programs, and information on public health hazards and cyber threats.

Lastly, the HMPC representatives report on efforts to integrate the LHMP into local plans, programs and policies and will report on these efforts at the annual HMPC plan review meeting.

5.2 Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

In order to identify and select mitigation actions to support the mitigation goals, each hazard identified in Section 4.1 Identifying Hazards: Natural Hazards was evaluated, as well as human-caused and human-health hazards identified in Section 4.4 Human-caused and Human-health Hazards. Only those hazards that were determined to be a high priority hazard were considered further in the development of hazard-specific mitigation actions.

The priority natural hazards are:

- Earthquake
- Wildfire
- Drought and Water Supply
- Flood: 100/500-Year
- Landslides
- Extreme Heat
- Severe Weather: Heavy Rains/Thunderstorms/Hail/Lightning
- High Winds

Dam incidents were quantitatively assessed in the plan, but the HMPC determined that because the District's facilities were not exposed to dam inundation hazards, and because they do not operate the two dams located upstream of the District's service area this hazard did not need to be prioritized. The District will participate in dam incident planning as it relates to the specific plan process for the Sonoma Development Center. Similarly, while dense fog can result in limited visibility and affect traffic flow, particularly in southern Sonoma Valley, it rarely affects water utility infrastructure, such as aboveground water storage tanks and underground pipelines. For this reason, dense fog is not a high priority hazard for the District and no dense fog mitigation actions are included in the plan. Public health hazards (pandemics/epidemics) and cyber threats were also identified by the HMPC as priority hazards, as noted in Section 4.4 Human-caused and Human-health Hazards. Climate change impacts are qualitatively discussed in each hazard profile section. Public Safety Power Shutoffs (PSPS), commonly associated with high wind and wildfire events, are addressed by the Severe Weather: High Wind actions.

Once it was determined which hazards warranted the development of specific mitigation actions, the HMPC analyzed viable mitigation options that supported the identified goals and objectives. The HMPC was provided with the following list of categories of mitigation actions:

- **Local Plans and Regulations:** These actions include government authorities, policies, or codes that influence the way land, buildings, and infrastructure are developed and built to reduce hazard losses. This includes planning and zoning, floodplain regulations, facility development standards, capital

improvement programs, open space preservation, and stormwater management regulations. These actions can also include development standards that are specific to special district facilities, such as avoiding critical water facility and infrastructure development in hazard areas.

- **Structure and Infrastructure Projects:** These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to critical facilities and infrastructure. This type of action also involves projects to construct man-made structures to reduce the impact of hazards. This includes acquisition, elevation, relocation, structural retrofits, utility undergrounding, floodwalls, detention and retention structures, culverts, storm shutters, and shatter-resistant glass. Many of these types of actions are projects eligible for funding through the FEMA Hazard Mitigation Assistance (HMA) program.
- **Natural Systems Protection**: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems that may provide protection to critical water facilities. They include actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. This includes sediment and erosion controls (e.g., erosion controls along bridge crossings), stream corridor restoration, forest management practices (e.g., defensible space maintenance around water storage tanks), conservation easements, and wetland restoration and preservation.
- **Education and Awareness Programs**: Actions to inform and educate citizens and water utility customers, elected officials, and property owners about the hazards and potential ways to mitigate them. This includes outreach with water utility billings, hazard information kiosks, and education programs. These actions may also include participation in programs, such as StormReady or Firewise Communities.

At the third HMPC meeting, also referred to as the mitigation strategy meeting the HMPC was provided with a matrix showing examples of potential mitigation action alternatives for each of the above categories, for each of the identified hazards. The HMPC was provided a handout that explains the categories and provided further examples. Another reference document titled "Mitigation Ideas" developed by FEMA was distributed to the HMPC during the mitigation strategy meeting. This document lists the common alternatives for mitigation by hazard. The HMPC was instructed to consider both future and existing District buildings and water infrastructure in considering possible mitigation actions. The HMPC was also asked to consider possible climate adaptation strategies in order comply with California Government Code Section 65302 subsection (g)(4). This code section addresses Senate Bill 379 requirements related to the probable consequences of climate change and assessing how climate change may affect critical facilities, infrastructure, and land uses. The HMPC was also reminded to review the California Adaptation Planning Guide (APG), which provides guidance to support communities in addressing the consequences of climate change. Specific climate adaptation strategies were discussed as they relate to the priority natural hazards. The HMPC also discussed which mitigation actions and strategies should be pursued first to address immediate District and customer needs.

A facilitated discussion took place to examine and analyze the options. Appendix C provides the matrix of alternatives considered. Each proposed mitigation action or activity was verbally discussed during the third HMPC meeting and documented in the virtual meeting chat room.

5.2.1 Prioritization Process

Once the mitigation actions were identified, the HMPC was provided with several decision-making tools, including FEMA's recommended prioritization criteria, STAPLEE, to assist in deciding why one

recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE stands for the following:

- **Social:** Does the measure treat people fairly? (e.g., social equity, different groups, different generations)
- **Technical:** Is the action technically feasible? Does it solve the problem?
- **Administrative:** Are there adequate staffing, funding, and other capabilities to implement the project?
- **Political:** Who are the stakeholders? Will there be political and public support for the project?
- **Legal:** Does the jurisdiction have the legal authority to implement the action? Is it legal?
- **Economic:** Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- **Environmental:** Does the action comply with environmental regulations? Will there be negative environmental consequences from the action?

Given the unique needs of the District as a water provider, the HMPC also discussed prioritizing actions that focus on reliability, resistance, recovery of assets, and redundancy, also referred to as the four R's. They reviewed planning materials and tools designed to assist local water districts in the development of climate adaptation and resiliency actions, including the following resilience evaluation criteria:

- **Reliability:** This criterion addresses how likely is it that the service provided by the mitigation action or project will be disrupted due to an identified natural hazard. This criterion considers the capability of an infrastructure project to maintain operations under a range of conditions.
- **Resistance:** This criterion addresses how likely is it that the mitigation action or project will be damaged due to one or more of the identified natural hazards. This criterion considers the physical protection of the infrastructure project.
- **Recovery of Assets:** This criterion considers the cost is to resume service following exposure to the identified natural hazard. This criterion considers the ability to recover from disruption, or the costs associated with getting the infrastructure back in service following a hazard event.
- **Redundancy:** This criterion considers the ability of the mitigation action or project is to continue service during exposure to a natural hazard even with some damage or impact to the infrastructure. This criterion considers the adaptability of the assets or networks or systems that are part of the project (e.g., alternate back-up system).

In accordance with the DMA requirements (44 CFR , Section 201.6(c)(3)), an emphasis was also placed on the importance of a benefit-cost analysis in determining action priority. As part of this evaluation, the benefits of proposed actions were weighed against estimated costs as part of the prioritization process. Other criteria used to assist in evaluating the benefit-cost of a mitigation action included:

- Does the action address priority hazards or areas with the highest risk?
- Does the action protect lives?
- Does the action protect infrastructure, community assets or critical facilities (lifelines)?
- Does the action meet multiple objectives (Multiple Objective Management)?
- What will the action cost?
- What is the timing of available funding?

The mitigation categories, multi-hazard actions, and criteria are included in Appendix C: Mitigation Categories, Alternatives, and Selection Criteria.

During the mitigation strategy meeting the HMPC discussed the STAPLEE criteria, but focused the prioritization process on the four R's: Reliability (capacity of the infrastructure project to maintain operations), Resistance (direct physical protection of the infrastructure project), Recovery of Assets (ability to recover from disruption), and Redundancy (adaptability of the project assets or ability of the project to continue to provide service during disruptions) (resilience evaluation criteria). With these criteria in mind, team members were asked to prioritize each mitigation action and explain why they selected the action to be prioritized. The projects were then listed in a survey poll to determine which mitigation actions were the most popular among the HMPC. The mitigation actions with the most percentage points in the survey poll became the higher priority projects. This process provided both consensus and priority for the recommendations.

The process of identification and analysis of mitigation alternatives allowed the HMPC to come to consensus and to collectively prioritize recommended mitigation actions. During the polling process, emphasis was placed on the importance of a benefit-cost review in determining project priority; however, this was not a quantitative analysis. Benefit-cost was considered in greater detail in the development of the Mitigation Action Plan detailed below in Section 5.3. For example, parameters were established for assigning subjective ratings (high, medium, low) to the benefits and costs of each mitigation action. Specifically, each action developed for this plan contains a description of the problem and proposed project, the entity with primary responsibility for implementation, any other alternatives considered, a cost estimate, expected project benefits as they relate to the 4 R's, potential funding sources, and a schedule for implementation. Development of these project details for each action and the results of a poll the HMPC completed to prioritize the mitigation actions led to the determination of an overall high, medium, or low priority for each action.

Recognizing the limitations in prioritizing actions from District departments and the regulatory requirement to prioritize by benefit-cost to ensure cost-effectiveness, the HMPC decided to pursue mitigation action strategy development and implementation according to the nature and extent of damages, the level of protection and benefits each action provides, political support, project cost, available funding, and regional partner's priorities (e.g., City of Sonoma, Sonoma Water). This process guided the development of a prioritized action plan for the District. Cost-effectiveness will be considered in greater detail through a formal benefit-cost analysis when seeking FEMA mitigation grant eligibility and funding (e.g. HMA Grant Program, Pre-Disaster Mitigation grant program) for eligible actions associated with this plan.

5.3 Mitigation Action Plan

Requirement §201.6(c)(3)(iii): The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This action plan was developed to present the recommendations developed by the HMPC for how the District can reduce the vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. Over time, the implementation of these projects will be tracked as a measure of demonstrated progress on meeting the plan's goals.

5.3.1 Compliance with the National Flood Insurance Program

Because the Valley of the Moon Water District, is a special district, it is not eligible to participate in the National Flood Insurance Program.

