Appendix G

Climate Vulnerability Assessment

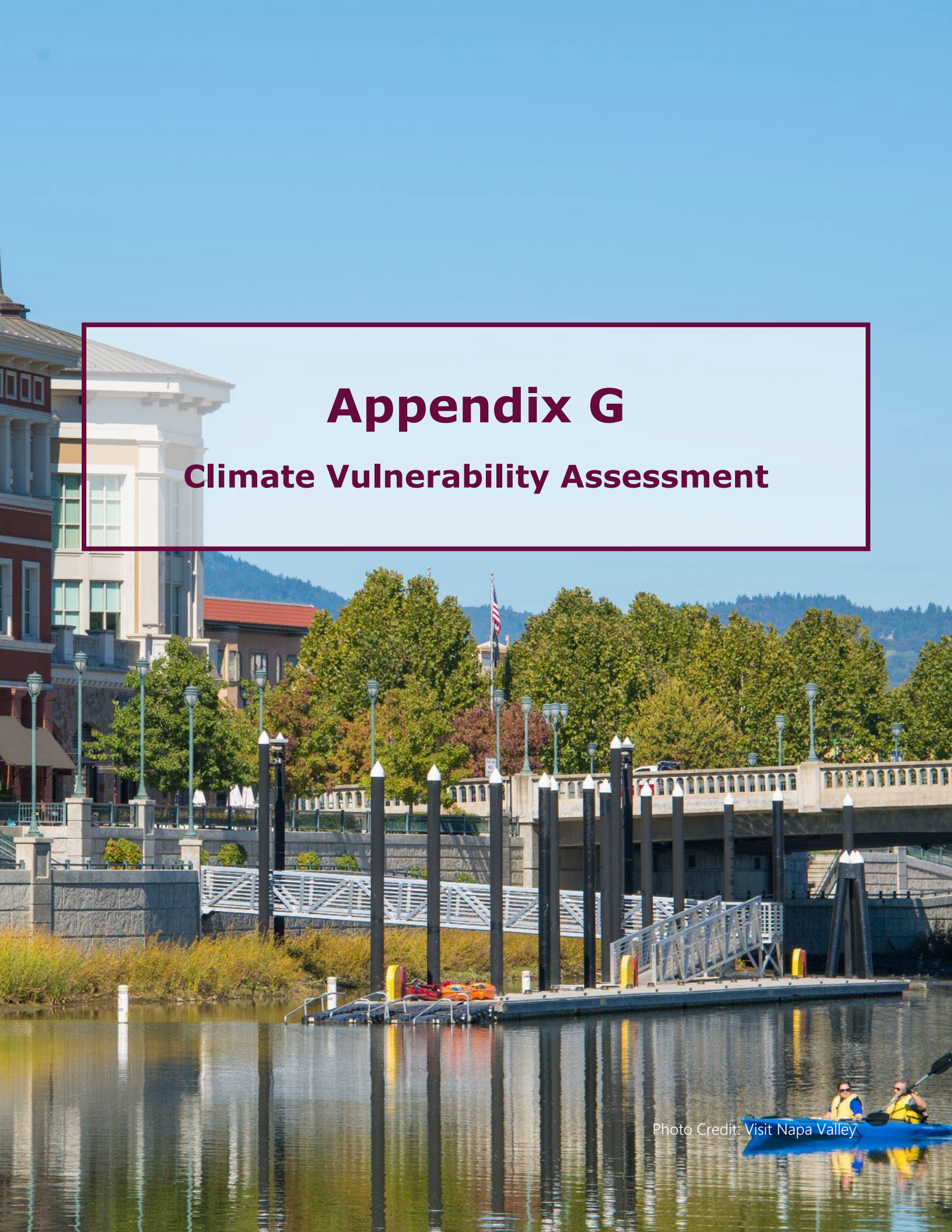

Photo Credit: Visit Napa Valley

Final Climate Vulnerability Assessment

for the

Napa County

Regional Climate Action and Adaptation Plan

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
APG	*California Adaptation Planning Guide*
ART Bay Area Report	*Adapting to Rising Tides, Bay Area: Regional Sea Level Rise Vulnerability and Adaptation Report*
BAAQMD	Bay Area Air Quality Management District
C2ES	Center of Climate and Energy Solutions
CAL FIRE	California Department of Forestry and Fire Protection
Cal OES	California Governor's Office of Emergency Services
Caltrans	California Department of Transportation
CCHPR	Climate Change and Health Profile Report: Napa County
CDPH	California Department of Public Health
CEC	California Energy Commission
Clean Air Plan	*2017 Clean Air Plan: Spare the Air, Cool the Climate*
Climate Assessment	*California's Fourth Climate Change Assessment*
CNRA	California Natural Resources Agency
CPUC	California Public Utilities Commission
CRS	Community Rating System
CWPP	Community Wildfire Protection Plan
District 4 Report	*Caltrans Climate Change Vulnerability Assessments: District 4 Technical Report*
DPA	Direct Protection Area
FEMA	Federal Emergency Management Agency
FHSZ	Fire Hazard Severity Zone
FRA	Federal Responsibility Area
FSC	Fire Safe Council
GHG	greenhouse gas
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HHSA	Napa County Health and Human Services Agency
HVAC	heating, ventilation, air conditioning
IPCC	Intergovernmental Panel on Climate Change
IRWMP	*San Francisco Bay Area Integrated Regional Water Management Plan*
KBDI	Keetch-Byram Drought Index
LHMP	*2021 City of Napa Local Hazard Mitigation Plan*

LNU	Sonoma-Lake-Napa Unit
LRA	Local Responsibility Area
MCE	Marin Clean Energy
MJHMP	*2020 Napa County Multi-Jurisdictional Hazard Mitigation Plan*
NCFF	Napa Communities Firewise Foundation
NDMC	National Drought Mitigation Center
NFIP	National Flood Insurance Program
OEHHA	California Office of Environmental Health Hazard Assessment
OLU	Operational Landscape Units
OPR	Governor's Office of Planning and Research
PG&E	Pacific Gas and Electric Company
$PM_{2.5}$	fine particulate matter measuring 2.5 micrometers or smaller
PSPS	Public Safety Power Shutoff
RCAAP	Napa County Regional Climate Action and Adaptation Plan
RCP	Representative Concentration Pathway
RISE	Resilience, Innovation, Sustainability, Empowerment program
Safeguarding California	*Safeguarding California Plan: 2018 Update*
SB	Senate Bill
SFBA Report	*California's Fourth Climate Change Assessment: San Francisco Bay Area Region Report*
SFEI	San Francisco Estuary Institute
SPUR	San Francisco Bay Area Planning and Urban Research Association
SRA	State Responsibility Area
Strategy	*California Climate Adaptation Strategy*
SVI	Social Vulnerability Index
UWMP	City of Napa 2020 Urban Water Management Plan
VA	Vulnerability Assessment
WSCP	Water Shortage Contingency Plan
WUI	wildland-urban interface

1 INTRODUCTION

This Vulnerability Assessment (VA) identifies and analyzes climate change effects that will impact Napa County. The VA is the first step in the adaptation planning process as part of the Napa County Regional Climate Action and Adaptation Plan (RCAAP), in which the County of Napa is collaborating with the five incorporated cities in the county to prepare a regionally-focused climate action and adaptation plan. The goal of the adaptation planning process included in the RCAAP effort is to improve community resilience countywide in the face of a changing climate. A resilient community is better prepared for current and future hazardous conditions and experiences less societal disruption when disaster strikes as the climate continues to change. Note that in this VA, "County" refers to the County of Napa as a local government agency, while "county" refers to the entire geographic area known as Napa County.

The purpose of the VA is to analyze countywide exposure to existing hazards, identify potential climate-related impacts from these hazards and sensitivities to these hazards and impacts, and determine the existing capacity of the County's local jurisdictions and communities to prepare for and adapt to these impacts, known as adaptive capacity. The VA will inform the next steps in the RCAAP's adaptation planning process, which include the development of climate adaptation and resilience strategies.

The primary effects of climate change include increased temperatures, changes in precipitation patterns, and sea level rise. These effects are expected to heighten and exacerbate risks posed by secondary climate change effects, including wildfires, extreme heat events, extreme precipitation and flooding, drought, and energy grid reliability issues. Climate-related hazards are wide-ranging, and while many of these hazards have historically posed a risk to the county, the frequency, intensity, and duration of them will shift because of climate change. The level of impact from these climate change effects will vary across the county due to physical, social, and economic variations.

1.1 CLIMATE CHANGE BACKGROUND

Since the beginning of the Industrial Revolution in the late 18th century, human activities—primarily the combustion of fossil fuels for electricity, heat, and transportation—have released an excessive amount of greenhouse gases (GHGs) into Earth's atmosphere. Significantly elevated levels of GHG emissions have intensified the greenhouse effect and have led to an unprecedented trend of human-caused (i.e., anthropogenic) warming of Earth's climate, among other climatic disruptions, known as climate change. There are many effects and associated impacts stemming from climate change that intersect with multiple facets of human society. Though it is a global issue, it is an issue that will be, and already is, experienced differently around the world. Over time, it has become an increasing priority to address climate change at multiple scales as weather patterns become more extreme, temperatures continue to rise, and polar ice caps continue to reduce in size over time.

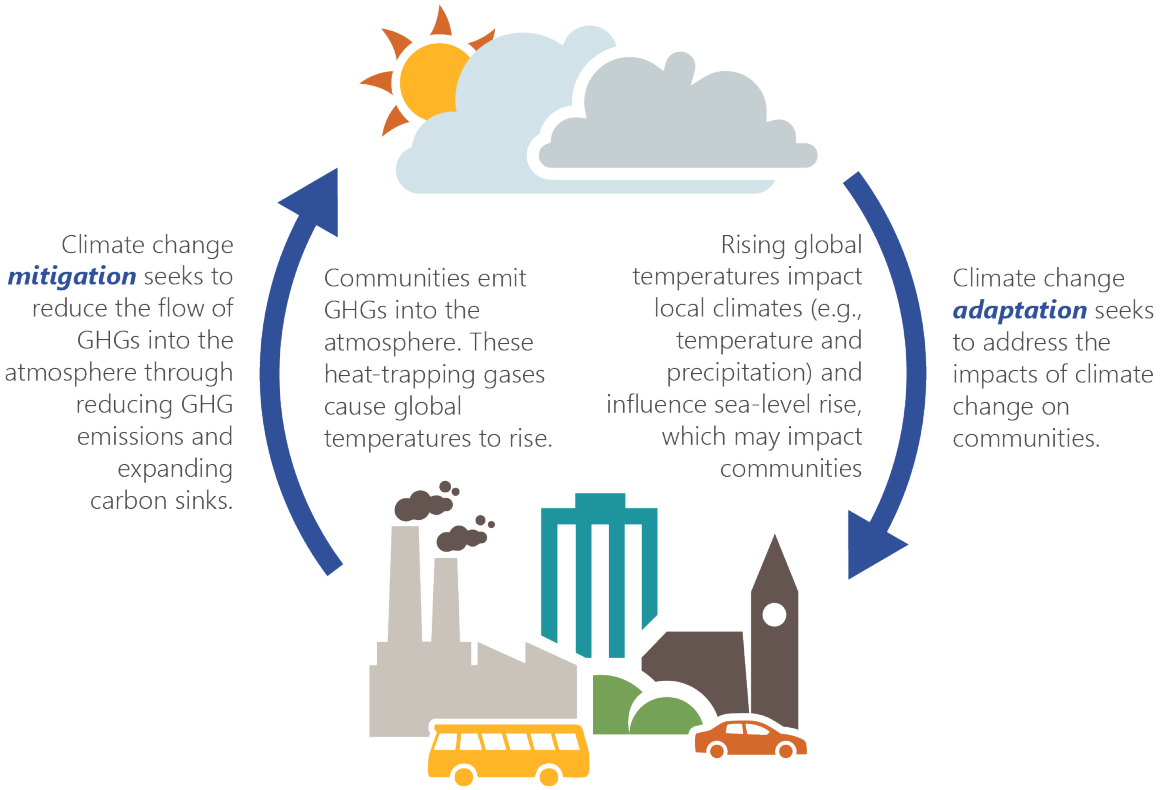
The average global surface temperature is expected to increase approximately 8 degrees Fahrenheit (°F) by the end of the century unless additional efforts are made to reduce GHG emissions (IPCC 2021). Depending on future GHG emissions scenarios, annual average maximum daily temperatures in California are projected to increase between 4.4 °F and 5.8 °F by 2050 and by 5.6 °F to 8.8 °F by 2100 (Pierce et al. 2018, cited in OPR, CEC, and CNRA 2018a). Temperature changes in the San Francisco Bay Area are expected to be consistent with California as a whole, with projected increases between roughly 5 °F and 8 °F by the end of the century (OPR, CEC, and CNRA 2018b). The state and the county have already begun to experience extreme weather effects, the frequency and intensity of which have been worsened by climate change (OPR, CEC, and CNRA 2018a). Extreme weather effects such as precipitation volatility (i.e., dramatic changes over a short period of time), increased average temperatures, and increased frequency of extreme heat events have led to increases in the frequency and intensity of human health and safety hazards such as wildfires, droughts, changes to water supply, and energy grid resiliency issues.

While it remains imperative to drastically reduce global GHG emissions, it is equally important for communities to engage in adaptation planning to prepare for and strengthen resilience to the adverse impacts of climate change. Local

efforts are critical in building climate resilience—the capacity of a community to prepare for and withstand disruptions, recover from shocks and stressors, and adapt and grow from turbulent experiences related to climate change—and can lead to a greater understanding of climate risks and strategies to reduce their impacts. There are plans, policies, and programs in place at the local and regional levels that address existing climate-related hazards. In some cases, these may be sufficient to address the potential for climate change to worsen existing hazards. In other cases, significant gaps exist, and new policies are needed. This VA intends to identify and address those gaps.

1.2 CLIMATE CHANGE MITIGATION AND ADAPTATION

Addressing climate change requires an integrated approach that targets both the sources of climate change and its effects. Targeting the sources of climate change is known as climate change mitigation and primarily involves reducing the flow of GHGs into the atmosphere. This can happen through the direct reduction of anthropogenic GHG emissions, or by enhancing carbon sinks (e.g., carbon sequestration), which capture and remove GHGs from the atmosphere, most notably carbon dioxide. The goal of climate change mitigation is to minimize significant human interference with the global climate. The extent to which climate change mitigation efforts are implemented today will likely determine the severity of climate change and its effects in the future. However, even in a scenario where anthropogenic GHG emissions were drastically and instantaneously reduced today, society will continue to endure a reduced degree of climate change and its associated effects. Adjusting to the effects of climate change that are already occurring and preparing for those that are anticipated to occur in the future is known as climate change adaptation. Climate change adaptation planning aims to enhance the resilience of communities to climate change impacts by analyzing jurisdiction-specific, climate-related vulnerabilities and developing strategies to respond to and prepare for current and future impacts. Figure 1 illustrates the relationship between climate change mitigation and climate change adaptation.



Source: Cal OES 2020; adapted by Ascent in 2024.