5.3.2 Mitigation Action Plan

This action plan presents the recommendations developed by the HMPC outlining how the District can reduce the risk and vulnerability of people, property, critical water supply and distribution infrastructure, and natural and cultural resources to future disaster losses. The mitigation actions developed by the HMPC are summarized in Table 5.1 and listed in detail in the mitigation action worksheets that follow. Table 5.1 is a summary table for quick reference. It identifies the mitigation action title, lead agency/department, hazards mitigated, priority and if the action mitigates losses to existing or future development. The 'Related Goal' column notes which of the four goals in Section 5.2 that the action helps achieve. The action worksheets that follow provide more background information, ideas for implementation, lead agency, partners, potential funding sources, cost estimates, benefits, and timeline for each identified action.

The District has other existing, detailed action descriptions in planning documents, such as the 2019 WMP, FY 2020/2021 Capital Improvement Program (CIP) and Budgets, and other planning mechanisms. These actions are considered to be part of this plan, and the details, to avoid duplication, should be referenced in their original source document. The HMPC also realizes that new needs, priorities, and adaptation strategies may arise as a result of a disaster or other circumstances and reserves the right to support new actions and strategies, as necessary, as long as they conform to the overall goals of this plan.

The actions included in this mitigation strategy are subject to further review and refinement; alternatives analyses; and reprioritization due to funding availability and/or other criteria. The District is not obligated by this document to implement any or all of these projects. Rather this mitigation strategy represents the desires of the District and the community to mitigate the risks and vulnerabilities from identified hazards.

Many of the action items included in this plan are also a collaborative effort among the District, Sonoma County, Sonoma Water, City of Sonoma, Sonoma Valley Groundwater Sustainability Agency (GSA) and other state, regional, and local agencies and stakeholders in the District's Planning Area and greater Sonoma Valley.

Table 5- 1: Mitigation Action Summary Table

Action ID	Action Title	New Action*	Hazard(s) Mitigated	Responsible Office / Agency	Address Existing or Future Development	Priority	Related Goal
Earthquake							
E-1	Conduct engineering-level study to understand seismic vulnerabilities of District critical assets	New	Earthquake	District	Both	High	1, 2, 3
E-2	Implementation of water pipe inspection and maintenance program	New	Earthquake	District	Existing	High	1, 2, 3
E-3	Earthquake hardening	New	Earthquake	District	Both	High	1, 2, 3, 4
Wildfire							
W-1	Wildfire vulnerability assessment	New	Wildfire	District	Existing	High	1, 2, 3, 4
W-2	Implement Pilot wildfire mitigation incentive program	New	Wildfire	District, Sonoma County	Both	High	1, 3, 4
W-3	Implement fire safe standards, design review, and code enforcement inspections	New	Wildfire	District, Sonoma County	Both	High	1, 3, 4
W-4	Increase water tank storage capacity	New	Wildfire, Drought and Water Supply	District	Both	Medium	1, 2
Drought and Water Supply							
DR-1	Emergency redundant main line connection to the City of Sonoma service area	New	Drought and Water Supply, Earthquake, Wildfire	District, City of Sonoma	Both	High	1, 2, 4
DR-2	Water mainline replacement and retrofit project	New	Drought and Water Supply	District	Both	High	1, 2, 3
DR-3	Alternative supplemental water supply project	New	Drought and Water Supply, Earthquake, Wildfire	District, City of Sonoma	Both	High	1, 2, 4

Action ID	Action Title	New Action*	Hazard(s) Mitigated	Responsible Office / Agency	Address Existing or Future Development	Priority	Related Goal
DR-4	Enhance coordination with regional partners to increase public awareness related to drought restrictions	New	Drought and Water Supply	Sonoma Water, Sonoma-Marin Water Saving Partnership, Sonoma County, HALTER Project, Sonoma Valley Unified School District, La Luz Center	Both	Medium	1, 2, 4
DR-5	Collaborate with the Sustainable GSA on development of groundwater management criteria and identifying recharge projects where there is groundwater depletion in the Sonoma Valley subbasin	New	Drought and Water Supply	District, Sonoma GSA, Sonoma Water, City of Sonoma	Both	Medium	1, 2, 3, 4
DR-6	Groundwater well installation and recharge to augment water supplies	New	Drought and Water Supply	District	Both	Medium	1, 2, 3
DR-7	Recycled water system project in Sonoma Valley to augment water supplies	New	Drought and Water Supply	District	Both	Low	1, 2
DR-8	Mini-rate study that compares off-peak versus peak water use cost structures to meet water demand objectives during drought events	New	Drought and Water Supply	District	Both	Low	1, 2
DR-9	Initiate a study to determine costs of purchasing off-peak water	New	Drought and Water Storage	District	Both	Low	1, 2, 3

Action ID	Action Title	New Action*	Hazard(s) Mitigated	Responsible Office / Agency	Address Existing or Future Development	Priority	Related Goal
	for aquifer storage and recovery						
			Flood				
F-1	Identification of water pipelines exposed to flooding and soil erosion along bridge crossing to prioritize and implement pipeline alignment upgrades	New	Flood	District	Existing	High	1, 2, 3
F-2	Boyes Boulevard water line replacement project	New	Flood	District	Existing	High	1, 3
			Landslide				
L-1	Donald Tank hillside stabilization	New	Landslide	District	Both	High	1, 3
			Severe Weather				
SW-1	Solar power back-up generation and battery storage at water tanks and installation of SCADA systems	New	Extreme Heat, Heavy Rains/Thunderstorms/Hail/Lightning/, and High Winds	District	Both	High	1, 3
SW-2	Critical water facility and infrastructure hardening and resilience projects against severe weather	New	Heavy Rains/Thunderstorms/Hail/Lightning and High Winds	District	Both	Medium	1, 2, 3, 4
			Dam Incidents				
D-1	Dam Incident Planning during Sonoma Development Center Specific Plan Process	New	Dam Incidents	District, Sonoma County, California DGS	Existing	Low	2, 3, 4

Action ID	Action Title	New Action*	Hazard(s) Mitigated	Responsible Office / Agency	Address Existing or Future Development	Priority	Related Goal
Public Health Hazards: Pandemic/Epidemic							
PH-1	Ensure continuity of District operations through implementation of Public Health and Safety Plan	New	Public Health Hazards	District	Both	High	1, 2
Cyber Threats							
CT-1	Implement a five-year training plan to enhance system security and exercise a recovery plan for District facilities	New	Cyber Threats	District	Both	High	1, 3
CT-2	Develop a Risk and Resilience Assessment (RRA) and update the Emergency Response Plan	New	Cyber Threats, Earthquake, Wildfires, Drought and Water Supply, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Winds, Dam Incidents	District	Both	High	1, 2, 3
CT-3	Leverage modern hardware and security system upgrades to improve risk management throughout District operations	New	Cyber Threats, Earthquake	District	Both	Medium	1, 3
Multi-Hazard Actions							
MH-1	Cross connection to City of Sonoma water system	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Severe Weather: Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District	Both	High	1, 2, 3
MH-2	Implementation of capital improvements in Water System Master Plan	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District	Existing	High	1, 2, 3

Action ID	Action Title	New Action*	Hazard(s) Mitigated	Responsible Office / Agency	Address Existing or Future Development	Priority	Related Goal
MH-3	"Map your Neighborhood" Preparedness Program	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District	Both	High	1, 2, 3, 4
MH-4	Scotts Dam removal at Lake Pillsbury	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District, Sonoma Water, Sonoma County	Both	Medium	1, 2, 4
MH-5	Conduct an Intertie Feasibility Study of new main aqueduct intertie from Sonoma Valley to Petaluma Valley	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District	Existing	Low	1, 2, 4
MH-6	Conduct an Intertie Feasibility Planning Study of new main aqueduct intertie from Sonoma Valley to American Canyon	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District	Both	Low	1, 2, 4
MH-7	On-site solar power generation and battery storage project	New	Multi-Hazard, Earthquake, Wildfire, Flooding, Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind	District	Both	Low	1, 3

Note: This is the District's first LHMP; therefore, all mitigation actions are new 2021 actions.

The following mitigation actions provide project specific information and implementation details on each mitigation activity identified. They are grouped by the type of hazard(s) they address.

E-1 Conduct engineering-level study to understand seismic vulnerabilities of District critical assets

Mitigation Project Title	Conduct engineering-level study to understand seismic vulnerabilities of District critical assets
Hazard(s) Mitigated	Earthquake
Project Description, Issue/Background	California and the District's service area are located in a region with high seismic activity given its proximity to nearby faults, such as the Healdsburg-Rogers Creek fault. The main aqueducts and water lines serving the District area mostly underground and susceptible to seismic activity. The aboveground infrastructure, such as water tanks could also crack, leak, or become unstable following an earthquake event. An engineering-level study that evaluates the seismic vulnerabilities of the District's critical water facilities should identify key stress points and weaknesses in the water system. The study will also make recommendations for specific retrofit, replacement, and facility hardening projects and identify detailed mitigation activities the District could consider integrating into the mandated RRA and ERP update and in the next LHMP update.
Related planning mechanisms	2019 WMP, RRA, ERP, 2015 Urban Water Management Plan (UWMP) (2020 Update)
Other Alternatives	None
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	District, Sonoma Water, City of Sonoma
Priority (High, Medium, Low)	High
Cost Estimate	$100,000 to $200,000 (Capital costs for project-specific retrofits could require up to $3 million in costs)
Benefits (Avoided Losses)	Addresses aging water distribution infrastructure that needs retrofitting and replacement and potential impacts to critical water infrastructure related to potential seismic damage (water line breaks, cracks, leaks) that could result in disruptions in the delivery of potable water supply.
Potential Funding	Operations and Maintenance Budget, State bonds, Federal Grants: Hazard Mitigation Grant Program (HMGP) and Building Resilient Infrastructure and Communities (BRIC) Program
Schedule	1 to 3 years

E-2 Implementation of water pipe inspection and maintenance program

Mitigation Project Title	Implementation of water pipe inspection and maintenance program
Hazard(s) Mitigated	Earthquake
Project Description, Issue/Background	The District includes a range of key facilities and maintenance projects in its CIP for the FY 2020/2021 period. Prioritized projects include replacing undersized steel water main lines and continuing routine water pipe inspections for facilities that are reaching their end of life span. Several of these capital improvement projects address minimizing earthquake hazards on existing water infrastructure, which would minimize vulnerabilities to critical water main lines and other facilities near their end of life span.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update, 2015 UWMP
Other Alternatives	Retrofit critical water facilities, Implementation of routine and existing maintenance program
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Water, City of Sonoma
Priority (High, Medium, Low)	High
Cost Estimate	Unknown
Benefits (Avoided Losses)	Implementation of a maintenance program that monitors the conditions of critical water infrastructure and the potential for seismic damage (aging infrastructure, pipeline exposure/erosion concerns, water line breaks, cracks, leaks) could promote the early identification of issues, which would minimize the potential for disruptions in the delivery of potable water supply.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

E-3 Earthquake hardening

Mitigation Project Title	Earthquake hardening
Hazard(s) Mitigated	Earthquake
Project Description, Issue/Background	The District has water infrastructure that is critical to the delivery of water service to customers in Sonoma Valley. Several water facilities serve communities in Sonoma Valley that are at risk to serious ground shaking based on their proximity to major regional faults. In some cases, these facilities are not built to the latest seismic standards and able to withstand an earthquake; lack necessary seismic retrofits and upgrades; and are nearing the end of their service life. Damage to these facilities can result in a loss of potable water service for an extended period in Sonoma Valley. Following an engineering-level study listed in Mitigation Action E-1 that focuses on potential projects the District can take to harden facilities against earthquake hazards, this action would involve implementing hardening the most susceptible facilities or those most critical in ensuring the District's reliable delivery of potable water. Specific actions may include adding structural improvements to storage tanks, booster pump stations, and the office and corporation yard, or adding bracing during construction retrofits. Other hardening retrofits may involve upgrading the water main lines and bridge crossings that traverse major faults. The District standards could also be updated ensuring that facilities are built ready to withstand an earthquake from the beginning of their service life. The following facilities have been identified as being at high risk to earthquakes based on ground shaking potential (greater than 135 percent spectral acceleration): • Arnold Drive Pump station • Verano Well Pump Station • Labre Well Pump Station • Temelec Water Tank #1 • Temelec Water Tank #2 The list of facilities vulnerable to earthquakes could be prioritized based on how critical each facility is to the functionality of the entire water system and also how critical the needed upgrades are to the District.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update
Other Alternatives	Retrofit critical water facilities, implementation of routine and existing maintenance program
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Water, City of Sonoma, Sonoma County
Priority (High, Medium, Low)	High
Cost Estimate	$1,500,000 to $3,000,000 depending on the actions and needs identified
Benefits (Avoided Losses)	The benefits are based on the losses avoided in terms of limiting potable water service disruptions and the replacement costs of damaged facilities from earthquake events.
Potential Funding	Operations and Maintenance Budget/Capital funds, Funding Assistance through Cal OES HMGP and BRIC program grant funding, State bonds
Schedule	3 to 5 years

W-1 Wildfire Vulnerability Assessment

Mitigation Project Title	Wildfire Vulnerability Assessment
Hazard(s) Mitigated	Wildfire
Project Description, Issue/Background	Sonoma Valley is a populated area situated within the wildland intermix and the wildland urban interface (WUI). The impacts of the 2017 and 2018 Nuns and Tubbs wildfires underscored the District's vulnerability to wildfire threats, as several homes and structures were lost and extensive damage occurred across the County, including a District water tank. Several wildland fires have occurred since these fires (Glass and Kincade Fires) and resulted in additional federally declared disasters in Sonoma County. The frequency and severity of these wildfires emphasize the need to implement mitigation and prevention measures to protect critical water infrastructure that serves Sonoma Valley. The completion of a detailed wildfire vulnerability assessment will identify specific water facility vulnerabilities and include the identification of project-specific improvements and infrastructure hardening necessary to minimize vulnerabilities to aboveground water facilities, such as water tanks and pump stations. The assessment will also identify landscape-level fuels reduction mitigation projects within District property or on adjacent public property that will establish defensible space around critical and essential facilities. Other recommendations will include a list of structural hardening and retrofit projects that limit combustibility.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update, Sonoma County Community Wildfire Protection Plan (CWPP) Update
Other Alternatives	Existing LHMP Risk Assessment
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Valley Fire District, Sonoma Valley Unified School District
Priority (High, Medium, Low)	High
Cost Estimate	$50,000
Benefits (Avoided Losses)	The identification of District water facilities that are vulnerable to wildfires and the identification of hardening projects will advance wildfire resiliency and adaptation to changing wildfire regimes in Sonoma Valley. An assessment will also support District resilience efforts specific to wildfire risk reduction, advance customers understanding of infrastructure vulnerabilities, and support capacity building among regional water utility providers, municipalities, unincorporated communities, and the local fire district.
Potential Funding	Operations and Maintenance Budget, State Climate Resilience Bond, State Grants (2020 Proposition 84 Wildfire Resiliency and Recovery Planning Grants) through California Department of Conservation (DOC) and the California Strategic Growth Council (SGC), Federal Grants: HMGP and BRIC Programs
Schedule	1 to 3 years

W-2 Implement Pilot Wildfire Mitigation Incentive Program

Mitigation Project Title	Implement Pilot Wildfire Preparedness Incentive Program
Hazard(s) Mitigated	Wildfire, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind
Project Description, Issue/Background	This action involves the District partnering with local fire districts to design and implement a pilot inspection and incentive program targeted to customers in the State Responsibility Area (SRA) Very High and High Fire Hazard Severity Zones (FHSZs). Field inspectors from the District and Sonoma Valley Fire District would inspect and assess whether property owners have implemented Best Management Practices (BMPs) in Water-use Efficiency, Irrigation Management, Ignition-resistant Retrofit, Evacuation/Fire Personnel Access, On-Site Rainwater Collection, On-site Water Storage, Fuels Reduction, and Defensible Space. This action would be implemented following the development of a new "hazard-zone" rate tier that would be established by the District to fund ongoing hazard mitigation projects and programs.
Related planning mechanisms	2019 WSP
Other Alternatives	Owners of WUI properties should be required to pay higher water rates justified by the added expenses of operating and implementing hazard mitigation projects and incentive programs needed to resiliently serve inherently vulnerable properties.
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Valley Fire District, Sonoma County
Priority (High, Medium, Low)	High
Cost Estimate	$100,000 (budget would become net zero after rate tier is established)
Benefits (Avoided Losses)	The District would avoid investments in serving unnecessarily vulnerable properties and help provide a price signal (financial incentive) to encourage and reward responsible WUI property owners while helping to mitigate equity issues and assisting other Sonoma County agencies.
Potential Funding	Operations and Maintenance Budget/Grant funds associated with the development of a new "hazard-zone" rate tier to fund ongoing HMPG and BRIC program funded projects, State bonds (related to climate resiliency)
Schedule	1 to 3 years

W-3 Support fire safe standards, design review, and code enforcement inspections

Mitigation Project Title	Implement fire safe standards, design review, and code enforcement inspections
Hazard(s) Mitigated	Wildfire
Project Description, Issue/Background	The District should not take on the burden of providing water services to existing customers or permitted new construction (or substantially altered existing buildings) located in SRA Very High and High FHSZs unless the developer and Sonoma County can certify that the project will implement the latest construction codes and BMPs in Ignition-resistant Construction, Evacuation/Fire Personnel Access, On-Site Rainwater Collection, On-site Water Storage, and Ongoing Maintenance for Fuels Reduction and Defensible Space. Similar to Mitigation Action W-2, this action would be implemented following the development of a new "hazard-zone" rate tier that would be established by the District to fund ongoing hazard mitigation projects and programs.
Related planning mechanisms	2019 WSP
Other Alternatives	Projects failing to achieve certification would not be able to receive service authorizations from the District, or else should pay higher water rates justified by the added expenses of operating hazard mitigation projects and programs needed to serve inherently vulnerable projects.
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma County, Sonoma Valley Fire District, Other Local Fire Districts
Priority (High, Medium, Low)	High
Cost Estimate	$100,000 (budget net zero after rate tier is established)
Benefits (Avoided Losses)	VOMWD will avoid investments in unnecessarily vulnerable existing and new development projects and help provide a price signal (financial incentive) to encourage and reward only responsible new WUI development while assisting other County agencies.
Potential Funding	Operations and Maintenance Budget/Grant funds associated with the development of a new "hazard-zone" rate tier to fund ongoing hazard mitigation projects and programs. Additional funding assistance through Cal OES HMGP, BRIC program, State Bonds (related to climate resiliency bond)
Schedule	1 to 3 years

W-4 Increase water tank storage capacity to augment water supplies and to increase water availability for fire suppression activities

Mitigation Project Title	Increase water tank storage capacity
Hazard(s) Mitigated	Wildfire, Drought and Water Supply
Project Description, Issue/Background	The District currently has one day of water storage; this project would involve increasing water storage capacity by either the construction and installation of a new water tank or replacing an existing tank with a larger-capacity steel water tank for additional storage and to support fire suppression and prevention activities.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WSP
Other Alternatives	None
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Valley Fire District, Other Local Fire District
Priority (High, Medium, Low)	High
Cost Estimate	$2,000,000
Benefits (Avoided Losses)	Additional water storage capacity within the District's service area will provide health and safety benefits and needed fire protection.
Potential Funding	Operations and Maintenance Budget, Cal OES HMGP, BRIC program, State bonds (related to climate resiliency bond)
Schedule	3 to 5 years