Figure 1 Relationship between Climate Change Mitigation and Adaptation

Climate change mitigation and adaptation are both crucial components of comprehensive climate change planning. While mitigation and adaptation are often separate planning efforts, it is important to consider both components as

part of the Napa County RCAAP. Many initiatives that focus on climate mitigation and reducing GHG emissions support climate adaptation objectives, and vice versa. These are referred to as 'co-benefits.' For example, renewable energy installations combined with battery storage systems will reduce reliance on fossil fuel-generated grid electricity, but they will also improve energy independence and resilience in the face of hazards exacerbated by climate change that threaten energy infrastructure, yielding both adaptation benefits as well as GHG emissions reductions. Similarly, building energy efficiency improvements, such as improving insulation in a home or structure, will help combat extreme heat events and decrease risks to humans of heat-related illnesses, but will also reduce cooling demands and thus save energy, reducing (i.e., mitigating) GHG emissions associated with energy consumption. Identifying co-benefits in climate mitigation and adaptation strategies in the climate action planning process is becoming an increasingly common approach taken by jurisdictions to address climate change.

1.3 REGULATORY SETTING

State law requires communities to address climate change adaptation through several planning processes, such as the development of general plans (Cal OES 2020). Specifically, Senate Bill (SB) 379 requires all cities and counties to update the general plan safety element to include climate adaptation and resiliency strategies beginning January 1, 2017. The requirements, which are codified in Government Code Section 65302(g)(4), generally include:

- A vulnerability assessment that identifies the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts;
- A set of adaptation and resilience goals, policies, and objectives based on the information specified in the climate vulnerability assessment for the protection of the community; and
- A set of feasible implementation measures designed to carry out the goals, policies, and objectives identified pursuant to the adaptation objectives.

1.4 GUIDANCE DOCUMENTS

Several key State guidance documents and resources were used to help develop the VA and are outlined in the following sections.

1.4.1 California Adaptation Planning Guide

The most recent version of the *California Adaptation Planning Guide* (APG) was released in June 2020 and was prepared by the California Governor's Office of Emergency Services (Cal OES). This version builds upon the first iteration of the APG that was released in 2012, and reflects the latest best practices, integrates recent updates to State plans, policies, programs, and regulations, and ensures that communities have guidance on using the best available science and information. The purpose of the APG is to guide local governments in climate change adaptation and resiliency planning, primarily through a step-by-step process that communities can use to plan for the impacts of climate change. The APG is designed to be flexible and guide communities through an adaptation planning process that is best suited to their needs (Cal OES 2020).

1.4.2 California's Fourth Climate Change Assessment

The Governor's Office of Planning and Research (OPR), the California Energy Commission (CEC), and the California Natural Resources Agency (CNRA) prepared *California's Fourth Climate Change Assessment* (Climate Assessment) in 2018. (The Fifth Climate Change Assessment is not expected to be released until 2026). The Climate Assessment was designed to address critical information gaps that decision-makers at the State, regional, and local levels need to close to protect and build the resilience of people, infrastructure, natural systems, working lands, and waterways to the impacts of climate change. The Climate Assessment also includes regional reports, which analyze and discuss the impacts on specific regions in the state, including *California's Fourth Climate Change Assessment: San Francisco Bay Area Region Report* (SFBA Report), which

encompasses the entirety of Napa County. The Climate Assessment and SFBA Report are referenced throughout this VA to provide information regarding regional climate change impacts.

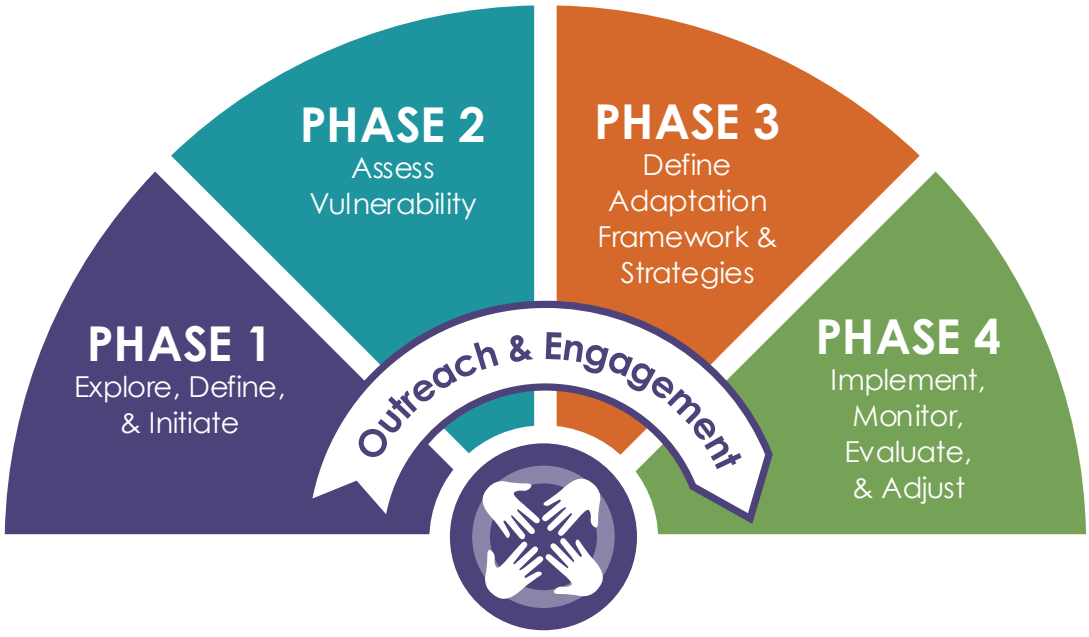
1.4.3 California Climate Adaptation Strategy

Every three years, the State of California is required to issue an updated statewide climate adaptation strategy. Alongside the update to the Climate Assessment, CNRA released the *Safeguarding California Plan: 2018 Update* (Safeguarding California), which served as the statewide climate adaptation strategy. Safeguarding California provided a holistic overview of the State's current and planned efforts to address the ongoing and forthcoming impacts of climate change and identified actions the State will take to protect communities, infrastructure, services, and the natural environment from climate change.

In April 2022, CNRA, in partnership with OPR's Integrated Climate Adaptation and Resiliency Program, released the *California Climate Adaptation Strategy* (Strategy), which serves as an update to Safeguarding California. The Strategy is organized around six outcome-based priorities and integrates key elements from numerous state plans and strategies, including statewide climate action plans, sector-based strategies, regionally focused strategies, and State stewardship plans. Each outcome-based priority consists of several unique goals, and each goal is comprised of specific climate actions that can be taken toward achieving that goal. The Strategy also identifies success metrics and an implementation timeline for each action within the strategy. The Strategy reflects the State's commitment to integrating climate resilience into the work of all state agencies, and this collective, statewide effort will ultimately support local communities.

1.5 ADAPTATION PLANNING PROCESS

The APG guides communities throughout the state in planning for and adapting to the impacts of climate change. The APG includes a four-phase process, illustrated in Figure 2, which allows communities to assess locally specific climate vulnerabilities and develop strategies to reduce climate change-related risks.



Source: Cal OES 2020; adapted by Ascent in 2024.

Figure 2 Adaptation Planning Process

- **Phase 1, "Explore, Define, and Initiate,"** includes scoping and defining the adaptation planning effort. Phase 1 also involves identifying key roles and interested parties in the local government and throughout the community to

contribute to the planning process. Potential climate change effects and important physical, social, and natural assets in the community are identified for further analysis.

- **Phase 2, "Assess Vulnerability,"** includes an analysis of potential climate change impacts and adaptive capacity to determine the vulnerability of populations, built environment, and community functions. The vulnerability assessment is composed of four steps: exposure, sensitivities and potential impacts, adaptive capacity, and vulnerability scoring. Phase 2 also integrates public input to provide a comprehensive assessment of the community's sensitivity to climate change and its ability to adapt.
- **Phase 3, "Define Adaptation Framework and Strategies,"** focuses on creating an adaptation framework and developing adaptation strategies based on the results of the vulnerability assessment. Adaptation strategies identify how the community will address the potential for harm based on the community's resources, goals, values, needs, and regional context. Community input is needed to prioritize adaptation strategies, identify co-benefits of strategies, and determine implementation steps.
- In **Phase 4, "Implement, Monitor, Evaluate, and Adjust,"** the adaptation framework is implemented, consistently monitored and evaluated, and adjusted based on continual learning, feedback, and/or triggers.

This VA encompasses Phase 2 "Assess Vulnerability" in the adaptation planning process recommended by the APG. Adaptation strategies will be developed based on the findings of this VA, under Phase 3 "Define Adaptation Framework and Strategies."

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2 VULNERABILITY ASSESSMENT

This section provides a comprehensive assessment of the county's vulnerabilities to climate change. It identifies and characterizes how climate change effects will exacerbate climate-related hazards and associated impacts in the county. The VA follows the process outlined in Phase 2 of the APG and is composed of the following four steps:

Exposure: The purpose of this step is to understand existing climate-related hazards within the county and how changes in climate variables (e.g., average temperature, precipitation) are projected to influence these hazards. Existing hazards that are likely to be exacerbated by the effects of climate change are identified and described based on historical data from sources such as the *2020 Napa County Multi-Jurisdictional Hazard Mitigation Plan* (MJHMP) and the 2021 City of Napa Local Hazard Mitigation Plan Update (LHMP). Climate projection data are used to develop forecasts for how existing hazards are expected to change within various timescales, including the near-term (current-2050), mid-term (2040-2069), and long-term (2070-2099).

Sensitivity and Potential Impacts: This step identifies the population groups and community assets in the county that are sensitive to localized climate impacts. Hazards influenced by climate change (e.g., extreme precipitation, flooding, wildfire) are generally projected to increase in severity, and additionally, climate change may generate new impacts that communities have not experienced historically. Using historical data, research from regional and State reports on climate impacts, and public input, this step seeks to assess the degree of sensitivity of people and assets based on the potential impacts of each exposure. Key populations and assets identified in the county are organized into three overarching categories: populations, built environment, and community functions. Each hazard included in the VA is analyzed and assigned a potential impact score using the criteria in Table 1.

Table 1 Potential Impacts Scoring

Score	Potential Impact Scoring Description
Low	Impact is unlikely based on projected exposure; would result in minor consequences to public health, safety, and/or other metrics of concern.
Medium	Impact is somewhat likely based on projected exposure; would result in some consequences to public health, safety, and/or other metrics of concern.
High	Impact is highly likely based on projected exposure; would result in substantial consequences to public health, safety, and/or other metrics of concern.

Source: Cal OES 2020.

Adaptive Capacity: The purpose of this step is to identify the County and local jurisdictions' current capacity to address future climate impacts, referred to as adaptive capacity. The County, local jurisdictions, partner agencies, and regional organizations have already taken steps to build resilience and protect sensitive populations and assets from existing hazards. The ability of the County and local agencies to adapt to each of the identified climate impacts is determined through a review of existing plans, policies, and programs, and public engagement. Adaptive capacity scoring is described in Table 2. A summary of partner agencies and regional organizations and their climate adaptation-related work is included in Section 2.3, "Adaptive Capacity."

Table 2 Adaptive Capacity Scoring

Score	Adaptive Capacity Scoring Description
Low	The County lacks capacity to manage climate change effect; major changes would be required.
Medium	The County has some capacity to manage climate change effect; some changes would be required.
High	The County has high capacity to manage climate change effect; minimal to no changes are required.

Source: Cal OES 2020.

Vulnerability Scoring: This step characterizes the county's vulnerability to each climate change effect. Vulnerability scores are based on several factors including the severity of projected climate impacts, how sensitive certain

populations and assets are to anticipated climate impacts, and whether sufficient adaptive capacity exists to manage future climate impacts. Higher vulnerability scores (5 being the highest) indicate that a climate change effect should be prioritized earlier than those with lower scores (1 being the lowest). This scoring provides an understanding of which climate vulnerabilities are most urgent and should be prioritized during the adaptation strategy development process. Table 3 presents the methodology used to determine the overall vulnerability scores, which is based on ratings for potential impacts and adaptive capacity.

Table 3 Vulnerability Scoring

		Vulnerability Score		
Potential Impacts	High	3	4	5
	Medium	2	3	4
	Low	1	2	3
		High	Medium	Low
		Adaptive Capacity		

Source: Cal OES 2020.

2.1 EXPOSURE

This section includes the exposure analysis, which relies on existing planning documents and resources to understand the county's historical natural hazards, and climate modeling to identify how these climate-related hazards are projected to change in the future. To better contextualize the county's exposure to these hazards, an overview of the county is presented first.

2.1.1 County Overview

Napa County is situated in the North Bay region of the San Francisco Bay Area. It is bordered by Sonoma County to the west, Solano County to the south and southeast, Lake County to the northwest, and Yolo County to the east. The County seat is the City of Napa. Napa Valley, located within Napa County, is internationally renowned for its wine production. The region is currently home to numerous vineyards and wineries, making it a popular destination for wine enthusiasts.

Indigenous people have lived in the county for over 10,000 years. The Indigenous people who originally inhabited the region were members of various Native American tribes, each with its own distinct language, culture, and traditions. These tribes have a rich history and connection to the land that predates the European settlement of the area. Tribes in the county include Patwin/Wintun, Wappo, Miwok, and Pomo. Indigenous traditional ecological knowledge has the potential to play a vital role in climate change assessment and adaptation efforts.

Napa County includes four incorporated cities, one town, and other unincorporated communities and rural areas. The county encompasses approximately 789 square miles of diverse landscapes, including hills and mountains that provide a scenic backdrop to vineyards and agricultural areas. Some notable features of the county include the Napa River, which flows from north to south through the county and plays a crucial role in the region's irrigation and agricultural practices, as well as Lake Berryessa, which is in the eastern part of the county. The wetlands located in the southern part of the county are also important for climate adaptation. The county experiences a Mediterranean climate, characterized by warm, dry summers and cool, wet winters. This climate is conducive to all kinds of agriculture, especially grape growing. The county's climate is one of the reasons for the success of the wine industry in the region (Napa County 2020).

2.1.2 Existing Hazards

The County's MJHMP, City of Napa's LHMP, and an array of additional plans and sources provide a comprehensive understanding of natural and anthropogenic hazards that have historically threatened the county. Acknowledging the existence of this wide array of hazards, for this VA, the focus will be on hazards in the county that are exacerbated by climate change including drought, flooding, and wildfire. The effects of climate change, including how climate change is exacerbating existing hazards, are addressed under Section 2.1.3 (Climate Change Effects). The following subsections discuss existing hazards as evaluated by the County, drawing from other sources as needed.

DROUGHT

The USGS defines drought as a period of drier-than-normal conditions that result in water-related problems. When rainfall is less than normal for several weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth of water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought (USGS n.d.).