DR-1 Emergency redundant main line connection to the City of Sonoma service area

Mitigation Project Title	Emergency redundant main line connection to the City of Sonoma service area
Hazard(s) Mitigated	Drought and Water Supply, Earthquake, Wildfire, High Wind
Project Description, Issue/Background	This action involves evaluating the feasibility of the installation of a secondary water intertie between the District's service area and the City of Sonoma service area to increase redundancy and include emergency potable water supply in the event of a natural disaster. The potential project would include a portable pump station to convey the water through the new connection, but the intertie would be a permanent facility.
Related planning mechanisms	2019 WSP
Other Alternatives	No Action, Re-establish Sonoma Development Center (SDC) Water Reservoir Intertie
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma, Sonoma County, California Department of General Services (DGS)
Priority (High, Medium, Low)	High
Cost Estimate	$150,000
Benefits (Avoided Losses)	Provides a back-up water supply to the District during emergencies related to drought, earthquakes, wildfires, and high wind events. This potential project would avoid impacts associated with the District's inability to deliver potable water supplies during disasters. This includes both the delivery of drinking water and possible water use for fire suppression.
Potential Funding	Operations and Maintenance Budget
Schedule	1 to 3 years

DR-2 Water mainline replacement and retrofit project

Mitigation Project Title	Water mainline replacement and retrofit project
Hazard(s) Mitigated	Drought and Water Supply, Earthquake, Wildfire
Project Description, Issue/Background	The District proposes major improvements and replacements to several water mainlines in the service area. These replacements are needed to upgrade lines that have insufficient water flow or for lines that have reached the end of their service life. Water main replacement projects in the FY 2020-2021 CIP include the Walnut Avenue, Oak Street and Penny Lane Replacement Projects (CIP-2947) and the Gibson Street, Riddle Road Easement, and Sobre Vista Replacement Projects (CIP-2984).
Related planning mechanisms	FY 2020/2021 CIP, 2019 WSP
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$500,000
Benefits (Avoided Losses)	This potential project would avoid impacts associated with the District's inability to deliver potable water supplies at sufficient flows during disasters. This includes both the delivery of drinking water and possible water use for fire suppression.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

DR-3 Alternative supplemental water supply project

Mitigation Project Title	Alternative supplemental water supply project
Hazard(s) Mitigated	Drought and Water Supply, Earthquake, Wildfire
Project Description, Issue/Background	The Sonoma Developmental Center (SDC) is a 945-acre property that includes a campus, agricultural lands, and open space that historically provided services to persons with developmental disabilities. The SDC closed in 2018 and the County is developing a specific plan for the property, including the reuse of the existing water supply reservoirs and water treatment facility. The District and the City of Sonoma are interested in exploring the feasibility of using the water supply available at the SDC Campus as an alternative emergency back-up source during wildfires and earthquakes. This action involves continued collaboration and engagement during the SDC Specific Plan process to provide local support and consideration of alternative water supplies at the campus.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WSP, SDC Specific Plan
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma, Sonoma County, California DGS, La Luz Center
Priority (High, Medium, Low)	High
Cost Estimate	$200,000
Benefits (Avoided Losses)	This potential project would avoid impacts associated with the District's inability to deliver water supplies during emergencies for fire suppression.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

DR-4 Enhance coordination with regional partners to increase public awareness related to drought restrictions

Mitigation Project Title	Enhance coordination with regional partners to increase public awareness on emergency preparedness related to drought restrictions
Hazard(s) Mitigated	Drought and Water Supply
Project Description, Issue/Background	This action involves coordination with key regional partners involved with water management, including the Sonoma-Marin Water Saving Partnership, Sonoma County, HALTER Project (Leading Residents to Safety and Preparedness) to increase public awareness around drought conditions and water supply restrictions and to better prepare District customers for drought and mitigation of drought through water conservation efforts. Providing educational awareness and consistent messaging in advance of or prior to a drought-related emergency and during an emergency can improve the ability of the District to provide seamless delivery of water services. Given there was a major multi-year drought in California that affected the District and several major wildfires occurred in Sonoma Valley in recent years, public education programs have improved the District's customer's preparedness during emergencies. Public outreach components include advanced messaging, website informational materials, brochures in billings, alert systems, and other communication platforms, in partnership with regional agencies and organizations. These materials can protect communities in Sonoma Valley, improve the response and recovery efforts, and reduce the impacts of natural disasters, particularly those related to drought where there is time to adjust to water restrictions.
Related planning mechanisms	Water Supply Contingency Plan (WSCP)
Other Alternatives	District's Emergency Preparedness Webpage
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Water, Sonoma-Marin Water Saving Partnership, Sonoma County, HALTER Project, Sonoma Valley Unified School District, La Luz Center
Priority (High, Medium, Low)	Medium
Cost Estimate	$25,000
Benefits (Avoided Losses)	Improved customer awareness can minimize District staff time responding to complaints related to water service disruptions and improve the District's ability to address hazard events and continue to delivery water services.
Potential Funding	Partner Match
Schedule	1 to 3 years

DR-5 Collaborate with the Sustainable Groundwater Agency on development of groundwater management criteria and identifying recharge projects where there is groundwater depletion in the Sonoma Valley subbasin

Mitigation Project Title	Collaborate with the Sustainable Groundwater Agency (GSA) on development of groundwater management criteria and identifying recharge projects where there is groundwater depletion in the Sonoma Valley subbasin
Hazard(s) Mitigated	Drought and Water Supply
Project Description, Issue/Background	California's Sustainable Groundwater Management Act (SGMA) addresses groundwater and aquifer recharge needs. Groundwater management will provide a buffer against drought and climate change and contribute to reliable water supplies. The protection of critical recharge areas will be addressed in the Draft Sonoma Valley Groundwater Sustainability Plan (GSP). This action involves District participation on the Sonoma Valley GSA that include recommending provisions that guide development or curtail development in areas that would harm or compromise recharge areas and promote the identification of recharge projects where groundwater depletion occurs in Sonoma Valley.
Related planning mechanisms	2020 Draft GSP, 2019 WSP, 2015 UWMP, Sonoma Valley Groundwater Recharge Program
Other Alternatives	District is currently a participating special district on the Board of Directors for the Sonoma Valley GSA with Sonoma Water, Sonoma County, and the City of Sonoma
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Water, Sonoma County, City of Sonoma
Priority (High, Medium, Low)	Medium
Cost Estimate	$25,000
Benefits (Avoided Losses)	Participation in the development of the Sonoma Valley GSP will help avoid undesirable groundwater issues and lay the foundation for actions to achieve the subbasin's sustainability goals related to groundwater quality and declining groundwater levels.
Potential Funding	Sonoma Valley GSA is funded by contributions from state grant revenue, member agencies, which will continue through the development of the GSP, and end in 2022.
Schedule	1 to 3 years

DR-6 Groundwater well installation and recharge

Mitigation Project Title	Groundwater well installation and recharge
Hazard(s) Mitigated	Drought and Water Supply
Project Description, Issue/Background	The District's facilities currently consist of six groundwater wells and ten water turnouts for delivery of water purchased from Sonoma Water. Of these six wells, four are active, one is being repaired, and one needs to be reactivated. While the majority (approximately 85 percent) of the District's water comes from Sonoma Water purchases and deliveries, the remaining is supplied by these six wells. In recent years, some of the shallower groundwater wells have resulted in reduced production or are offline due to drought/dry conditions. The District is exploring options to add additional wells or recharge existing wells (i.e. drilling deeper) with enough capacity to achieve 1,775 gallons per minute (gpm). New groundwater wells would include the Labre Well rehabilitation/recharge project, Chestnut Well installation, and installation of Park Well. The new wells will also provide emergency generation back-up supply.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WSP, 2015 UWMP
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma
Priority (High, Medium, Low)	Medium
Cost Estimate	$2,000,000 per well (2021/2022 Budget allocates $900,000 for Park Well, other well estimates depend on site specific well locations)
Benefits (Avoided Losses)	Installation and rehabilitation of these wells will expand the District's groundwater supply and meet demand and minimize limited water supply risks associated with reduced water deliveries from the Russian River system during drought events. Additional wells will also provide health and safety benefits and improved fire protection.
Potential Funding	Operations and Maintenance Budget
Schedule	1 to 3 years

DR-7 Recycled Water System Project in Sonoma Valley to augment water supplies

Mitigation Project Title	Recycled water system project in Sonoma Valley to augment water supplies
Hazard(s) Mitigated	Drought and Water Supply
Project Description, Issue/Background	Recycled water is cleaned wastewater from homes and businesses. It is used for crop irrigation, landscaping, wildlife habitat enhancement and industrial water processes. Its benefits include the conservation of drinking water, wildlife habitat protection, and wetland restoration. Based on the actions developed as part of the Sonoma Valley GSP, the District would collaborate with member agencies to study and develop water reuse systems that could be constructed in the service area to supply recycled water. The District would also support implementation of a recycled water system project that includes a wastewater treatment facility, storage tank, water pipeline infrastructure, and a pumping station that are each geographically positioned to provide water supply to the District's residential and commercial customers.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update, 2015 UWMP (2020 Update)
Other Alternatives	No Action, Continued reliance on surface water deliveries and groundwater
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma Water, Sonoma County Sanitation District, City of Sonoma
Priority (High, Medium, Low)	Low
Cost Estimate	$3,000,000 to $5,000,000
Benefits (Avoided Losses)	The recycled water will be used to offset potable drinking water supplies, limit groundwater pumping, and reduce local declines of groundwater levels in the Sonoma Valley subbasin.
Potential Funding	California Department of Water Resources (DWR) Proposition 84, State bonds (climate resiliency bond)
Schedule	5 to 10 years

DR-8 Mini-rate study that compares off-peak versus peak water use cost structures to meet water demand objectives during drought events

Mitigation Project Title	Mini-rate study that compares off-peak versus peak water use cost structures to meet water demand objectives during drought events
Hazard(s) Mitigated	Drought and Water Supply
Project Description, Issue/Background	Potable water use in the District's service area has generally decreased over the past 20 years, although the variations are assumed to be associated with hydrologic conditions, economics, and extended droughts. A water rate study that evaluates and compares peak water demand versus off-peak water demand can help the District better achieve water demand management objectives during drought events. Water conservation rate structures can achieve these objectives by understanding growing water demands, system reliability during drought conditions, and water storage capacity needs.
Related planning mechanisms	Existing District Rate Structure
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma, La Luz Center
Priority (High, Medium, Low)	Low
Cost Estimate	$50,000
Benefits (Avoided Losses)	The evaluation from a rate study can help the District avoid limited water supplies from reduced surface water deliveries by water management and storage objectives and the implementation of voluntary and mandated water restrictions during drought events.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

DR-9 Initiate a study to determine costs of purchasing off-peak water for aquifer storage and recovery

Mitigation Project Title	Initiate a study to determine costs of purchasing off-peak water for aquifer storage and recovery
Hazard(s) Mitigated	Drought and Water Supply
Project Description, Issue/Background	This action involves enhancing groundwater resources by expanding the District's water storage capacities to provide optimal sufficiency levels in the event of an extended drought or other natural disaster. The action consists of initiating a study to determine the planning, permitting, and implementation costs of purchasing off-peak water for aquifer storage and recovery and seeking funding for the development that allows the District to install additional wells or water storage facilities for recovery.
Related planning mechanisms	None
Other Alternatives	No Action, Continued purchase of peak water based on current demand
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma, Sonoma Valley GSA
Priority (High, Medium, Low)	Low
Cost Estimate	$50,000 to $100,000
Benefits (Avoided Losses)	Reduces uncertainties in the reliability of future regional water supplies, including both surface and groundwater in Sonoma County. A feasibility study that explores a water storage and recovery facility would enhance the District's ability to manage water resources and allow the District to use stored water during drought or dry weather conditions (i.e., summer and fall seasons) or during emergencies. Like Aquifer Storage and Recovery (ASR) projects, this project would improve the resiliency and sustainability of water resources in Sonoma Valley and avoid impacts related to water restrictions.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

F-1 Identification of water pipelines exposed to flooding and soil erosion along bridge crossings to prioritize and implement pipeline alignment upgrades

Mitigation Project Title	Identification of water pipelines exposed to flooding and soil erosion along bridge crossings to prioritize and implement pipeline alignment upgrades
Hazard(s) Mitigated	Flooding
Project Description, Issue/Background	This project involves the identification of water pipelines that are exposed to soil erosion as a result of stormwater runoff and flooding along Sonoma Creek. It specifically involves the identification of pipelines along up to seven bridge crossings in Sonoma Valley that are potentially eroding or exposed due to localized runoff and flood events. This action could be implemented in conjunction with Mitigation Action E-2, which involves water pipe inspections and maintenance. The purpose of this project is to identify problem areas along exposed pipelines and to implement project upgrades at specific pipeline alignments and bridge crossings.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update, 2015 UWMP
Other Alternatives	Retrofit Water Pipelines, Implementation of routine and existing maintenance program
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma, Sonoma Water
Priority (High, Medium, Low)	Medium
Cost Estimate	Unknown
Benefits (Avoided Losses)	The identification of the structural conditions of critical water infrastructure, including water main pipelines near areas susceptible to stormwater runoff and flooding along bridge crossings would promote the early identification of structural issues, which would minimize the potential for disruptions in the delivery of potable water supply.
Potential Funding	Operations and Maintenance Budget, State bonds, Federal Grants: HMGP and BRIC Programs funding
Schedule	3 to 5 years

F-2 Boyes Boulevard water line replacement project

Mitigation Project Title	Boyes Boulevard water line replacement project
Hazard(s) Mitigated	Flooding, Drought and Water Supply
Project Description, Issue/Background	Sonoma County is replacing Boyes Boulevard Bridge located in central Sonoma Valley in the Boyes Boulevard neighborhood near Sonoma Creek. This project involves replacing the Boyes Bridge pipeline and other utilities during the bridge replacement project; the project design is complete and construction began in 2019/2020. Water line replacement along the bridge will minimize soil erosion hazards and potential pipe corrosion associated with flooding and stormwater runoff.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update, 2015 UWMP
Other Alternatives	Retrofit water pipelines, Implementation of routine and existing maintenance program
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma County
Priority (High, Medium, Low)	High
Cost Estimate	$5,100,000
Benefits (Avoided Losses)	The identification of the structural conditions of critical water infrastructure, including aging water main pipelines near areas susceptible to stormwater runoff and flooding will avoid potential structural issues and ensure a reliable delivery of potable water supplies.
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal Grants
Schedule	1 to 3 years

L-1 Donald Tank hillside stabilization

Mitigation Project Title	Donald Tank hillside stabilization
Hazard(s) Mitigated	Landslide
Project Description, Issue/Background	There are several geologic formations commonly associated with slope stability problems in Sonoma Valley. The central portion of the District's service area has a low landslide susceptibility, but the surrounding areas to the north, east, and west have moderate to high landslide susceptibility based on the surrounding topography. Landslides and small debris flows are common in the north, east, and west portion of the District's service areas where there are steep slopes and weak soils. Post-wildfire areas are also locations where heavy rains can cause erosion, and in turn landslides or debris flows. There has been one small landslide event in the District's service area that impacted Donald Tank in 2018. A small landslide occurred above the Donald Tank and damaged the perimeter fence around the tank, but it did not affect the facility. Because of this landslide, the District needed to relocate a water main and apply for disaster assistance through FEMA's Public Assistance (PA) Program, which covered the material removal associated with the small landslide. However, the PA funding did not cover additional improvements the District needed for rehabilitation and further stabilization of the slope. Future landslides in the vicinity also have the potential to impact the pumping and power generation equipment. There is also another site that has been impacted by a landslide that occurred several years ago due to heavy rains that destabilized a slope on the east side of Donald Street. This action covers supporting rehabilitation of the destabilized slopes in the District's planning area.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$500,000
Benefits (Avoided Losses)	The full rehabilitation of the slope above the Donald Tank and along on the east side of Donald Street will avoid potential soil erosion and instability issues and future potential damage to major facilities, such as water tanks.
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal HMGP and BRIC program funding
Schedule	1 to 3 years

SW-1 Solar power back-up generation and battery storage at water tanks and installation of SCADA systems

Mitigation Project Title	Solar power back-up generation and battery storage at water tanks and installation of SCADA systems
Hazard(s) Mitigated	Extreme Heat, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Winds, Wildfires
Project Description, Issue/Background	Extreme heat poses a threat to the operations of the District's related to water storage evapotranspiration rates and potential diminished water quality. Higher temperatures due to drought and extreme heat can result in operational water quality challenges in the potable water delivered to customers. Extreme heat events and lightning-induced power outages can lead to power outages, which could in turn delay water deliveries. PSPS related to severe weather associated with high wind and lightning can also impact the District's ability to deliver water supplies to its customers. The District's service area has a history of wildfires and high winds that have resulted in power outages and recent PSPS. There have also been lightning strikes in Sonoma Valley that have resulted in wildfires and impacted District water facilities. Increasing temperatures in California and the Sonoma region are also likely to result in PSPS. This action would involve establishing greater energy independence within the District's operations through the installation of solar-powered back-up generators with battery storage at various District facilities (e.g., pump stations) to reduce future vulnerabilities to the water distribution system related to extreme heat, high winds, lightning, and wildfires. Currently, all of the District's pump stations have permanent generators that provide back-up electrical supply, but this action will improve the District's ability to deliver water redundant power capabilities through increased renewable back-up generation. Renewable back-up power also ensures the District's operation and administrative staff can remain operable during disaster events that occur in combination of PSPS (high wind events, wildfire risk, lightning, and planned power outages). Solar power back-up generation and battery storage has been installed at District water tanks, but this mitigation action involves improvements, such as improved and engineered solar sizing in conjunction with the facility served, as well as increased solar surface area and battery storage at all facilities.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP, RRA, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$200,000 to $300,000
Benefits (Avoided Losses)	Solar-powered back-up generators at District pump stations will avoid potential impacts associated with long-term power outages and disruptions in the delivery of potable water associated with extreme heat, high winds, lightning
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal HMGP funding
Schedule	1 to 3 years

SW-2 Critical infrastructure hardening and resilience projects against severe weather

Mitigation Project Title	Critical water facility and infrastructure hardening and resilience projects
Hazard(s) Mitigated	Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, High Wind
Project Description, Issue/Background	The District has many water tanks, pump stations, and other water infrastructure that are critical to the delivery of water service to customers in Sonoma Valley. Several water facilities serve communities in Sonoma Valley at risk to wildfire that are located in the WUI and at risk to lightning strikes and associated power surges. In some cases, these facilities are not constructed of fire-resistant materials, which was the case with the loss of Saddle water tank during the Tubbs fire; lack necessary retrofits and upgrades needed to withstand lightning strikes and power surges; and lack defensible space. Damage to these facilities can result in a loss of potable water service for an extended period. Following a wildfire vulnerability assessment listed in Mitigation Action W-1 that focuses on potential projects the District can take to harden facilities, this action would involve implementing hardening susceptible facilities against the threat of wildfires and other severe weather events related to lightning, thunder, and wind. Specific actions may include adding concrete, masonry, steel, or other ignition-resistant materials during construction retrofits; and incorporating baffled vents to prevent embers from entering structures and building panels. Actions may also include the installation of lightning protection devices (e.g. lightning rods and grounding devices) and surge protectors on electrical control panels and equipment at water storage tanks, pump stations, and other facilities with electronic devices. The following facilities have been identified as being at high risk to wildfire hazards and several of these facilities have also been impacted by past severe weather events related to lightning: • Chestnut Booster Pump Station #1 • Park Well Pump Station • Aqua Caliente Well Pump Station • Agua Caliente Booster Pump Station • Chestnut Booster Pump Station #2 • Temelec Water Tank #1 • Temelec Water Tank #2 • Chestnut Tank • Chestnut Hydro-pneumatic Tank • Glenn Ellen Tank • Closed Isolation Valves (GV6, GV8, GV12) The list of facilities vulnerable to wildfire hazards and severe weather events could be prioritized based on how critical each facility is to the functionality of the entire water system and also how critical the needed upgrades are to the District.
Related planning mechanisms	2019 WMP, Evaluation of a preferred hardening alternative by facility type (prioritization based on customers served and wildfire recurrence interval). If multiple projects are implemented, the District can maximize efficiencies through standard design requirements, bidding, and construction processes.
Other Alternatives	No Action, Replacement, Relocation of Pump Stations/Tanks, Re-construction with Ignition-Resistant Materials, Defensible Space and Fuel Reduction Only
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma