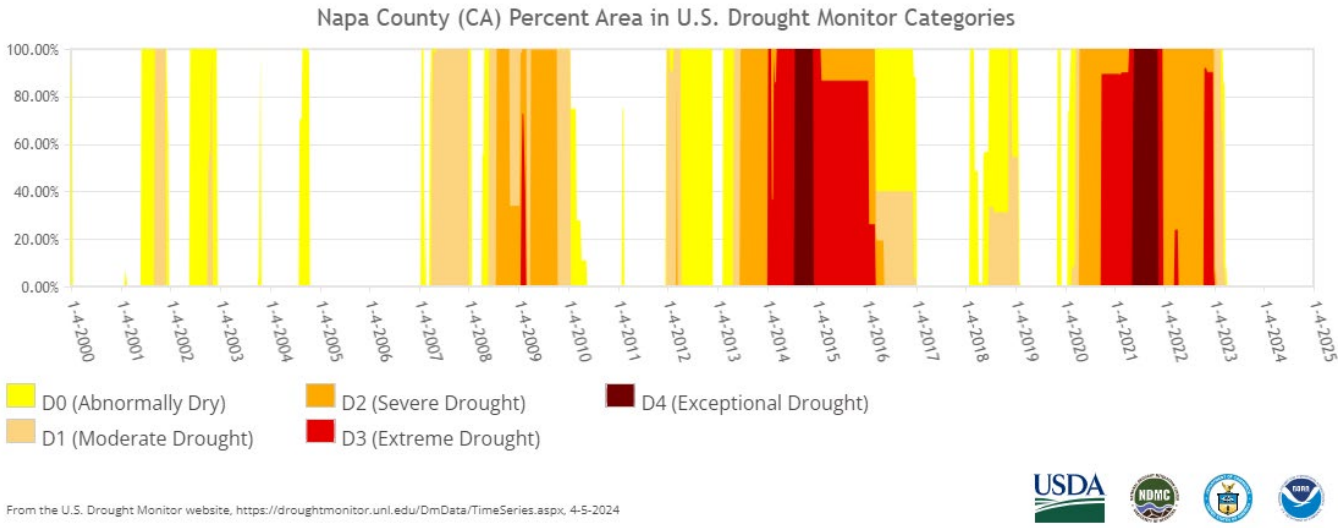
The term "drought" can have different meanings to different people, depending on how a water deficiency affects them. Droughts have been classified into different types such as:

- Meteorological drought – lack of precipitation;
- Agricultural drought – lack of soil moisture, or;
- Hydrologic drought -reduced streamflow or groundwater levels;

During times of drought, vegetation is visibly dry, stream and river flows decline, water levels in lakes and reservoirs fall, and the depth of water in wells increases. As drought persists, longer-term impacts can emerge, such as land subsidence, seawater intrusion, and damage to ecosystems. Unlike the immediate impacts of drought, however, long-term impacts can be harder to see, but more costly to manage in the future.

As addressed in the County's MJHMP, California's water resources have been stressed by periodic drought cycles and, in some places, overuse, creating the need for unprecedented restrictions in water diversions from the Sacramento-San Joaquin Delta in recent years. Climate change is expected to increase drought and extreme weather. While the duration of drought is variable, California and Napa County will certainly continue to be impacted by drought (Napa County 2020).

Overall, the frequency and severity of droughts can vary. According to historical data prepared by the National Drought Mitigation Center (NDMC), Napa County has experienced some level of drought in most years of the 21st century thus far (as of 2024). Figure 3 displays a time series of the percent area of Napa County classified within the five US Drought Monitor categories (i.e., D0 – Abnormally Dry, D1 – Moderate Drought, D2 – Severe Drought, D3 – Extreme Drought, and D4 – Exceptional Drought) since 2000. As displayed in the figure, the period from roughly 2011 to 2016 was a period of intense and prolonged drought, with much of the county experiencing multiple years of extreme and exceptional drought (i.e., D3 & D4). The drought during this period was one of the most severe droughts on record and it affected the entire state to the point where Governor Brown declared a statewide drought emergency in 2014, which was not lifted until 2017. The county also experienced extreme and exceptional drought from late 2020 to early 2023. As noted in the County's MJHMP, the severity and extent of a drought depends on the degree of soil moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts can have significant impacts on water supply, which can then impact agriculture, people, and property functions,



Source: NDMC 2024.

Figure 3 Napa County Percent Area in US Drought Monitor Categories Since 2000

Unlike most disasters, droughts normally occur slowly but last a long time. On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to cost between $6 billion and $8 billion annually in the US and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Moreover, a drought can result in farmers not being able to plant crops or the failure of planted crops, which results in loss of work for farm workers and those in food processing and winemaking jobs.

FLOODING

The County's MJHMP notes that in Napa County, a flood occurs when the existing channel of a stream, river, canyon, or other water course cannot contain runoff from rainfall or snowmelt, resulting in overflow onto adjacent lands. Flooding may also occur due to high tides and wind. The main factors affecting flood damage are water depth and velocity. Deeper and faster flood flows can cause more damage. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. Flood reduction, prevention, and mitigation are a major challenge to county residents and floodplain managers alike. The county is located within three watersheds: Napa River Watershed, Putah Creek Watershed and Suisun Creek Watershed. Many areas of the county are at risk of flooding, especially low-lying properties near the Napa River and its feeder streams, as this section explores in further depth. Flooding in Napa County routinely develops from north to south. The location of flood hazard zones in Napa County is mainly focused around the Napa River and the San Francisco Bay, but also exist along the tributaries of Suisun and Putah Creeks. Although the Napa River is the main drainage for the surrounding watershed, and the Napa River/Napa Creek Flood Protection Project will prevent catastrophic flooding along the river's banks, there remains a significant threat of flooding along the Napa River and many feeder streams in the watershed (Napa County 2020). Regardless of the Napa River/Napa Creek Flood Protection Project, Napa River and its adjoining areas are still designated as 100-year flood hazard zones.

Both 100-year floodplains and 500-year floodplains exist in the county. A 100-year floodplain is one that has a 1 percent chance (i.e., a 1-in-100 chance) of experiencing a flood in any given year, whereas a 500-year floodplain has a

0.2 percent chance (i.e., a 1-in-500 chance) of experiencing a flood in any given year. The County's *2023 General Plan Safety Element* also profiles flood hazards. Figure SAF-3 of the Safety Element shows the locations of 100-year floodplains and 500-year floodplains in the county. As discussed above, the majority of the floodplains are along Napa River, while 100-year floodplains are also elsewhere within the county (Napa County 2023).

Based on Federal Emergency Management Agency (FEMA) data, from May 1953 to January 2024, Napa County experienced a total of 39 hazard events resulting in Major Disaster Declarations, of which eight were flooding events and 10 were severe storm-related events (FEMA 2024). For context, a Major Disaster Declaration is any major disaster resulting from a natural event that the President of the United States determines has caused damage of such severity that it is beyond the combined capabilities of State and local governments to respond to. Major Disaster Declarations provide a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work. Figure 4 displays the types of each of these 39 Major Disaster Declarations that Napa County has endured. Recently, and notably, together with other California Counties, Napa County experienced a series of heavy rain and flooding events from January to April 2023, caused by atmospheric rivers.

Furthermore, the County's MJHMP notes that Napa County will experience flooding in the future, with the probability of flooding in Napa County between 10 and 100 percent annually.

WILDFIRE

The County's MJHMP notes that a wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as energy supply infrastructure, smoking, campfires, equipment use, and arson. The 2018 California State Hazard Mitigation Plan also provides the following definition of wildfires: any free-burning vegetative fire that initiates from an unplanned ignition, whether natural (e.g., lightning) or human-caused (e.g., powerlines, mechanical equipment, escaped prescribed fires), where the management objective is full suppression.

Napa County is mainly characterized by a narrow valley floor surrounded by and intermingled with steep, hilly, wooded terrain—areas highly susceptible to wildfires. Such fires expose residential and other development within the county to an increased risk of conflagration, or extensive fire which destroys a great deal of land or property. The hilly/mountainous terrain on the east and west sides of Napa Valley strongly influences both wildfire behavior and fire suppression capabilities. Moreover, the wildland-urban interface (WUI) is defined by the U.S. Fire Administration as the zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. The County's MJHMP identifies the potential for significant damage from wildfire hazards to life and property increases in WUI areas. A few county communities, including Angwin and Calistoga, are located in WUI areas.

Wind is also a significant factor in the spread of fire. As fires spread faster, burning embers are carried with the wind to adjacent exposed areas. The Napa Valley has a characteristic southerly wind that originates from the San Francisco Bay and San Pablo Bay and, during the dry season, an occasional northerly wind of significant velocity. Both are significant factors in the spread of wildfires.

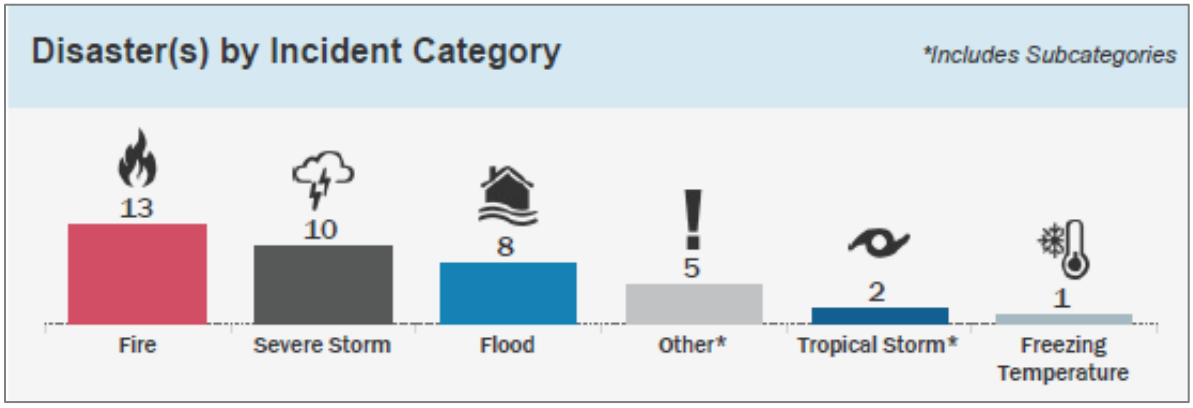
To help better refine areas of wildfire concern, the California Department of Forestry and Fire Protection (CAL FIRE) establishes and maps Fire Hazard Severity Zones (FHSZs), or areas of significant fire hazards based on factors such as fuel, weather, terrain, and the number of days of moderate, high, and extreme fire hazard potential. FHSZs range from "Moderate," "High," and "Very High."

Several agencies have responsibility for wildfire protection within any jurisdiction, ranging from local and tribal organizations to federal organizations. To address wildfire jurisdictional responsibilities, the State Legislature has designated Local Responsibility Areas (LRA), State Responsibility Areas (SRA), and Federal Responsibility Areas (FRA). FRAs encompass fire-prone wildland areas owned or managed by a federal agency responsible for wildfire response and safety on federal lands. SRAs include land under various ownership types in the state where CAL FIRE has legal and financial responsibility for wildfire protection, which include forested or other undeveloped lands, but does not include incorporated cities or federal lands. LRAs typically include lands in incorporated towns and cities, cultivated

agricultural lands, and other lands that otherwise do not meet the criteria for SRA or FRA, inclusive of some land in unincorporated counties. Figure SAF-9 of the County's General Plan Safety Plan shows the locations of these areas, together with FHSZs in the county. As shown in Figure SAF-9, a significant portion of the county is SRA and is also designated in the very high FHSZ (Napa County 2023).

Wildfires have proven to be costly and have put many elements of the county at risk, including human lives, property, rivers and watersheds, agriculture, open space, timber, recreation, wildlife habitats, historic and cultural assets, scenic assets, and local economies, among others. Of the 39 hazard events resulting in Major Disaster Declarations that Napa County experienced from May 1953 to January 2024, 13 of them were wildfire events, which are displayed in Figure 4 alongside the other types of Major Disaster Declarations the county has experienced (FEMA 2024). Note that the county experienced four Major Disaster Declarations due to fire hazards in 2020 (two in August, one in September, and one in October). The county also experienced four Major Disaster Declarations due to fire hazards in 2017 (three in September, and one in October). Ten out of the 13 fire-related Major Disaster Declarations occurred since 2000.

The County's MJHMP notes that the county faces a wildfire fire threat every year. The majority of past wildfire events in the county were in the summer months (typically June through August). The frequency of wildfire events may increase because of increasingly drier conditions caused by climate change. The county is already considered to be an area that is at high risk for wildfires. Climate change is projected to increase this current risk by anywhere from 10 to 20 percent, and the County will need to continue to adapt to this projected increase. This increase could cause additional threats to the county and has the potential to affect emergency services, roads, water supplies, housing access, public health, and quality of life. Moreover, fire risk will also continue to grow as more people build in WUI areas, which increases the exposure of people, buildings, infrastructure, and other assets and values to wildfire hazards. However, according to input received from the County and local agencies in the region, in recent years, the implementation of more stringent building and road standards, the requirement for fire insurance, and other related factors have markedly diminished new construction in WUI areas. Of the 1,350 homes that were destroyed in 2017, 2018, and 2020, less than half of them were rebuilt.



Source: FEMA 2024.

Figure 4 Napa County Major Disaster Declarations (Federal) from 1953–2023

2.1.3 Climate Change Effects

Climate change effects are categorized as primary (direct) and secondary (indirect). Primary effects are those that are caused by the direct effects of increased GHG emissions on the global climate, from which secondary effects result. The primary climate change effects analyzed for the county include increased temperatures, changes in precipitation patterns, and sea level rise. The secondary climate change effects, which can occur because of individual changes or a combination of changes in the primary climate change effects, include increased wildfire risk or severity, increased frequency of extreme heat events, increased frequency or severity of extreme precipitation and flooding events, increased risk of drought and associated water supply impacts, and energy grid resiliency issues.

Though the precise extent of future climate change effects is uncertain, historical climate data and forecasted GHG emissions can be used to project climate change effects through near-term (current-2050), mid-term (2040-2069), and long-term (2070-2099) timescales, unless noted otherwise for individual climate change effects. The time periods are established as 30-year time intervals to gather accurate data on average changes in the climate, which is typically measured over 30-year periods or longer. This results in overlap among some periods. Due to annual fluctuations in climate variables, climate data on shorter periods may be less accurate and not reflect long-term averages (NOAA 2020). To assess the potential effects of climate change, the APG recommends using Cal-Adapt, a tool developed by the CEC and the University of California, Berkeley Geospatial Innovation Facility that uses global climate simulation model data to identify how climate change might affect various geographies in California. Cal-Adapt addresses the uncertainty in future GHG emissions by using Representative Concentration Pathways (RCPs) developed by the Intergovernmental Panel on Climate Change (IPCC). These RCPs depict two future emissions scenarios. RCP 4.5 represents a lower emissions scenario in which GHG emissions continue to rise through 2040 and then decrease to below 1990 levels by the end of the century. RCP 8.5 represents a high emissions scenario, or business-as-usual scenario, where GHG emissions continue to increase through the end of the century. As recommended by the APG, this VA evaluates near-term and mid-term climate change effects and their associated impacts under the high emissions scenario (RCP 8.5), as this takes a conservative approach and assumes a worst-case scenario. Additionally, near-term and mid-term changes in climate variables are similar under both the low and high emissions scenarios. On the other hand, because long-term global GHG emissions trends are less certain and climate impacts vary more considerably between scenarios, a discussion of both the low and high emissions scenarios is included for this timescale (OPR, CEC, and CNRA 2018a).

Cal-Adapt downscales global climate models to local and regional resolutions using the Localized Constructed Analogs statistical technique. Four of the models included have been selected by California's Climate Action Team Research Working Group as priority models for research contributing to the Climate Assessment. The first model, CanESM2, represents an "average" simulation. The second model, CNRM-CM5, represents a "cooler/wetter" simulation. The third model, HadGEM2-ES, represents a "warmer/drier" simulation. The fourth model, MIROC5, represents a "dissimilar" simulation that is most unlike the other three to produce maximal coverage of possible future climate conditions. To analyze climate projections for the county, the average of the downscaled data provided by these four models was used. The boundaries of the study area for this analysis are the geographic boundaries of Napa County as a whole, unless otherwise noted.