Priority (High, Medium, Low)	High
Cost Estimate	$250,000 to $4,000,000 depending on the actions and needs identified
Benefits (Avoided Losses)	The benefits are based on the losses avoided in terms of limiting potable water service disruptions and the replacement costs of damaged facilities from extreme weather events. The District standards would also be updated ensuring that facilities are ready to operate in any weather conditions.
Potential Funding	Operations and Maintenance Budget/Capital funds, Funding Assistance through Cal OES HMGP, BRIC program funding, State bonds (climate resiliency bond)
Schedule	3 to 5 years

D-1 Dam Incident Planning during Sonoma Development Center Specific Plan process

Mitigation Project Title	Dam Incident Planning during Sonoma Development Center Specific Plan Process
Hazard(s) Mitigated	Dam Incidents
Project Description, Issue/Background	There are four potential dams of concern upstream of the District's Planning Area that have been constructed for flood control, water and irrigation storage, water treatment impoundment, and recreation purposes. Of these dams, two are rated as High Hazard, including the Suttonfield Dam and the Fern Dam. The Suttonfield Dam was built in 1938 and it is owned by SDC (now the California DGS) and is located north of El Verano along Sonoma Creek. Suttonfield Lake has a storage capacity of 600 acre-feet; this dam has an EAP in place. Fern Lake Dam was built in 1921 and is also owned by the SDC (now the California DGS). Fern Lake has a storage capacity of 241 acre-feet; this dam has an EAP in place. There is no history of dam incidents associated with either dam, and in the unlikely event of a dam failure, none of the District's critical water facilities and infrastructure assets would be impacted. However, given the two dam inundation areas would impact residential populations located downstream of the two high hazard dams, this action involves dam incident planning during the development of the SDC Specific Plan process. Collaboration with Sonoma County and the California DGS regarding dam incident planning would minimize the District's inability to provide water to residential customers during a dam incident and promote better coordination during the implementation of the two dam EAPs during disaster events.
Related planning mechanisms	2016 Sonoma County HMP, RRA, ERP Update, Suttonfield Dam EAP, Fern Dam EAP
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma County, California DGS, La Luz Center
Priority (High, Medium, Low)	High
Cost Estimate	$20,000
Benefits (Avoided Losses)	Dam incident planning that involves collaboration with the County and State will avoid impacts to the downstream community and potential short-term disruptions in the District's ability to safely deliver water supplies.
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal HMGP funding, BRIC program funding
Schedule	1 to 3 years

PH-1 Ensure continuity of District operations through implementation of Public Health and Safety Plan

Mitigation Project Title	Ensure continuity of District operations through implementation of Public Health and Safety Plan
Hazard(s) Mitigated	Public Health Hazards: Pandemic/Epidemic
Project Description, Issue/Background	The District currently implements a Public Health and Safety Plan that was designed and recently updated to protect both employees and customers from public health hazards, such as pandemics, epidemics, and other infectious diseases. This action involves implementing the Public Health and Safety Plan by monitoring updates from the Centers for Disease Control and Prevention (CDC) and local health agencies at Sonoma County for the latest developments regarding public health hazards, such as the COVID-19 pandemic, vaccine distribution, and following the recommended guidance measures. Precautions and safety measures in the plan include telecommuting and alternative work schedules for employees (where feasible); promoting good hygiene practices (hand washing, hand sanitizing stations in lobby) within the District office; providing appropriate Personal Protection Equipment (PPE), such as face masks, gloves, or other protective equipment; installing plexiglass shields in the District office; implementing social distancing guidelines in the workplace; and enhancing cleaning measures. Other actions that may be considered as part of regular updates to the District Public Health and Safety Plan include a separated office space or trailer for mobile incident command posts. This would ensure command and communication support near incidents and the ability of District staff to work near disaster locations.
Related planning mechanisms	FY 2020/2021 CIP, RRA, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Sonoma County
Priority (High, Medium, Low)	High
Cost Estimate	$150,000 to $300,000 depending on the District office upgrades and feasibility of acquisition of a separate office space or trailer for incident command posts
Benefits (Avoided Losses)	Avoids emergency management costs, allows employees to work safely and the opportunity to continue to work while they are recovering from an illness, or caring for a family member. This action protects the District employees that interact with customers in the lobby. The plan also promotes cooperation with Sonoma County Department of Health Services and other agencies.
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal HMGP funding
Schedule	1 to 3 years

CT-1 Implement a five-year training plan to enhance system security and exercise a recovery plan for District facilities

Mitigation Project Title	Implement a five-year training plan to enhance system security and exercise a recovery plan for District facilities
Hazard(s) Mitigated	Cyber Threats
Project Description, Issue/Background	This training program focuses on regularly emphasizing the importance of cyber security awareness to District employees, such as safe internet browsing practices, and secure email handling. The purpose of implementing a recovery plan during an information technology (IT) disruption is to allow the District to continue services. It involves identifying stakeholders (customers), response team members (District staff), hardware inventory, back-up strategies, testing, communication execution, and training steps that must be completed during loss of service or IT security.
Related planning mechanisms	FY 2020/2021 CIP, RRA, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$100,000
Benefits (Avoided Losses)	Avoids potential security breaches and threats to District's information technology, operation systems, and water distribution system.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

CT-2 Develop a Risk and Resilience Assessment and update the Emergency Response Plan

Mitigation Project Title	Develop a Risk and Resilience Assessment (RRA) and update the Emergency Response Plan
Hazard(s) Mitigated	Cyber Threats, Earthquake, Wildfire, Flood, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, Drought and Water Supply
Project Description, Issue/Background	The District will prepare a RRA and ERP update pursuant to Section 2013 (a) through (f) of America's Water Infrastructure Act (AWIA). AWIA Section 2013 amends the Safe Drinking Water Act (SDWA) to address resiliency and sustainability of water systems to both natural and intentional threats. This legislation reinforces the critical role that municipal water infrastructure plays in communities and the need for federal funding to help support water infrastructure. Prior to AWIA, SDWA Section 1433 required water systems to assess vulnerabilities to terrorist or other intentional acts and prepare ERPs but did not require updates to those risk assessments or ERPs. AWIA Section 2013 expands the risk types to include risks of natural hazards in addition to malevolent acts. The RRA and ERP update will further identify potential natural and human-caused vulnerabilities in the District's water delivery system and assess current resiliency capabilities. The two plans will also provide recommendations for additional resilience actions and projects, and an updated ERP will outline the roles and responsibilities of the District that allow for efficient response during emergencies.
Related planning mechanisms	FY 2020/2021 CIP, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$20,000
Benefits (Avoided Losses)	The development and implementation of the two plans will minimize potential natural and human-caused hazard impacts on the District's water facilities, provide early identification of potential security breaches and related threats to the District's IT system, and prevent potential terrorist or other malevolent acts that could result in major impacts and disaster costs on the District.
Potential Funding	Operations and Maintenance Budget
Schedule	1 to 3 years

CT-3 Leverage modern hardware and security system upgrades to improve risk management throughout District operations

Mitigation Project Title	Leverage modern hardware and security system upgrades to improve risk management throughout District operations
Hazard(s) Mitigated	Cyber Threats
Project Description, Issue/Background	This action involves budgeting and acquiring modern hardware and security system upgrades to reduce the District's risk to cyber security and IT data breaches.
Related planning mechanisms	FY 2020/2021 CIP, RRA, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$200,000 - $400,000
Benefits (Avoided Losses)	Avoids potential security breaches and threats to District's IT systems, operation systems, and water distribution system.
Potential Funding	Operations and Maintenance Budget
Schedule	1 to 3 years

MH-1 Cross connection to City of Sonoma water system

Mitigation Project Title	Cross connection to City of Sonoma water system
Hazard(s) Mitigated	Earthquake, Wildfire, Drought and Water Supply, High Wind, Multi-Hazard
Project Description, Issue/Background	The District currently does not have a cross connection via a major water main line to the City of Sonoma water system. This project involves a planning and feasibility study that considers cross connection options between the District's service area and water lines to the City of Sonoma service areas and water lines. Upon completion of a planning and feasibility study, this action also involves the development, implementation, and construction of a main water line to the City's water system to make available additional water supply during critical events and emergency response activities.
Related planning mechanisms	FY 2020/2021 CIP, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Sonoma
Priority (High, Medium, Low)	High
Cost Estimate	$500,000 to $1,000,000
Benefits (Avoided Losses)	Access to additional water supply from the City of Sonoma water supply system for District customers or fire suppression needs could save lives and properties in Sonoma Valley during an earthquake or wildfire event.
Potential Funding	Operations and Maintenance Budget
Schedule	3 to 5 years

MH-2 Implementation of capital improvements in Water System Master Plan

Mitigation Project Title	Implementation of capital improvements in Water System Master Plan
Hazard(s) Mitigated	Earthquake, Wildfire, Drought and Water Supply Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, Multi-Hazard
Project Description, Issue/Background	The District's WMP was recently updated in 2019 to provide the District with an overall plan for infrastructure improvements to ensure the District can reliably and cost-effectively service its customers through 2050. Improvement projects were developed as part of the plan to identify supply and storage deficiencies and aging infrastructure. Priority projects include the replacement of all steel water mains, addressing fire flow deficiencies in sensitive areas (near schools, WUI, etc.), Saddle Tank Replacement Project, the Donald Tank Hillside Stabilization Project, and installation of new groundwater wells to meet a 40 percent local supply goal. This project would involve tracking and prioritizing specific capital improvements that best mitigate top natural hazards in the District's Planning Area, such as earthquake, wildfire, and severe weather hazards associated with high winds and lightning.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WMP
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	None
Priority (High, Medium, Low)	High
Cost Estimate	$500,000 to $1,000,000 depending on the size and scale of project
Benefits (Avoided Losses)	The benefits are based upon the losses avoided in terms of potable water service delivery and replacement costs associated with damaged water facilities and infrastructure.
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal Grants: HMGP and BRIC Program funding
Schedule	1 to 3 years