PRIMARY CLIMATE CHANGE EFFECTS

Increased Temperatures

Though average annual temperature varies depending on location within Napa County, this analysis focuses on the county as a whole. According to Cal-Adapt, the historic (1961-1990) average annual maximum temperature for the county is 71.1 °F, and the historic average annual minimum temperature is 43.6 °F. As shown in Table 4, both are projected to increase throughout the century (CEC 2024a). The average annual maximum temperature in the county is projected to increase to 74.7 °F in the near-term and 76.0 °F in the mid-term under RCP 8.5. The average annual maximum temperature is projected to increase to 76.4 °F and 79.2 °F in the long-term under RCPs 4.5 and 8.5, respectively. Figure 5 graphically displays the increase in average annual maximum temperature within the county through the end of the century (CEC 2024b). The average annual minimum temperature in the county is projected to increase to 47.2 °F in the near-term and 48.3 °F in the mid-term under RCP 8.5. The average annual minimum temperature is projected to increase to 48.7 °F and 51.9 °F in the long-term under RCPs 4.5 and 8.5, respectively.

Historic average annual temperatures, along with future projected temperatures across each timescale, could vary slightly depending on location within the county. To show potential temperature differences due to geographic locations, temperature data was extracted for the cities of St. Helena and American Canyon. St. Helena is an inland incorporated city in the northwestern portion of the county, whereas American Canyon is a coastal city adjacent to the San Francisco Bay in the southernmost portion of the county. According to the data, the historic average annual maximum temperature in St. Helena is 71.6 °F, and the historic average annual maximum temperature in American Canyon is 71.4 °F. This data shows that there is not a significant difference in annual average maximum temperature

in these different geographic locations selected for the county. Meanwhile, the change in temperature across each timescale from the historic average is also similar in jurisdictions across the county. For example, in the long term under RCP 8.5, St. Helena is projected to have an average annual maximum temperature of 79.9 °F or an increase of 8.3 °F from its historic average. Similarly, American Canyon is projected to have an average annual maximum temperature of 79.1 °F in the long term under RCP 8.5, or an increase of 7.7°F from its historic average. These respective increases in temperature of 8.3 °F and 7.7 °F are also similar to the projected 8.1 °F increase across the county as a whole, which is shown in Table 4 (CEC 2024a). Increased temperatures in the county will likely influence secondary climate change effects, including increased wildfire risk, increased frequency of extreme heat events, and drought and water supply.

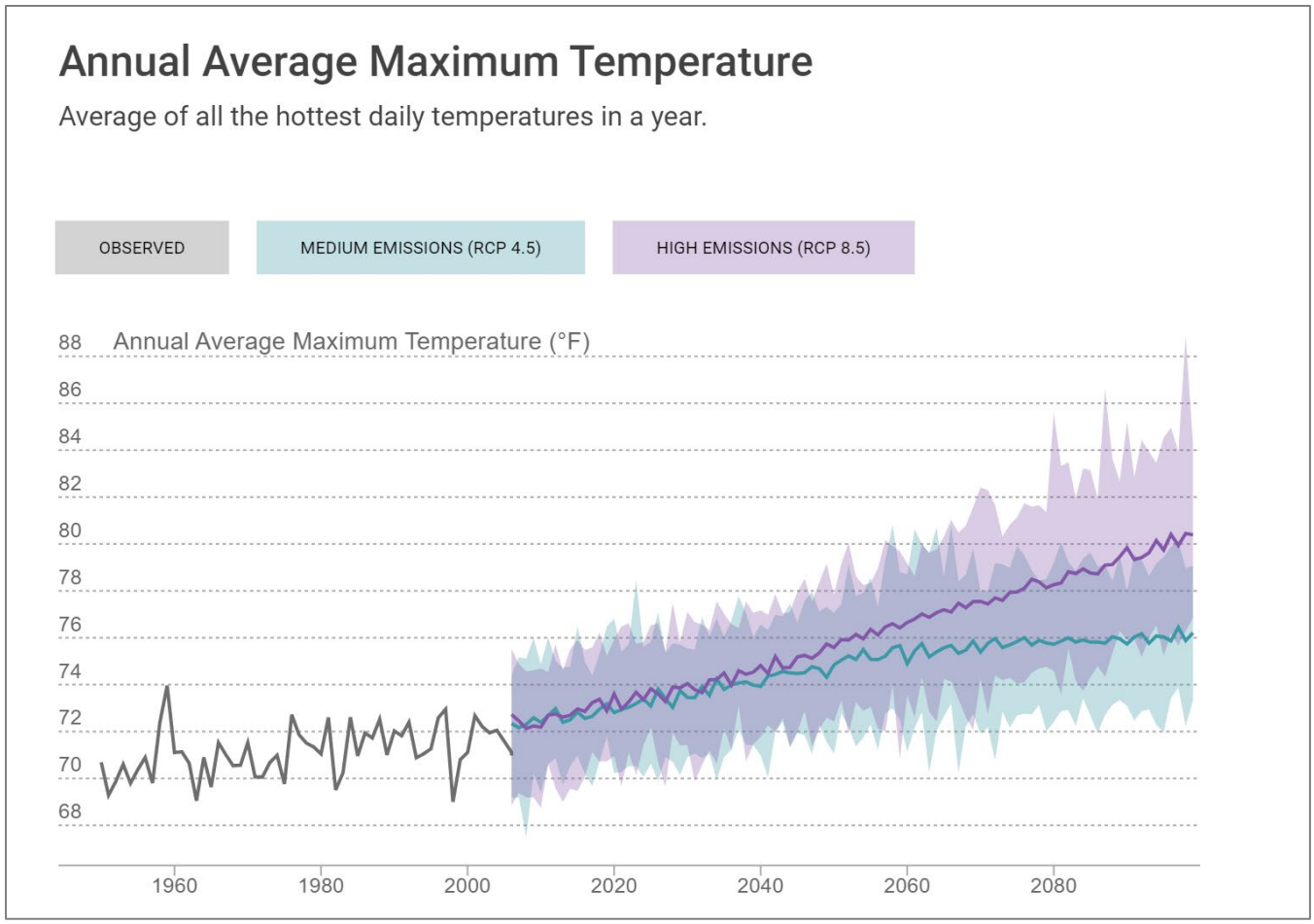
Table 4 Changes in Average Annual Temperature in Napa County

Average Annual Temperature	Historic (1961-1990)	Near-Term[1] (current-2050)	Mid-Term[1] (2035-2064)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Maximum Temperature (ºF)	71.1	74.7	76.0	76.4	79.2
Maximum Temperature Difference from Historic (ºF)	N/A	+3.6	+4.9	+5.3	+8.1
Minimum Temperature (ºF)	43.6	47.2	48.3	48.7	51.9
Minimum Temperature Difference from Historic (ºF)	N/A	+3.6	+4.7	+5.1	+8.3

Notes: ºF = degrees Fahrenheit; N/A = not applicable; RCP = Representative Concentration Pathway.

[1] Projections for the near-term and mid-term timescales are based on RCP 8.5.

Source: CEC 2024a.



Source: CEC 2024b.

Figure 5 Napa County Projected Increase in Average Annual Maximum Temperature through 2099

Changes in Precipitation Patterns

According to Cal-Adapt, the historic average annual precipitation in the county is 31.3 inches. As shown in Table 5, the average annual precipitation in the county is projected to increase to 36.2 inches in the near-term and 36.9 inches in the mid-term under RCP 8.5. In the long-term, average annual precipitation is projected to increase to 34 inches under RCP 4.5, and 41 inches under RCP 8.5 (CEC 2024a).

Historic average annual precipitation, along with future projected average annual precipitation across each timescale, can vary slightly depending on location within the county. Using the same examples as before (i.e., average annual maximum temperature), the historic average annual precipitation in St. Helena is 37.3 inches, whereas the historic average annual precipitation in American Canyon is 20.9 inches, which shows that there is a significant difference in average annual precipitation in these different geographic locations selected for the county. Moreover, in the long-term under RCP 8.5, St. Helena is projected to have an average annual precipitation of 48.9 inches, or an increase of 11.6 inches from its historic average. On the other hand, American Canyon is projected to have an average annual precipitation of 27.1 inches in the long-term under RCP 8.5, or an increase of 6.2 inches from its historic average. Based on the data, the predicted future changes in precipitation also differ slightly by different geographic locations in the county. The inland areas are projected to get more increasing annual precipitation than the coastal areas. The county's overall increase in precipitation will likely be between inland and coastal levels: 11.6 inches (inland) > 9.7 inches (county) > 6.2 inches (coastal) (CEC 2024a).

While average annual precipitation in the county is projected to trend upward in future years, overall precipitation patterns are also projected to change, with precipitation variability expected to continue, and potentially increase, over time across the San

Francisco Bay Area, inclusive of the county. Historically, precipitation in the San Francisco Bay Area exhibits "booms and busts," which refers to the existence of both very wet years and very dry years (OPR, CEC, and CNRA 2018b). The amount of precipitation that falls in any particular year is largely influenced by occurrences of large, discrete winter storms, which often provide a substantial fraction of the region's annual precipitation. As these storms happen in the coming decades, they will likely become more intense, and potentially more damaging. In general, periods of precipitation are projected to be wetter, but on an annual basis, there will likely be fewer total days with precipitation. Furthermore, climate projections show a likely increase in extreme dry events, which may result in severe and prolonged drought (OPR, CEC, and CNRA 2018b). Overall, the projected increase in average annual precipitation and changes in precipitation patterns through the end of the century will likely influence secondary climate change effects, including increased wildfire risk, extreme precipitation and flooding, drought and water supply shortages.

Table 5 Changes in Average Annual Precipitation in Napa County

Average Annual Precipitation	Historic (1961-1990)	Near-Term[1] (current-2050)	Mid-Term[1] (2035-2064)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Average Annual Precipitation (inches)	31.3	36.2	36.9	34.0	41.0
Average Annual Precipitation Difference from Historic (inches)	N/A	+4.9	+5.6	+2.7	+9.7

Notes: N/A = not applicable; RCP = Representative Concentration Pathway.

[1] Projections for the near-term and mid-term timescales are based on RCP 8.5.

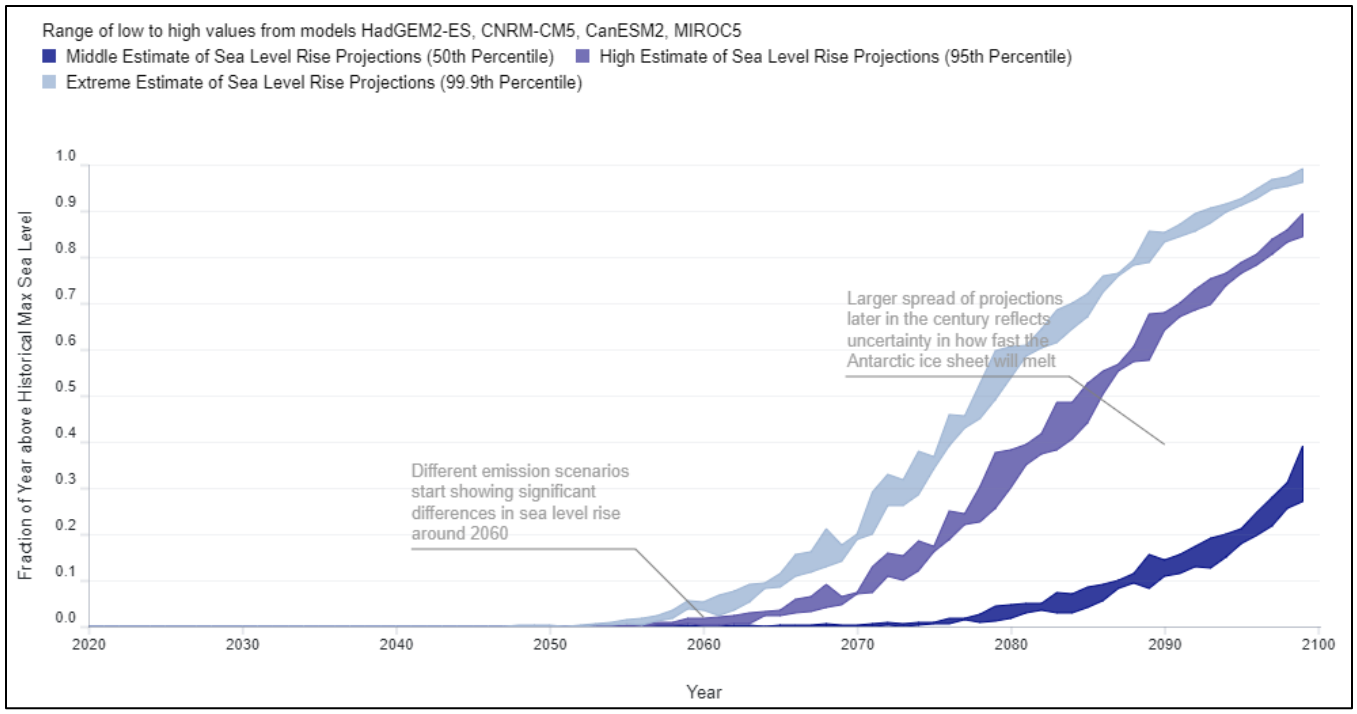
Source: CEC 2024a.

Sea Level Rise

Cal-Adapt provides probabilistic sea level rise projections for both RCPs 4.5 and 8.5, which incorporate estimates of components that contribute to global and regional sea level rise (e.g., thermal expansion of seawater, glacier ice melt, glacial isostatic adjustments, etc.). The sea level rise projections for RCP 8.5 also incorporate relatively recent scientific findings on the potential for rapid demise of the West Antarctic Ice Sheet, which could dramatically accelerate sea level rise in the latter decades of this century. The probabilistic framework is helpful because, despite substantial advances in the science of sea level rise, significant uncertainty remains in mid- and late-century projections of sea levels. Probabilistic sea level rise projections provide a range of possible outcomes in a framework that enables decision-makers to choose a number that is appropriate for their level of risk tolerance. Sea level rise scenarios presented in Cal-Adapt include the 50th percentile (middle estimate), 95th percentile (high estimate), and 99.9th percentile (extreme estimate) (CEC 2024c).

According to Cal-Adapt, the historic maximum sea level at the San Francisco tide gauge station is 67 inches. The San Francisco tide gauge station was chosen for this analysis as it is the closest of the 11 gauge stations across the state in proximity to the county as a whole and thus would provide the most relevant projections. Figure 6 displays the projected fraction of the year that sea level would be over the historic maximum sea level at the San Francisco (67 inches) tide gauge station under RCP 8.5 and each of the above-noted sea level rise scenarios (middle, high, and extreme estimates). As shown, it takes until roughly mid-century for each sea level rise scenario to start showing significant differences.

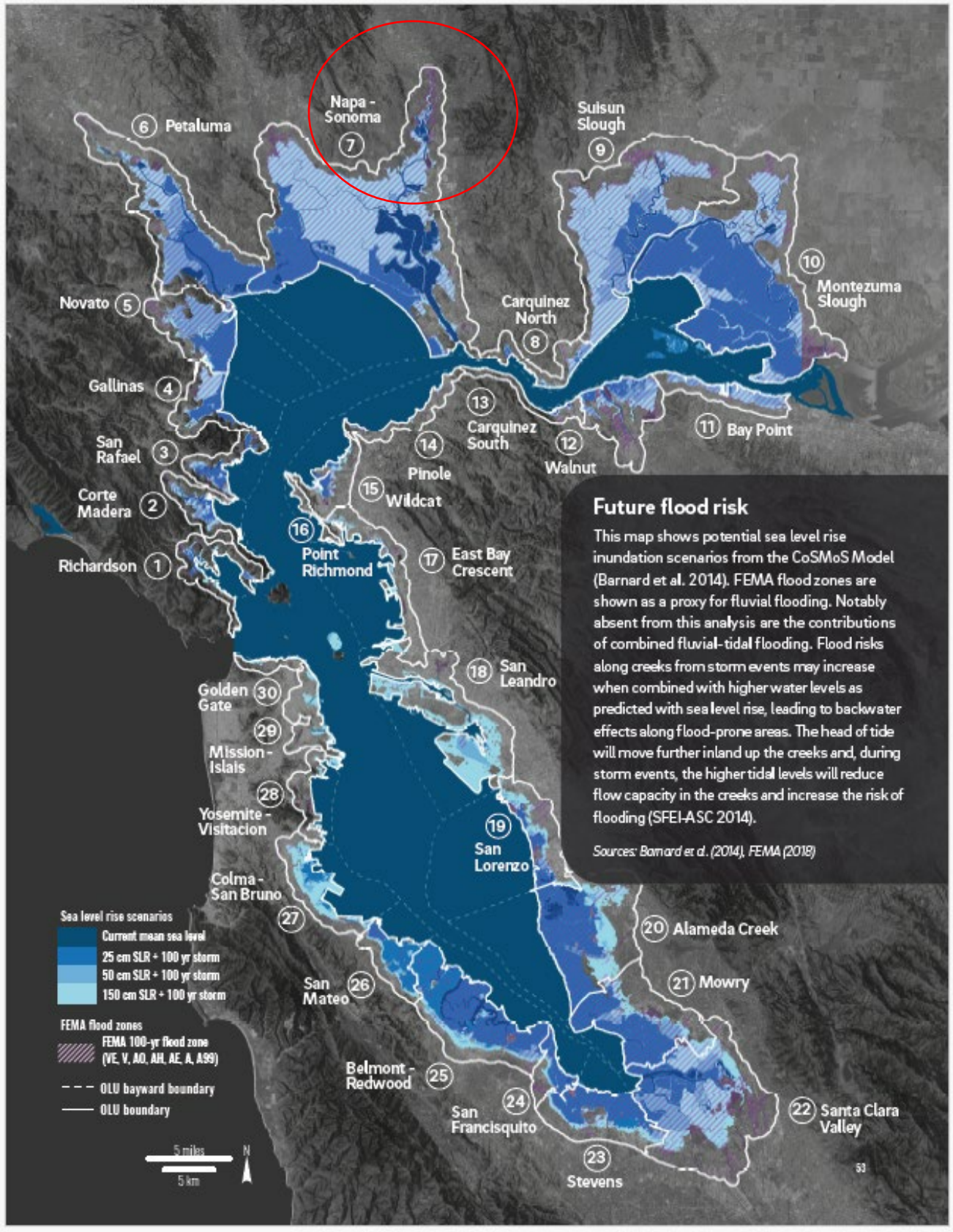
The County's MJHMP's Climate Change Hazard Profile included extensive discussion on sea level rise. As shown in the MJHMP's Figure 4-43: Sea Level Rise Potential of the MJHMP, the southern portion of the county, which includes the City of Napa, is projected to have moderate to high sea level rise potential. Moreover, although sea level rise will not impact most of the county directly and significantly, it can indirectly impact more inland communities. For example, landward intrusions of seawater due to sea level rise can make groundwater levels rise, which could result in subsurface flooding of underground utilities, basements, and other infrastructure, affecting the future suitability of land for commercial and residential use. Additionally, sea level rise will increase the severity of coastal flooding, one of the secondary climate change effects identified in this VA (Napa County 2020).



Source: CEC 2024c.

Figure 6 Projected Fraction of Year with Sea Level Above Historic Maximum at the San Francisco Tide Gauge Station Under RCP 8.5

Furthermore, the San Francisco Estuary Institute (SFEI) and the San Francisco Bay Area Planning and Urban Research Association (SPUR) released the *San Francisco Bay Shoreline Adaptation Atlas – Working with Nature to Plan for Sea Level Rise Using Operational Landscape Units (OLU)* report in April 2019. OLUs are a practical way to manage the physical and jurisdictional complexity of the Bay shoreline regarding adapting to sea level rise. A key purpose of the OLU framework is to identify where nature-based approaches, such as beaches, marshes, and subtidal reefs, can help create a resilient shoreline with multiple benefits against sea level rise. Napa County, grouped with Sonoma County, serves as the Napa-Sonoma OLU. According to the report's simulated sea level rise scenario analyses, an estimated 27 percent, 29 percent and 68 percent of the Napa-Sonoma OLU would be inundated if the OLU experiences a 100-year storm surge with 25 cm (0.8 feet), 50 cm (1.6 feet) and 150 cm (4.9 feet) sea level rise scenarios. Figure 7 below also shows the inundation areas under these different sea level rise scenarios (Napa-Sonoma OLU is circled in red) (SFEI and SPUR 2019).



Source: SFEI and SPUR 2019.

Figure 7 Estimated Bay Area Sea Level Rise Inundation under Different Future Scenarios

SECONDARY CLIMATE CHANGE EFFECTS

Increased Wildfire Risk

Historically, attention to wildfire in the state has mostly focused on the Sierra Nevada region and Southern California, but recent large and destructive wildfires in the San Francisco Bay Area have rapidly shifted attention to the ongoing risks in this region, inclusive of Napa County (OPR, CEC, and CNRA 2018b). Fire danger is complex. It is impacted by human activity, vegetation, wind, temperature, relative humidity, atmospheric stability, etc. Cal-Adapt provides projections for the future annual number of days when Keetch-Byram Drought Index (KBDI) is higher than 600. KBDI provides an estimate for how dry the soil and vegetative detritus is and represents a simplified proxy for the favorability of occurrence and spread of wildfire. However, Cal-Adapt clarifies that KBDI is not itself a predictor of fire. Table 6 displays the projected change in the annual number of days where KBDI > 600 within the county under RCP 8.5 for the near-term and mid-term timescales, and under both emissions scenarios, RCPs 4.5 and 8.5, for the long-term timescale.

The historic average annual number of days where KBDI > 600 in the county is 102.1. The average annual number of days where KBDI > 600 in the county is projected to increase to 113 in the near-term and 120.1 in the mid-term under RCP 8.5. The average annual number of days where KBDI > 600 is projected to increase to 121.8 in the long-term under RCP 4.5, and 140.3 in the long-term under RCP 8.5. Although it is difficult to pinpoint the exact timing, location, duration, and severity of future wildfires, the area's most susceptible to wildfire are the hilly/mountainous terrain on the east and west sides of Napa Valley, also described in Section 2.1.2. Also, a significant portion of the county is located in very high FHSZ.

Table 6 Changes in Annual Number of Days where KBDI > 600 in Napa County

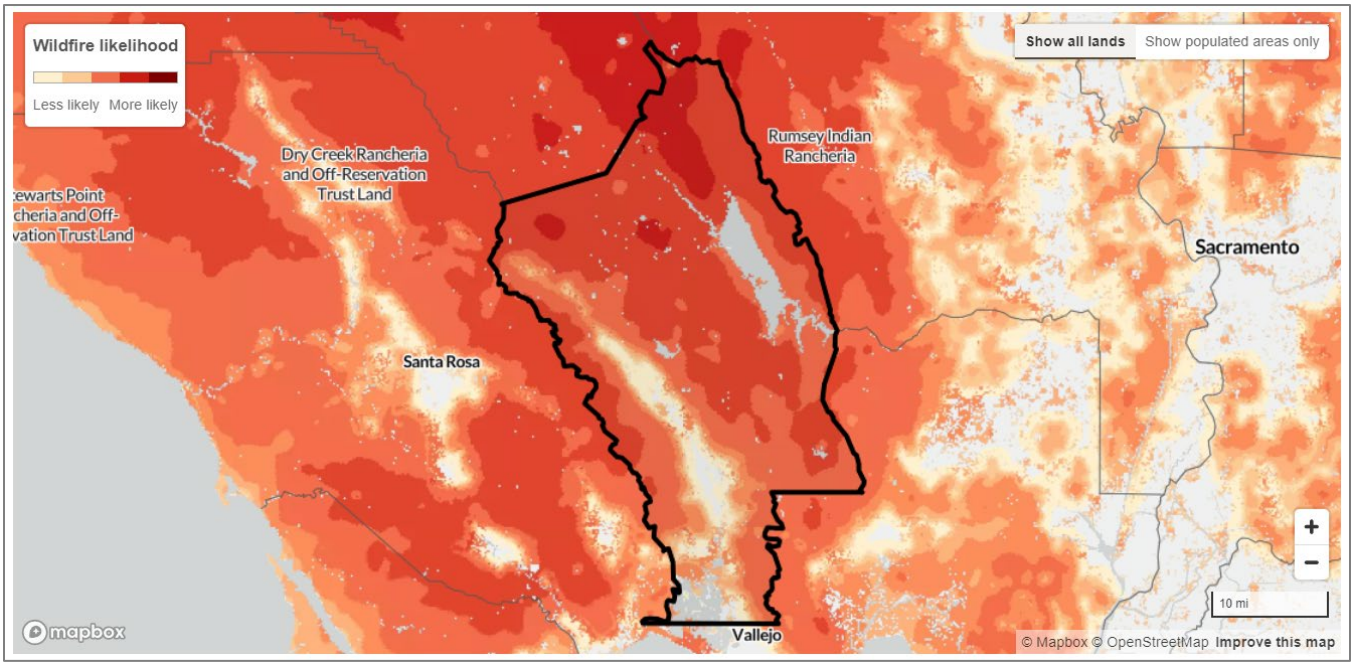
Average Annual Area Burned	Historic (1961-1990)	Near-Term[1] (current-2050)	Mid-Term[1] (2035-2064)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Annual Number of Days where KBDI >600 (days)	102.1	113.0	120.1	121.8	140.3
Annual Number of Days where KBDI >600 Difference from Historic (days)	N/A	+10.9	+18	+19.7	+38.2

Notes: N/A = not applicable; RCP = Representative Concentration Pathway.

1. Projections for the near-term and mid-term timescales are based on RCP 8.5.

Source: CEC 2024b.

Furthermore, Wildfire Risk to Communities is a tool created by USDA Forest Service that contains interactive maps, charts, and resources to help communities understand, explore, and reduce wildfire risk. This tool provides data on wildfire likelihood. As shown in Figure 8 below, the majority of Napa County has a "more likely" wildfire likelihood, which is greater than 74 percent of the other counties in the US.



Source: Wildfire Risk to Communities 2020.

Figure 8 Napa County Wildfire Likelihood

Increased Frequency of Extreme Heat Events

The Cal-Adapt tool provides estimates of future instances of extreme heat events. Extreme heat events include extreme heat days and heatwaves. Cal-Adapt defines an extreme heat day as a day when the daily maximum temperature exceeds the 98th historical percentile of daily maximum temperatures based on observed data from

1961–1990 between April and October. Heatwave events are characterized as periods of sustained extreme heat and are defined by Cal-Adapt as four or more consecutive extreme heat days.

Extreme heat day thresholds vary significantly for different portions of the county due to various geographic, topographic, and climatological factors. However, to be consistent with exposure analyses of other climate change effects, the study area in Cal-Adapt was kept as the geographic boundaries of the entire county. Table 7 below displays the data for extreme heat events in the county through the end of the century. The default extreme heat threshold for the county is 98.6°F, meaning 98 percent of all recorded temperatures between April and October from 1961 to 1990 were below 98.6 °F. Historically, the county experienced an average of 4.3 extreme heat days and 0.2 heatwaves per year from 1961-1990. As a result of rising temperatures from climate change, the county is projected to experience 15.9 extreme heat days and 1.5 heatwaves annually in the near-term, and 22.1 extreme heat days and 2.5 heatwaves annually in the mid-term under RCP 8.5. In the long-term, the county is projected to experience 24 extreme heat days and 2.6 heatwaves annually under RCP 4.5, and 40 extreme heat days and 5.4 heatwaves annually under RCP 8.5. In addition to the increasing number of extreme heat days and heatwaves on an annual basis, the length of consecutive extreme heat days is also projected to increase through the end of the century, as shown in Table 7. Moreover, the County's MJHMP mentions that high heat events can occur throughout Napa County and are projected to worsen with climate change.

Figure 9 provides a visual representation of the projected increase in the annual number of extreme heat days in the county through the end of the century using the four priority models previously described (i.e., CanESM2, CNRM-CM5, HadGEM2-ES, and MIROC5). Noting that the presented data is for Napa County as a whole and acknowledging that extreme heat is experienced differently across the county due to a range of factors (e.g., limited air conditioning in certain areas), a more in-depth discussion of heat-related sensitivities and potential impacts is presented in Section 2.2.5.

Table 7 Changes in Extreme Heat Events in Napa County

Annual Averages	Historic (1961-1990)	Near-Term[1] (current-2050)	Mid-Term[1] (2035-2064)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Number of Extreme Heat Days[2]	4.3	15.9	22.1	24.0	40.0
Number of Heatwaves[3]	0.2	1.5	2.5	2.6	5.4
Number of Days in Longest Stretch of Consecutive Extreme Heat Days	2.1	5.0	6.2	6.2	10.1

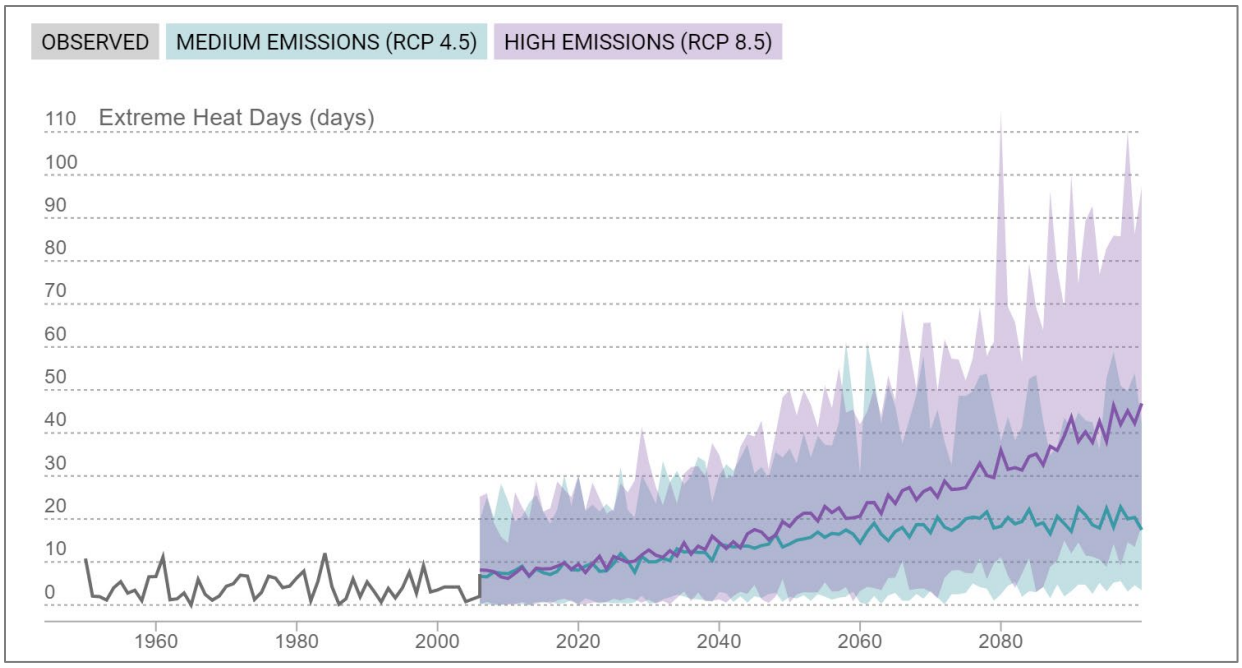
Notes: RCP = Representative Concentration Pathway.