MH-3 "Map your Neighborhood" Preparedness Program

Mitigation Project Title	"Map your Neighborhood" Preparedness Program
Hazard(s) Mitigated	Earthquake, Wildfire, High Winds, Dam Incidents, Multi-Hazard
Project Description, Issue/Background	The District should partner with the "Map Your Neighborhood" program recently launched by the Springs Municipal Advisory Council (MAC). This program would 1) integrate District-specified hazard preparedness information and data collection (e.g., BMPs in Ignition-resistant and Earthquake Building Retrofit, Fuels Reduction, Defensible Space, Evacuation/Fire Personnel Access, On-site Water Storage, On-Site Rainwater Collection, Water-use Efficiency, Irrigation Management, etc.), and, 2) help expand the number and diversity of neighborhood "blocks" the program can reach in 2021 and beyond.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WSP
Other Alternatives	The District could continue to rely exclusively on its own independent community outreach and engagement strategies to achieve these same preparedness objectives; however such an approach is likely to be less cost-effective than partnering.
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Springs MAC, North Valley MAC, Sonoma County, City of Sonoma, Sonoma Valley Fire District, La Luz Center
Priority (High, Medium, Low)	High
Cost Estimate	$30,000
Benefits (Avoided Losses)	Conduct outreach and collect hard-to-reach data cost effectively, while improving preparedness and assisting other agencies.
Potential Funding	Operations and Maintenance Budget, State grants
Schedule	1 to 3 years

MH-4 Scotts Dam Removal at Lake Pillsbury

Mitigation Project Title	Scotts Dam Removal at Lake Pillsbury
Hazard(s) Mitigated	Drought and Water Supply, Multi-Hazard
Project Description, Issue/Background	The removal of Scotts Dam at Lake Pillsbury along the Eel River in Mendocino County could result in potential decreases in surface water contract obligations and deliveries from the Russian River to the District via the Potter Valley Hydroelectric Project and Lake Mendocino operated by PG&E, the Federal Energy Regulatory Commission , and Sonoma Water. The $500 million dam removal project proposed by Sonoma County and other regional partners would remove the dam and acquire the associated Potter Valley Hydroelectric Project from PG&E. Dam removal would result in long-term benefits to native North Coast salmon and steelhead habitat, but short-term impacts related to mercury pollution in Sonoma County water supplies. The proposed dam removal project provides more opportunities for local control and management of the water resources at Lake Pillsbury. The District would be a supporting partner for this mitigation project.
Related planning mechanisms	2019 WMP
Other Alternatives	No Action
Responsible Office/ Agency	Sonoma County, Sonoma Water, District Operations and Maintenance Staff
Partners	Sonoma County, Sonoma Water
Priority (High, Medium, Low)	Medium
Cost Estimate	$5,000,000 (allocated to other water agencies and Army Corps of Engineers)
Benefits (Avoided Losses)	Dam removal and local acquisition of the hydroelectric project would provide Sonoma County and local water district authority over water management and potential avoided losses during drought conditions and other natural hazard events.
Potential Funding	Federal and State grant funding
Schedule	10 to 20 years

MH-5 Conduct an Intertie Feasibility Planning Study of new main aqueduct intertie from Sonoma Valley to Petaluma Valley

Mitigation Project Title	Conduct an Intertie Feasibility Study of new main aqueduct intertie from Sonoma Valley to Petaluma Valley
Hazard(s) Mitigated	Earthquake, Wildfire, Drought and Water Supply, High Winds, Multi-Hazard
Project Description, Issue/Background	The District's water supply is provided by a single point of delivery via the Sonoma Aqueduct that is part of the Sonoma Water supply and distribution system. In the event of a major earthquake or wildfire or emergency interruption to this facility, the District's service area could experience water shortages for unknown periods of time and with limited alternative sources of back-up supply. A feasibility study that considers the addition of a redundant emergency intertie to the City of Petaluma water supply system could provide an alternative source of water for the District.
Related planning mechanisms	FY 2020/2021 CIP, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Petaluma
Priority (High, Medium, Low)	Low
Cost Estimate	$300,000
Benefits (Avoided Losses)	A feasibility planning study will determine the constructability and environmental constraints associated with an emergency intertie that may mitigate serious disruptions in water supply for the customers in Sonoma Valley and protect public health and safety during potential disaster events. This could also serve as a multi-jurisdictional project in coordination with the City of Sonoma, the City of Petaluma, and small water purveyors in Sonoma Valley.
Potential Funding	Operations and Maintenance Budget
Schedule	5 to 10 years

MH-6 Conduct an Intertie Feasibility Planning Study of new main aqueduct intertie from Sonoma Valley to American Canyon

Mitigation Project Title	Conduct an Intertie Feasibility Planning Study of new main aqueduct intertie from Sonoma Valley to American Canyon
Hazard(s) Mitigated	Earthquake, Wildfire, Drought and Water Supply, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, Multi-Hazard
Project Description, Issue/Background	The District's water supply is provided by a single point of delivery via the Sonoma Aqueduct that is part of the Sonoma Water supply and distribution system. In the event of a major earthquake or wildfire or emergency interruption to this facility, the District's service area could experience water shortages for unknown periods of time and with limited alternative sources of back-up supply. A feasibility study that considers the addition of a redundant emergency intertie to the City of Napa water supply system in American Canyon could provide an alternative source of water for the District.
Related planning mechanisms	FY 2020/2021 CIP, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	City of Napa
Priority (High, Medium, Low)	Low
Cost Estimate	$300,000
Benefits (Avoided Losses)	A feasibility planning study will determine the constructability and environmental constraints associated with an emergency intertie that may mitigate serious disruptions in water supply for the customers in Sonoma Valley and protect public health and safety during potential disaster events. This could also serve as a multi-jurisdictional project in coordination with the City of Sonoma and small water purveyors in Sonoma Valley.
Potential Funding	Operations and Maintenance Budget
Schedule	5 to 10 years

MH-7 On-site solar power generation and battery storage energy lifeline project

Mitigation Project Title	On-site solar power generation and battery storage project
Hazard(s) Mitigated	Earthquake, Wildfire, Severe Weather: Heavy Rain/Thunderstorms/Lightning/Hail, Multi-Hazard
Project Description, Issue/Background	The installation of an on-site solar power array and battery storage system on District property would improve the energy independence of the District's facilities and infrastructure and operations. Energy efficiency and on-site installation of renewable energy system or microgrids and associated battery storage (on roof or in parking lot) would improve reliability of District operations and ensure adequate power and in turn water delivery is available in the event of a PSPS or power outage caused by high winds or wildfire.
Related planning mechanisms	FY 2020/2021 CIP, 2019 WSP, ERP Update
Other Alternatives	No Action
Responsible Office/ Agency	District Operations and Maintenance Staff
Partners	Public/Private Partnerships (PG&E, California Energy Commission [CEC], California Public Utility Commission [CPUC], Others), CEC Electric Program Investment Change (EPIC) Program
Priority (High, Medium, Low)	Low
Cost Estimate	$500,000 to $1,000,000 depending on the size and scale of project
Benefits (Avoided Losses)	Funding a renewable energy development project to protect the District's power supply would ensure uninterrupted delivery of water services to customers in Sonoma Valley. A District microgrid project would protect critical water infrastructure, support reconnection to the grid, and limit water disruptions in Sonoma Valley. This type of renewable energy project also creates a replicable and low-carbon resilience project that could lower District operating and energy costs and reduce greenhouse gas (GHG) emissions.
Potential Funding	Operations and Maintenance Budget, State Bonds, Federal Grants: HMGP and BRIC Program funding
Schedule	5 to 10 years

6 Plan Adoption

44 U.S. CFR Requirement §201.6 Local Mitigation Plans (c)(5): The local hazard mitigation plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, county commissioner, Tribal Council).

The purpose of formally adopting this plan is to confirm support from the Valley of the Moon Water District (District), raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 of the 10-step planning process: Adopt the Plan, in accordance with the requirements of DMA of 2000. The District Board of Directors has adopted this local hazard mitigation plan by passing a resolution. A copy of the generic resolution is included in Appendix D: Adoption Resolution. Once the plan is adopted, Appendix D will include the executed copies.

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7 Plan Implementation and Maintenance

44 U.S. CFR Requirement §201.6 Local Mitigation Plans (c)(4): The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This is Planning Step 10 of the 10-step planning process. This chapter provides an overview of the overall strategy for plan implementation and maintenance, and outlines the method and schedule for monitoring, updating, and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

7.1 Implementation

Once adopted, the plan faces the test of its worth: implementation. While this plan contains many worthwhile actions, the Valley of the Moon Water District (District) will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned to each action and funding availability. Low or no-cost actions more readily demonstrate progress toward successful plan implementation. Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government or special districts and development.

Implementation will be accomplished by adhering to the schedules identified for each action (see Chapter 5) and through constant and energetic efforts to update and highlight the multi-objective, win-win benefits of each project to the District's customers, community, and its stakeholders. These efforts include the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable, and resilient community. The four main components of implementation are:

- **Implement** the actions recommended by this plan;
- **Utilize** and enforce existing rules, regulations, policies and procedures;
- **Communicate** the hazard information collected and analyzed through this planning process so that the community better understands what and where hazards can occur, and what they can do themselves to be better prepared; and
- **Publicize** the "success stories" that are achieved through the Hazard Mitigation Planning Committee's (HMPC) ongoing efforts.

An important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other plans, such as the District's 2015 *Urban Water Management Plan* (UWMP) updates. The District already implements policies and programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs, such as the District's *2019 Water System Master Plan (WSP)* and UWMP, and recommends implementing actions, where possible, through these other program mechanisms.

Simultaneously with these efforts, it is important to constantly monitor funding opportunities that can be leveraged to implement the more expensive recommended actions (for example, structural hillside stabilization and repair projects or installation of steel water storage tanks). This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding does become available, the District will be in a position to capitalize on the opportunity. Funding

opportunities to be monitored include special pre- and post-disaster funds, special district budgeted funds, state and federal earmarked funds, and other grant programs, including those that can serve or support multi-objective applications.