[1] Projections for the near-term and mid-term timescales are based on RCP 8.5.

[2] The threshold for an extreme heat day in Napa County is 98.6 °F.

[3] A heatwave is characterized as a period of sustained extreme heat and is defined by Cal-Adapt as four or more consecutive extreme heat days.

Source: CEC 2024d.



Source: CEC 2024b.

Figure 9 Napa County Projected Increase in Extreme Heat Days through 2099

Extreme Precipitation and Flooding

In the Cal-Adapt tool, extreme precipitation events are defined as events where 2-day rainfall totals are above an extreme threshold (i.e., days having precipitation at or exceeding the 95th percentile). For the county as a whole, this threshold is approximately 1.47 inches over a 2-day period. Similar to extreme heat thresholds, extreme precipitation thresholds vary significantly for different portions of the county due to various geographic, topographic, and climatological factors. However, to be consistent with exposure analyses of other climate change effects, the study area in Cal-Adapt was kept as the geographic boundaries of the entire county. According to Cal-Adapt, the county has historically experienced an average of 3.3 extreme precipitation events per year from 1961-1990. Under RCP 8.5, the county is expected to experience 3.9 extreme precipitation events per year in the near-term and 4.3 extreme precipitation events per year in the mid-term. In the long-term, the county is projected to experience 4.2 extreme precipitation events per year under RCP 4.5, and 5.4 extreme precipitation events per year under RCP 8.5 (CEC 2024e). Changes in extreme precipitation events in the county are shown in Table 8. Though the table displays an increase in the average annual number of extreme precipitation events through the end of the century, it is important to note that the quantity of extreme precipitation events in the county may vary considerably year-to-year due to California's highly variable climate setting. However, as the climate continues to warm, atmospheric rivers, responsible for many of the extreme precipitation events across the state, will carry more moisture and may make extreme precipitation events more severe (Polade et al. 2017).

Table 8 Changes in Extreme Precipitation Events in Napa County

Average Annual Number of Extreme Precipitation Events[1]	Historic (1961-1990)	Near-Term[2] (current-2050)	Mid-Term[2] (2040-2069)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Average Annual Number of Extreme Precipitation Events	3.3	3.9	4.3	4.2	5.4
Average Annual Number of Extreme Precipitation Events Difference from Historic	N/A	+0.6	+1.0	+0.9	+2.1

Notes: The annual year for extreme precipitation events refers to the water year, which is a 12-month period from October 1, for any given year through September 30, of the following year; N/A = not applicable; RCP = Representative Concentration Pathway.

[1] The threshold for an extreme precipitation event in Napa County is 1.47 inches of precipitation over a 2-day period.

[2] Projections for the near-term and mid-term timescales are based on RCP 8.5.

Source: CEC 2022e.

As the potential increases for more extreme precipitation events to occur on an annual basis through the end of the century, the county may also experience an increase in the frequency and intensity of flood events. Though the occurrence of extreme precipitation events is a major source of flooding in the county, and will increasingly be so in the future, it is not the only source. As discussed previously, sea level rise is another major source of flooding across the entire county as rising seas will put new areas at risk of coastal flooding, and also increase the likelihood and intensity of floods in areas already at risk. Figure 10 displays projected flooding inundation across the entire county under four distinct sea level rise scenarios associated with a 100-year storm: 1.6 feet of sea level rise, 3.3 feet of sea level rise, 5.0 feet of sea level rise, and 6.6 feet of sea level rise. As noted previously, although most of the county will not experience direct impacts associated with sea level rise and associated flooding, the southern portion of the county, including parts of American Canyon and City of Napa, is exposed to potential inundation caused by sea level rise and the aggregated storm events. Also, according to the County's MJHMP, when combined with a 4.92-feet rise in sea level rise, climate change is projected to expose 13,000 additional acres to 100-year flood risk. While most of these areas are undeveloped, some developed areas are at risk and should be accounted for in future plans.

Drought and Water Supply

As shown in Table 5 above and discussed in the Changes in Precipitation Patterns as a primary climate change effect, under both emissions scenarios, RCPs 4.5 and 8.5, the county is expected to experience slight overall increases in average annual precipitation in the long-term. However, in addition to these slight increases in average annual precipitation, overall precipitation patterns are projected to change, with precipitation variability expected to increase substantially. The county and state have a highly variable climate that is susceptible to prolonged periods of drought, and recent research suggests that extended drought occurrences could become more pervasive in future decades. While the state does not see the average annual precipitation changing significantly in the next 50-75 years, precipitation will likely be delivered in more intense storms and within a shorter wet season. Research suggests that for much of the state, wet years will become wetter, and the dry years will become drier. Dry years are also likely to be followed by additional dry years, increasing the risk of drought (CEC 2024f).

Cal-Adapt provides predictions on the county's future annual maximum length of dry spell. The annual maximum length of dry spell is the maximum number of consecutive days with precipitation < 1mm for each year. Table 9 displays the projected change in the county's annual maximum length of dry spell under RCP 8.5 for the near-term and mid-term timescales, and under both emissions scenarios, RCPs 4.5 and 8.5, for the long-term timescale. The historic annual maximum length of dry spell for the county is 110.8 days. The county's annual maximum length of dry spell is projected to increase to 111.2 days for both near-term and mid-term under RCP 8.5. The county's annual maximum length of dry spell is projected to slightly decrease to 110.3 days in the long-term under RCP 4.5, while increase to 116.4 days in the long-term under RCP 8.5 (CEC 2024b).

Furthermore, according to input received from the County and local agencies in the region, it is important to acknowledge that water supply in the region is not solely reliant on local trends, but also on broader state trends, as Napa communities depend on the State Water Project. While municipal reservoirs contribute only a fraction to the overall supply, the majority of cities' water originates from Oroville Dam via the North Bay Aqueduct. On the other hand, rural areas directly depend on wells and/or Lake Berryessa for their water sources.

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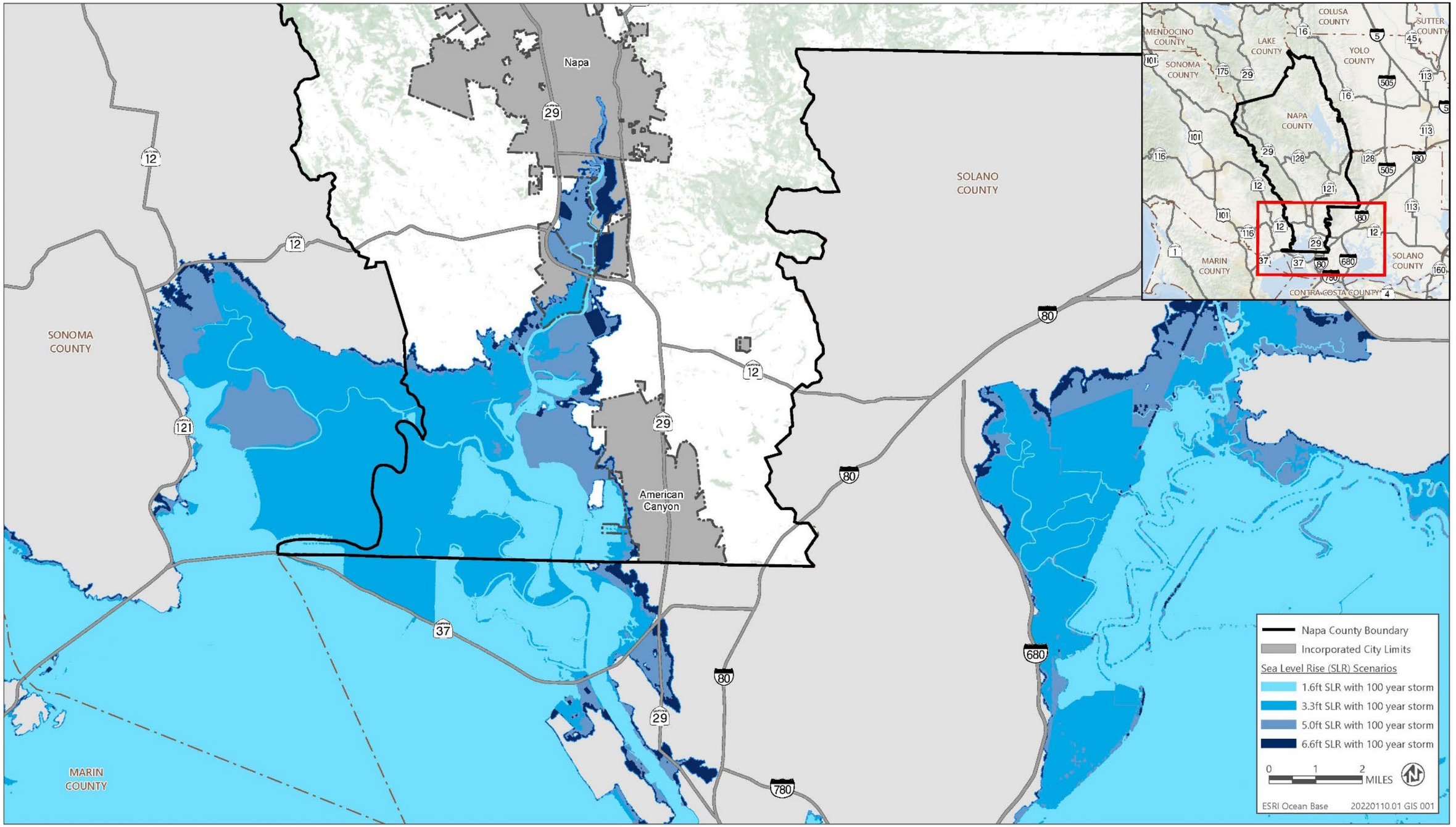


Source: USGS Coastal Storm Modeling System - Projected sea level rise and flood exposure data (CoSMoS v3.1; Barnard et al. 2018); accessed via the Our Coast Our Future web platform (Point Blue Conservation Science and USGS 2019); adapted by Ascent in 2024.

Figure 10 Napa County Sea Level Rise Scenarios

Table 9 Changes in Annual Maximum Length of Dry Spell for Napa County

Annual Maximum Length of Dry Spell	Historic (1961-1990)	Near-Term[1] (current-2050)	Mid-Term[1] (2035-2064)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Annual Maximum Length of Dry Spell (days)	110.8	111.2	111.2	110.3	116.4
Annual Maximum Length of Dry Spell Difference from Historic (days)	N/A	+0.4	+0.4	-0.5	+5.6

Notes: N/A = not applicable; RCP = Representative Concentration Pathway.

1. Projections for the near-term and mid-term timescales are based on RCP 8.5.

Source: CEC 2024b.

The county will experience extended drought periods like this as a result of climate change, and without effective adaptations, future droughts will challenge the management of the San Francisco Bay Area's water supplies, inclusive of the county (OPR, CEC, and CNRA 2018b).

Energy Grid Impacts

The impact of increased temperatures on the energy grid is a significant concern, especially considering the potential for more frequent and intense heatwaves due to climate change. Higher temperatures can strain energy infrastructure and present various challenges to the reliable operation of the power grid. Rising temperatures can lead to increased demand for cooling, especially in regions prone to heatwaves. This surge in demand can strain the electrical grid as more people use air conditioning and cooling systems. Extreme heat can also cause stress on power generation and distribution equipment, leading to failures and outages. Transformers, power lines, and other components may experience reduced efficiency and reliability in higher temperatures. Moreover, solar energy and hydropower are also subject to climate disruptions. For example, inconsistent precipitation can lead to a lack of consistency in hydropower production.

Electrical power disruptions can be grouped into two categories: intentional and unintentional. Intentional disruptions include planned disruptions, unscheduled, demand-side management, and load shedding. It is necessary to intentionally disrupt the service to prevent larger system failures when needed. A new intentional power disruption type has occurred in California related to wildfires that were ignited by downed power lines or malfunctioned electrical equipment that caused the Camp Fire in 2018. Because of the severity of that catastrophic wildfire event, the California Public Utilities Commission (CPUC) directed the three largest energy utilities in California to prepare their customers for wildfire threats and related power outages during severe weather events. This emergency preparedness resulted in safety procedures now referred to as public safety power shutoffs (PSPS) designed to protect customers and communities during severe weather events when power is proactively shut off for public safety reasons to prevent a wildfire. In comparison, unintentional disruptions are outages that come with no advance notice. Unintentional disruptions can be the most problematic and can include system failures or malfunction, equipment overload, fallen trees, vandalism, severe weather (lightning, high winds, flooding), and wildfires that damage transmission lines.

The relationship between wildfires and energy grid resiliency is a critical aspect of modern infrastructure planning, particularly in regions prone to wildfires. Wildfires can have severe and far-reaching impacts on the reliability and safety of the energy grid. For example, wildfires can result in power line damage and eventually result in grid disruption and outages. The occurrences of wildfires may also hinder emergency response efforts, making it challenging for utility crews to access affected areas and repair damaged infrastructure promptly. Moreover, as mentioned previously, utilities may implement PSPS to proactively reduce the risk of wildfire ignition caused by power lines. However, while PSPS can help prevent wildfires, they also lead to power disruptions for residents and businesses.

Furthermore, flooding events can also pose significant challenges to energy grids. Floodwater can damage critical components of the energy infrastructure, including power plants, substations, transformers, and power lines. Substations, where electricity is transformed and distributed, are particularly vulnerable to flooding. Damage to substation equipment can disrupt the flow of electricity through the grid and affect large areas. In addition, flooding poses electrical safety risks, which can create hazardous conditions for both the public and utility workers trying to repair and restore the grid.

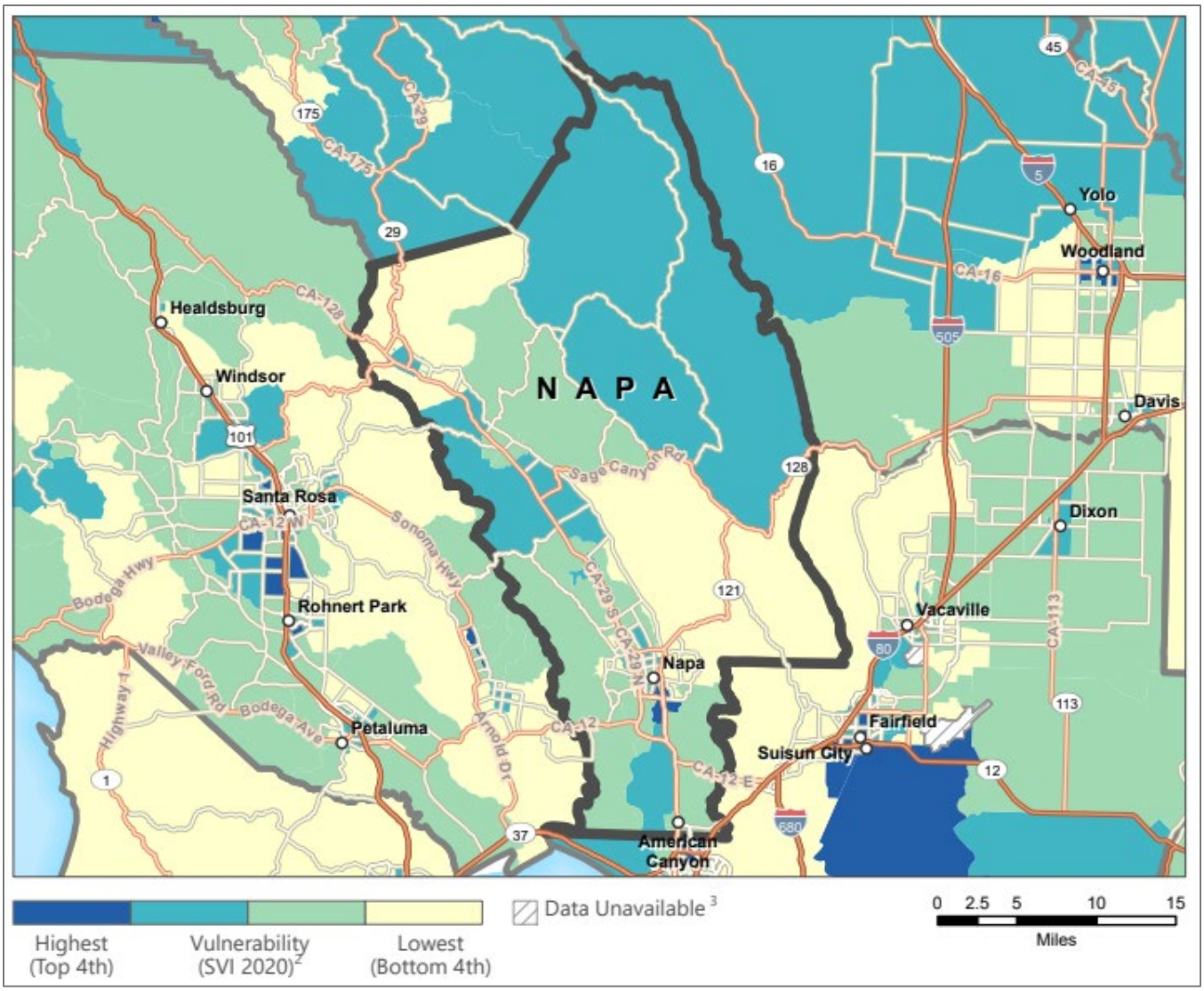
2.2 SENSITIVITY AND POTENTIAL IMPACTS

The second step of the VA process is conducting a sensitivity analysis and the analysis of potential impacts. The first objective of this step is to identify which populations and assets may be sensitive to climate change effects. The second objective is to determine the specific potential impacts that those populations and assets may face as a result of climate change effects. Key populations and assets identified in the county are organized into the following overarching categories: populations, built environment, and community functions. These categories are described in more detail below under Sections 2.2.1 through 2.2.3. Climate change effects and related impacts on each of these categories are then discussed in Sections 2.2.4 through 2.2.8, including increased wildfire risk, increased temperatures and extreme heat, extreme precipitation and flooding (including sea level rise), drought and water supply, and impacts to the energy grid.

2.2.1 Populations

While all persons in the county will experience impacts from climate change, some populations are more vulnerable to climate impacts due to a variety of factors. Vulnerable populations are those that "experience heightened risk and increased sensitivity to climate change and have less capacity and fewer resources to cope with, adapt to, or recover from climate impacts" (OPR 2018). These disproportionate effects are caused by physical, social, political, and economic factors, which are exacerbated by climate impacts. Some of these factors include race, class, sexual orientation and identification, national origin, and income inequality, among others (OPR 2018).

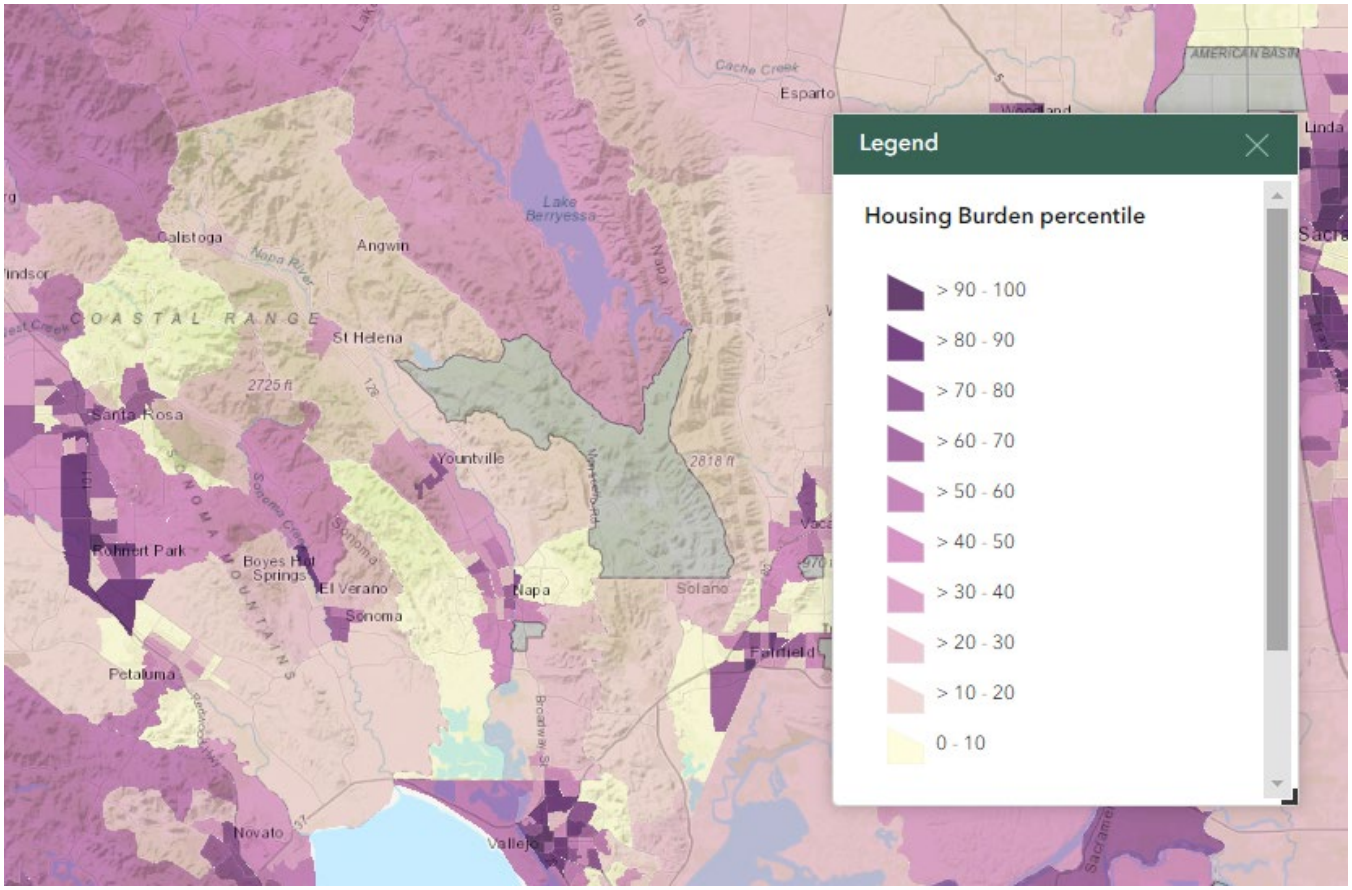
Within the county, an array of populations is vulnerable to the effects of climate change. The Social Vulnerability Index (SVI), developed by the Centers for Disease Control and Prevention, is a tool intended to assist local planners in better preparing for and responding to hazards by identifying and mapping areas where populations are most likely to need support before, during, and after a hazardous event, including those linked to or exacerbated by climate change. The SVI groups 16 distinct census-derived factors (e.g., poverty, lack of vehicle access, housing challenges) into four themes (i.e., socioeconomic status, household characteristics, racial and ethnic minority status, housing type/transportation) that summarize the extent to which an area is socially vulnerable to hazards. Figure 11 displays variations in social vulnerability in the county according to SVI. As shown in Figure 11, the most vulnerable populations are primarily in the northern, northeastern, western and southern portions of the county (CDC 2020). Specific vulnerable populations in the county include but are not limited to, children, pregnant people, the elderly, communities of color, linguistically isolated communities, individuals experiencing homelessness, low-income individuals, individuals with access and functional needs, workers in vulnerable occupations, and those with preexisting health issues. It is important to plan for all groups that, for one reason or another, lack available resources or capacity to react or adapt to the impacts of climate change. However, note that the SVI shows social vulnerability from a census tract level and may not capture broad disparities in the degree of vulnerability. For example, census tracts identified to be vulnerable may still contain people or households that are not socially vulnerable, and vice versa.



Source: CDC 2020.

Figure 11 Napa County Social Vulnerability Index

Moreover, the CalEnviroScreen 4.0 tool developed by the California Office of Environmental Health Hazard Assessment (OEHHA) also offers insights on potentially vulnerable communities. California has extremely high housing costs relative to much of the country, which can make it hard for many to afford housing. Also, households with lower incomes may spend a larger proportion of their income on housing and may suffer from housing-induced poverty. The CalEnviroScreen tool includes an indicator map that shows areas in the county where there are higher percentages of housing-burdened low-income households (see Figure 12). These are households that are both low-income and highly burdened by housing costs. As shown in Figure 12, a few communities near the City of Napa and Town of Yountville have relatively higher housing burdens while also are relatively low-income.



Source: OEHHA 2023.

Figure 12 Napa County Housing-Burdened Low-Income Households

2.2.2 Built Environment

The built environment in the county includes assets that are essential to the health and welfare of residents and visitors and are especially important during and following hazard events linked to or exacerbated by climate change. This ranges from residential and commercial buildings to an array of critical infrastructure, including essential facilities (e.g., fire stations, medical facilities, schools), transportation infrastructure (e.g., roadways, bridges, railroads), and utility infrastructure (i.e., energy, communications, and water and wastewater). Critical infrastructure, in general, refers to any structure or other improvement that, because of its function, size, service area, or uniqueness, has the potential to disrupt vital socioeconomic activities if it is destroyed, damaged, or functionally impaired.

2.2.3 Community Functions

Community functions are the resources, assets, operations, economic sectors, and services that are created or influenced by the interaction between populations and the built environment and allow day-to-day activities to continue in the county. Some of the county's community functions include, but are not limited to, agriculture (including wine industry), tourism and recreation, transportation and mobility, housing, essential and emergency services, energy delivery, and other utility operations (e.g., communications). Increases in the frequency and/or severity of hazards linked to climate change will cause environmental, economic, and/or social impacts across these community functions, which are crucial to the integrity and resilience of the county.

2.2.4 Increased Wildfire Risk

POPULATIONS

According to the County's MJHMP, in the unincorporated county, 7,123, 5,118, and 8,618 residents reside in very high, high, and moderate FHSZs respectively (Napa County 2020).

According to input received from the County and local agencies in the region, 11 people died due to wildfire events in Napa County since 2017. As noted in the County's MJHMP, smoke and air pollution from wildfires can also be a severe health hazard and cause breathing difficulties or exacerbate existing illnesses, especially in sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire contains visible and invisible emissions that contain particulate matter, gases such as carbon monoxide and nitrogen oxides, and toxics such as formaldehyde and benzene. Long term impacts include but are not limited to respiratory health effects such as bronchitis and asthma, as well as cardiovascular health effects such as an increased risk of heart attacks and strokes. Mental health impacts including anxiety, depression and post-traumatic stress disorder can also result from wildfire events. Furthermore, individuals with access and functional needs and those with certain medical issues residing in healthcare facilities are also inherently vulnerable during wildfires resulting in evacuations. Additionally, first responders are exposed to the dangers of wildfire from direct incident response and after-effects from smoke inhalation and heat stroke.

Wildfires can also create hazardous conditions even after they are suppressed. Most notably, destructive debris flows triggered by intense precipitation are one of the most dangerous post-fire hazards, and the risk of debris flows is directly correlated with the degree of vegetation loss and soil exposure after a wildfire (USGS 2018). Post-wildfire debris flows can adversely impact the county in different ways, but the deadly impact it can have on human lives is notable. Moreover, wildfires can lead to water supply and soil contamination. 2021 research shows that when combined with extreme precipitation, a series of watershed effects from headwaters to areas downstream can be triggered post-fire. These post-fire watershed hazards via source water contamination, flash floods, and mudslides can represent substantial, systemic long-term risks to drinking water production, aquatic life, and socio-economic activity (Robinne et al. 2021). However, based on input received from the County and local agencies in the region, over the past seven years, the County and such agencies have been dedicated to removing post-fire contaminated soil and debris to remediate impacts.

Moreover, the County's MJHMP mentions that wildfire can negatively impact farmworkers because of the potential degradation of transportation infrastructure and the need to work outside at key times such as grape harvesting. Because many agricultural workers cannot afford to live in the county due to high housing costs and the lack of affordable housing, their access and mobility could be impaired and result in evacuation challenges. Additionally, outdoor agriculture workers may be exposed to wildfire smoke during the grape harvest, which also coincides with peak wildfire season in the fall months

Overall, the entire population of the county is vulnerable to the impacts of wildfire, both directly and indirectly, which may be exacerbated because of climate change. However, wildfires disproportionately impact vulnerable populations due to an array of factors, including health disparities, lower mobility (reduced access to vehicles or ability to pay for temporary housing) lower access to resources, which is exacerbated by language barriers, lower levels of internet access, and hesitancy to contact authorities for help from undocumented individuals because of fears regarding immigration status. Due to structural inequities, renters and lower-income homeowners are often limited in their ability to build or upgrade to fire-safe building codes and maintain defensible space and therefore, have higher rates of uninsured or underinsured homes and belongings lost in fires (OPR, CEC, and CNRA 2018b).

BUILT ENVIRONMENT

Increased wildfire risk in the county poses significant threats to the county's built environment, especially within WUI areas and the county's FHSZs. Based on the analysis carried out in the County's MJHMP, 64 percent of the residential parcels in the unincorporated county are in at least moderate or higher FHSZs. These parcels possess a total value of

almost $10 billion which makes up 53.8 percent of the total value of the residential parcels in the unincorporated county. According to input received from the County and local agencies in the region, over 1,350 homes and over 30 wineries with a property value loss of over $1.5 billion have been destroyed since 2017. In addition, many of the county's critical facilities are in high and very high FHSZs. For example, eight dams, 13 bridges, four residential elder care facilities, and four schools are in very high FHSZs. Moreover, nearly 180 miles of roadways and over 10 miles of transmission lines are in very high FHSZs. As mentioned in the Cal Fire Sonoma-Lake-Napa Unit 2023 Strategic Fire Plan, assets at risk of wildfire include homes, infrastructure including water and power supply, rivers and watersheds, air quality, soil, wildlife and associated habitats, recreation areas including tourist attractions, scenic beauty, historical buildings, cultural unique areas, and timber holdings (CAL FIRE 2023).