7.1.1 Role of Hazard Mitigation Planning Committee in Implementation and Maintenance

With adoption of this plan, the District will be tasked with plan implementation and maintenance. The District agrees to:

- Provide a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Monitor multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Assist in implementation and update of this plan;
- Report on plan progress and recommended changes to the District's Board of Directors (Board); and
- Inform and solicit input from the public.

The primary duty of the District is to see the plan successfully carried out and to report to the Board and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the District's LHMP Webpage (and others as appropriate). These activities can be achieved through reconvening the HMPC on an annual basis.

7.2 Maintenance

Plan maintenance is defined as the ongoing effort to monitor and evaluate plan implementation, and to update the plan as progress, roadblocks, or changing circumstances are recognized.

The District will designate a Lead Hazard Mitigation Manager who will coordinate plan reviews in consultation with the District's departments and other participating jurisdictions and stakeholders.

7.2.1 Maintenance Schedule

In order to monitor progress and update the mitigation strategies identified in the action plan, the Lead Hazard Mitigation Manager and the HMPC will revisit this plan annually and within 45 days after a hazard event. The annual review will be conducted by the HMPC each year. The HMPC will review progress on the LHMP and complete an annual update to the Board.

This plan will be also updated, approved and adopted within a five-year cycle as per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000 unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. With the initial approval of this plan occurring in 2021, the plan will need to be updated, reviewed and approved by Cal OES and by FEMA Region IX, and re-adopted by the Board of Directors by no later than December of 2026 (or within 5 years of the initial approval, which ever date occurs first).

The District will monitor planning grant opportunities from Cal OES and FEMA for funds to assist with the update.

7.2.2 Maintenance Evaluation Process

The HMPC will continually monitor the incorporation process, evaluation and update methodology, continued public participation, and completion of the actions/projects to assure that the plan is being implemented. By monitoring these processes, the HMPC will be able to regularly evaluate the effectiveness of the plan and facilitate necessary changes as needed.

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability may include:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions,
- Increased vulnerability as a result of new development (and/or annexation) and/or,
- Increased vulnerability as a result of new hazards or circumstances.

The HMPC will use the following process to evaluate progress of any changes in vulnerability as a result of plan implementation.

- A representative from District departments identified in each mitigation action will be responsible for tracking project status and reporting to the HMPC on an annual basis to provide feedback on whether the mitigation action as implemented meets the defined objectives and is likely to be successful in reducing vulnerabilities (this action may apply best to the District's Hazard Mitigation Manager given the small size of the District).
  - If the project does not meet identified objectives, or if the mitigation action is new, the HMPC will determine what alternate mitigation actions (or projects) may be implemented, and an assigned individual will be responsible for facilitating and overseeing the scope of action definition. The assigned individual will make any required modification recommendations of the plan to the HMPC, implement the action, monitor the results of the action, and report the findings to the HMPC.
- Projects that were not ranked high priority but were identified as potential mitigation strategies will be reviewed for feasibility and continued appropriateness during the annual monitoring period and the 5-year updating of this plan.
- Changes will be made to the plan to accommodate for mitigation action projects that have failed or are not considered feasible after a review for their consistency with established criteria, the time frame, priorities, and/or funding resources.

Updating of the plan will be by written changes and submissions, as the District deems appropriate and necessary, and as approved by the Board. Updates to this plan will:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Document hazard events and impacts that occurred within the five-year period;
- Incorporate new data or studies on hazards and risks, specifically on climate change and its effects on flooding and wildfires;
- Incorporate new capabilities or changes in capabilities;
- Incorporate documentation of continued public involvement;

- Incorporate documentation to update the planning process that may include new or additional stakeholder involvement;
- Incorporate growth and development-related changes to water supply and infrastructure demands;
- Incorporate new project recommendations or changes in project prioritization;
- Include a public involvement process to receive public comment on the updated plan prior to submitting the updated plan to Cal OES and FEMA Region IX; and
- Include adoption by the Board following Cal OES/FEMA approval.

Annual Review

As part of an annual review process, the District's HMPC will provide opportunities for public input on the LHMP. The District and HMPC will schedule formal LHMP updates at regularly scheduled public meetings to ensure routine maintenance and plan evaluation. The LHMP is designed to be a living document that can be annually updated. Review will involve the following planning processes to encourage public participation, evaluate the effectiveness of the plan, and track mitigation action progress:

- Circulate a press release announcement on the annual review meeting. The press release will advertise the date, time, and location of the public meeting and provide contact information of the Lead Hazard Mitigation Manager.
- Electronic mailings regarding the annual review meeting will be emailed to federal, state, and local agencies, the HMPC, and other representatives.
- Prior to the annual review meeting, the HMPC and District will provide an update on their mitigation actions.
- The Lead Hazard Mitigation Manager will announce the meeting using other forms of traditional and digital media platforms, such as newspaper notices, radio announcements, and social media posts.
- A summary of the annual review meeting will be posted on the District's LHMP Webpage and include an annual report on the status of the implementation of the mitigation actions.

The review process should also include information on changing conditions in the District. Specifically, the update should note growth and development changes in the District's Planning Area, the number of improved water supply assets and related infrastructure, natural hazard events and damage information, and major capital improvement projects to water facilities and infrastructure (e.g. water mains, utility access roads). The review process should also address changing legislation and new federal and state policies, so these policy updates can be incorporated into the LHMP.

7.2.3 Incorporation into Existing Planning Mechanisms

Planning mechanisms are governance tools used to manage local land use development and community decision-making, such as general plans, floodplain management plans, building codes, emergency operation plans, capital improvement plans, or other long-range plans. Another important implementation mechanism that is highly effective and low-cost is incorporation of the LHMP recommendations and their underlying principles into existing District plans and mechanisms. Federal regulations require that LHMPs describe a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as a general plan or capital improvement plan. An example of incorporating mitigation actions into other planning mechanisms would be to identify the goals and strategies of the LHMP and document how they have been used to further mitigation efforts in other planning documents.

As previously stated in Section 7.1 of this plan, mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. As described in this plan's capability assessment, the District already implements policies and programs to reduce losses to life and property from hazards. This plan therefore builds upon previous related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms.

These existing mechanisms include (but are not limited to) the following:

- *Water System Master Plan* (WMP) (2019)
- *Urban Water Management Plan* (2015)
- Sonoma Valley Groundwater Sustainability Agency
  - *Draft Groundwater Sustainability Plan*
- Water Conservation Regional Partnerships
  - Sonoma-Marin Saving Water Partnership
  - *Sonoma Water Local Hazard Mitigation Plan* (2018)
  - State Water Resources Board
- Capital Improvement Plans and Budgets
  - *2020/2021 – 2024/2025 Capital Improvement Program*
- Other plans and policies outlined in the capability assessment
- Other plans, regulations, and practices with a mitigation focus

HMPC members involved in the updates to the planning mechanisms listed above will be responsible for integrating the findings and recommendations of this LHMP with these other plans, programs, and mechanisms as appropriate. As an action step to ensure integration with other planning mechanisms, the Lead Hazard Mitigation Manager will discuss this topic at the annual meeting (refer to Section 7.2.1, Maintenance Schedule) with the HMPC. The HMPC will discuss if there are opportunities to incorporate the plan into other planning mechanisms and who will be responsible for leveraging those opportunities. HMPC members representing local jurisdictions will work with their jurisdictional planning teams to integrate their identified mitigation actions into their own local plans, programs, and mechanisms. Efforts to integrate the hazard mitigation plan into local plans, programs, and policies will be reported during the annual HMPC plan review meeting. Successful integration efforts will be recorded during the meeting.

Specific examples of incorporation of the LHMP into existing planning mechanisms include:

- Integration of mitigation actions identified in this mitigation strategy with the actions and implementation priorities established in the WMP. Key people responsible for development of WSMP Plan should participate in the future HMPC, as they can identify key projects in the WSMP and integrate them into the mitigation strategy of the LHMP. The implementation process will be successful through the coordination and effort of individuals from these various organizations.
- Using the risk assessment information in this plan to update any hazard analyses in other District vulnerability assessments.
- Integration of this LHMP into other District Infrastructure Master Plans and the Capital Improvement Program.

Efforts should continuously be made to monitor the progress of mitigation actions implemented through these other planning mechanisms and, where appropriate, the priority actions should be incorporated into updates of this hazard mitigation plan.

7.2.4 Continued Public Involvement

Continued public involvement is imperative to the overall success of the plan's implementation and goal(s). Efforts will be made to involve the public in the plan maintenance, evaluation, and review process. This includes maintaining a digital version of the plan on the District's LHMP Webpage for public review. In addition, information on whom to contact within the District will be posted with the plan. The designated Lead Hazard Mitigation Manager at the District will maintain a file of comments received for reference during the next five-year update.

Annual LHMP Review

Any revisions to the plan that may occur as a result of a disaster will also be made public and posted on the District's LHMP Webpage, social media sites, and local media platforms. The District's Lead Hazard Mitigation Manager will place an advertisement in the local newspaper, and also circulate electronic press releases that specify the date and time for review and public input. The District will also invite federal, state, and local agencies to participate, with the HMPC.

Five-Year LHMP Update

The five-year update process provides an opportunity to solicit participation from new and existing stakeholders, to publicize success stories from plan implementation, and seek additional public comment. A public hearing(s) or survey to receive public comment on the plan will be held during the plan update period. When the HMPC reconvenes for the update, the planning process will involve all stakeholders participating in the planning process, including those who joined the HMPC after the initial effort, to update and revise the plan. Public participation will be encouraged and invited through, LHMP Webpage postings and press releases, in addition to email and social media announcements.

Continued public outreach and education is a mitigation strategy in Chapter 5 of this plan, emphasizing a multi-hazard public education and awareness program to be conducted on an annual basis. Activities related to public involvement during the 2020-2021 planning process are documented in Chapter 3 and Appendix A and C.

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