Wildfires may also impact transportation infrastructure in the county. For example, the California Department of Transportation (Caltrans) has identified portions of State Route (SR)29 within the county that will be exposed to increased risk of wildfire in future years (Caltrans 2018). Moreover, according to input received from the County and local agencies in the region, all of SR29 and SR128 north of Calistoga, all of SR121 and SR128 east of the City of Napa, and most of SR12 are in fire hazard severity zones as of April 2024. During the 2017 and 2020 wildfire events, fires burned all around SR29, SR128, and SR121. Wildfires crossed SR12 in 2017 and even crossed SR29 on the valley floor in 2020. While roadways and bridges typically sustain minimal to moderate damage during wildfire events, except in extreme scenarios, wildfires can create conditions that obstruct these assets through fallen trees, downed power lines, and other debris. This is particularly concerning for residents who are isolated in more rural areas that may not have many egress options during a wildfire-related evacuation. In addition to the obstruction of these assets, the cracking and degradation of pavement is another risk related to wildfires.

COMMUNITY FUNCTIONS

The increased risk and severity of wildfire through the end of the century has the potential to impact or disrupt the county's community functions. As mentioned previously, electric utilities can carry out PSPS events during severe weather events to prevent wildfire. When PSPS events happen, power will remain out for as long as extreme and dangerous conditions pose a potential fire risk and until utilities can inspect and repair power lines and equipment. Once utilities deem it safe to do so, power will be systematically restored. While PSPS events are meant to prevent the ignition of potentially widespread, devastating wildfires, vulnerable populations without alternate power options (e.g., low-income individuals, individuals requiring electric-powered medical devices) may be adversely impacted by the PSPS event itself (e.g., loss of air conditioning during extreme heat conditions). Similarly, wildfire-induced loss of power affecting fire stations, police stations, and emergency dispatch and medical services, but not necessarily a purposive PSPS event, could diminish emergency dispatching, communications, and response capabilities, especially when coupled with evacuation-related traffic congestion.

Wildfires can also have severe economic impacts and other impacts on community functions within the county. At a basic level, wildfires include the cost of fire suppression and disruptions to the consumption and production of local goods and services. These costs are expected to increase in the future parallel to increased wildfire risk. One of the county's pillar industries – the wine industry, tourism, and thousands of acres of vineyards, can be affected by wildfire, as noted in the County's MJHMP. In addition to the direct impacts such as loss of vineyards and property, indirect impacts can also occur. a temporary downturn in tourism is expected during wildfire events. For vineyards that are near fire-prone areas, smoke from wildfire can cause damage, particularly for red grapes, where the grape skin is still used in the winemaking process. Studies have shown that wildfire smoke can potentially infuse grape skin. Furthermore, wildfires can directly threaten vineyards, particularly at the start of harvest season. When wildfires occur, evacuation orders may leave certain vineyards inaccessible for a period. Without access, grapes may remain on the vine too long, exposing them to smoke and rendering them unsuitable for winemaking. Moreover, considering the feedback provided by the County and local agencies in the region, it is evident that the county's current housing supply is already under strain. Should wildfires occur with increased frequency and severity, this strain may intensify, leading to a further shortage of housing supply.

2.2.5 Increased Temperatures and Extreme Heat

POPULATIONS

Increased temperatures and extreme heat exacerbated by climate change are one of the primary health concerns in the county, and the entire population of the county will be exposed to this climate change effect. Across the state, including the San Francisco Bay Area and Napa County, extreme heat ranks amongst the deadliest of all hazards (CNRA 2022). Temperature-related mortality (including from extreme heat) is projected to be among the most deadly and costly impacts of climate change in certain locations around the globe. Higher temperatures and extreme heat can lead to heat stroke and increase the risk of or exacerbate cardiovascular disease, respiratory disease, kidney failure, and preterm births (LAO 2022). Non-fatal heat stroke, specifically, can result in severe mental status changes, seizures, loss of consciousness, and abnormal cardiac rhythm (Cal EPA and CDPH 2013). Additionally, extreme heat can exacerbate other pre-existing conditions in certain vulnerable populations, such as the medically fragile and chronically ill. Moreover, as noted by the Center of Climate and Energy Solutions (C2ES), in extreme temperatures, air quality is also affected. Hot and sunny days can increase the production of ground-level ozone, a harmful pollutant that is the main component of smog, which can damage the respiratory system and is particularly harmful for those with asthma (C2ES n.d.). This correlation between extreme heat and heightened levels of pollutants is locally substantiated by data from the Bay Area Air Quality Management District (BAAQMD) (BAAQMD 2017).

In more densely populated areas of the county such as incorporated cities, increased temperatures, and extreme heat can contribute to the urban heat island effect, which makes these areas comparatively hotter than surrounding areas due to the higher density of heat-absorbing structures and lack of green space. In addition to the heightened temperatures in these areas, the urban heat island effect creates conditions more conducive to the production of smog, ground-level ozone, and Particulate Matter ($PM_{2.5}$). Heatwaves in cities are projected to cause two to three times more heat-related deaths by mid-century (CNRA 2022). Air conditioning can alleviate some of the discomfort felt during periods of extreme heat and lower the risk of mortality, but many coastal areas across the San Francisco Bay Area, inclusive of areas within the county, lack air conditioning due to historically lower temperatures.

Overall, when it comes to increased temperatures and extreme heat, vulnerable populations will likely experience the worst impacts, as heat-related risk is associated with physical, social, political, and economic factors. Children, the elderly, pregnant people, and people with chronic illnesses can be especially sensitive to heat exposure. Combining these characteristics and existing health inequities with additional factors, such as poverty, linguistic isolation, and housing insecurity, can put individuals at disproportionately high risk of heat-related illness and death (CNRA 2022). Additionally, people who work long hours outdoors, such as those working in agriculture and transportation maintenance, among others, are at heightened exposure and risk to increased temperatures and extreme heat (Caltrans 2018).

BUILT ENVIRONMENT

Increasing temperatures and increased frequency of extreme heat events are likely to affect the county's built environment primarily through changes in energy use, as well as disproportionate impacts on individuals residing in units that do not have air conditioning. Cal-Adapt provides data on the shifts in Cooling Degree Days and Heating Degree Days, which are measurements used to assess the energy demand needed for cooling and heating buildings in different climate zones throughout California. A "degree day" does not equate to a single day of the year, but rather compares the average outdoor temperatures recorded for a location to a standard temperature (i.e., 65 °F). For example, if the average temperature for a day is 80 °F, the day has 15 Cooling Degree Days (80 – 65 = 15). Degree days are used in the State's Title 24 Building Energy Efficiency Standards to help design the energy demand needed for heating and cooling in the various climate zones throughout the state. To illustrate how climate change is likely to affect energy demand for heating and cooling in the future, Table 10 includes the relative shift in Cooling Degree Days and Heating Degree Days in the county through 2099. As displayed, the county is projected to have decreases in Heating Degree Days and relatively significant increases in Cooling Degree Days through the end of the century, most notably with a 243.4 percent increase in Cooling Degree Days in the long-term under RCP 8.5 (CEC 2024h). These projections

for the county correlate to an overall significant increase in cooling costs through the end of the century, with a slight decrease in heating costs, which can potentially be due to warmer winters. Additionally, apart from projected changes in building energy use, increased temperatures can add to the heat load of buildings in more densely populated areas and can therefore worsen existing urban heat island effects, adding to the risk of extreme heat.

Table 10 Changes in Heating and Cooling Degree Days in Napa County

Annual Averages	Historic (1961-1990)	Near-Term[1] (current-2050)	Mid-Term[1] (2040-2069)	Long-Term (2070-2099)	
				RCP 4.5	RCP 8.5
Number of Heating Degree Days	3,379	2,580	2,278	2,274	1,761
Percent Change in Heating Degree Days from Historic	N/A	-23.6%	-32.6%	-32.7%	-47.9%
Number of Cooling Degree Days	572	1,115	1,395	1,375	1,964
Percent Change in Cooling Degree Days from Historic	N/A	+94.9%	+143.9%	+140.4%	+243.4%

Notes: RCP = Representative Concentration Pathway.

[1] Projections for the near-term and mid-term timescales are based on RCP 8.5.

Source: CEC 2024h.

In addition to the impacts of increased temperatures and extreme heat on buildings and energy use, transportation systems will also be affected. Transportation infrastructure is designed and constructed to withstand certain variabilities in weather and temperature based on observations of historical weather trends for specific climate regions. The performance of transportation infrastructure may begin to decline when the severity of extreme heat periods exceeds historical ranges. For example, extreme heat may cause pavement discontinuities and deformation, an increase in the risk of buckling of highways and railroad tracks, and may cause premature deterioration of transportation infrastructure, decreasing transportation safety and creating higher maintenance costs (Caltrans 2018). Air conditioning units in buses are placed under increased stress and risk of failure when maximum daily temperatures reach 100 °F, which is a temperature threshold that certain areas of the county may exceed more frequently over time according to Cal-Adapt (Cambridge Systematics 2015). Further, while bridges are designed to expand during periods of extreme heat, projected increases in extreme heat events could go beyond design criteria, resulting in cracking and crushing of the roadway deck, as well as increased maintenance costs (Transportation Research Board 2008).

COMMUNITY FUNCTIONS

Increased temperatures and extreme heat may increase the risks to the county's community functions. Similar to and connected with increased wildfire risk, increased temperatures and extreme heat can trigger a PSPS event, which can adversely affect vulnerable populations without alternate power options (e.g., greater risk of the development of heat-related illnesses due to inaccessible air conditioning) and could potentially disrupt emergency dispatching, communications, and response capabilities. Agriculture in the county could be significantly impacted by extreme heat, especially when coupled with drought. The county's overall labor availability can be restricted due to extreme heat. Moreover, higher temperatures can lead to increased evaporation rates of surface water and increased evapotranspiration in plants, resulting in decreased soil moisture content and increased demand for irrigation. For the county's wine industry, in particular, recent research in 2023 shows that the growing season start and duration, along with other temperature-related measures of importance to premium wine grapes in Napa Valley have changed as the climate over the western United States has warmed. Vintners and farmers will need to carefully monitor the climate, especially during certain times of the year, like the harvest, when temperatures are vital (Cayan et al. 2023). Furthermore, increased temperatures and extreme heat could result in many residences, schools, and businesses needing to add air conditioning systems and remodel any outdoor facilities (e.g., playgrounds) with more heat-resistant materials, despite financial barriers that may exist (LAO 2022).

2.2.6 Extreme Precipitation, Sea Level Rise, and Flooding,

POPULATIONS

The populations that will likely be most directly affected by extreme precipitation and flooding in the county are those that reside in the county's 100- and 500-year floodplains. According to the County's MJHMP, in the unincorporated county, 3,785 and 284 residents reside in 100- and 500-year floodplains respectively. This represents approximately 11.1 percent and 1 percent of the unincorporated county population, respectively (Napa County 2020). Additionally, related but separate from the county's populations that reside in floodplains are the populations that are at direct risk of coastal flooding and inundation resulting from sea level rise. As noted in the County's MJHMP, less than one percent of the County's population is considered at risk and vulnerable to sea level rise. However, as sea levels rise, the area and the number of people at risk because of flooding will rise. Depending on the severity of a flooding event, populations may be displaced or lose their homes and livelihoods, in addition to the risk of injuries and even death. Moreover, flooding can result in the overflow of sewage systems or hazardous waste site infiltration, which may create conditions that release contaminants and promote water- and food-borne diseases. (OPR, CEC, and CNRA 2018b).

All residents and visitors of the county may be sensitive to extreme precipitation and flooding. Vulnerable population groups will likely face disproportionate negative impacts to extreme precipitation and flooding, especially in the context of climate change. In addition to lacking adequate shelter and protection from these events, individuals experiencing homelessness, along with some broader county communities, may have limited access to warning messages and other pertinent information from the County and other public health and safety agencies. The elderly and individuals with access and functional needs may also face these challenges and are likely to have limited mobility and ability to react to and prepare for these events. For low-income individuals, risks of isolation and lost resources are elevated during flooding events. Because these residents have a lower rate of car ownership than the general population, they are heavily reliant on public transportation and frequently have limited mobility during extreme weather events and emergencies (OPR, CEC, and CNRA 2018b). Other vulnerable populations to extreme precipitation and flooding in the county include communities of color, linguistically isolated communities, children, and the elderly.

BUILT ENVIRONMENT

When it comes to flooding- and extreme precipitation-related impacts on the county's built environment, residential property is notably at risk, especially homes that lie within the county's floodplains or are at risk of sea level rise. As discussed in the County's MJHMP, within the unincorporated county, 7.5 percent of the total parcels are located in 100-year or 500-year floodplains. These parcels possess a total value of almost $1.7 billion, which makes up 9.2 percent of the unincorporated county's total parcel value. In addition, much of the county's critical infrastructure is at direct risk from flooding. A total of 100 facilities are located in 100-year or 500-year floodplains, including but not limited to two fire stations and 56 bridges. Over 180 miles of linear utilities are also exposed to 100-year or 500-year flood events, including over 60 miles of streets. Regarding sea level rise, the southwestern portion of the county includes the mouth of the Napa River, which forms a tidal estuary that drains into San Pablo Bay. Because several physical structures (i.e., levees) are currently in place to protect against a 100-year flood event, approximately 36 acres in the county are currently at risk for flooding. Taking a 1.5 m (4.9 feet) rise in sea level into account however, along with other storm factors, it is projected that an additional 13,000 acres could be inundated by a 100-year flood event (Napa County 2020).

Extreme precipitation events are often followed by flash floods, landslides, mudslides, and debris flows. These hazards can impact roadways within the county. In general, bridges and certain roadways often provide the only ingress and egress to some neighborhoods, while these facilities can be exposed to flooding events. Moreover, flooding-related disruption of the transportation network may reduce the capacity of individuals to evacuate or access hospitals and other health-related infrastructure in the event of an emergency and can prevent emergency services providers from reaching vulnerable populations or making necessary repairs (OPR, CEC, and CNRA 2018b). Meanwhile, local bus routes and bus stops can be directly affected.

Critical facilities such as electric distribution lines, pipelines, and public buildings are also at direct risk of flooding-induced scouring, which is the removal of sediment, such as sand and gravel, caused by swiftly moving water and compromising the integrity of a structure. The projected increases in annual precipitation will increase the vulnerability of these structures in the future. Flooding-related disruptions can also occur within power and fuel distribution networks, as well as water delivery or wastewater treatment systems, which can create substantial risks to public health depending on the length of the disruption (OPR, CEC, and CNRA 2018b). Flooding can cause underground utilities, along with water and sewer systems, to be damaged, or otherwise adversely affected via high inflow and infiltration. If drainage systems or culverts are backed up by floodwaters, pronounced localized flooding can occur. Furthermore, floodwater may infiltrate drinking water supplies, causing contamination. Facilities that are known to manufacture, process, store, or use hazardous materials, such as fuel stations, could also be damaged during flooding events. If damaged, these facilities, or containers holding these materials, can release chemicals that are carcinogenic, or otherwise detrimental to human health and the environment. Furthermore, seawater backflow resulting from coastal flooding can impair coastal sanitation drainage systems during flood events, requiring costly upgrades and alterations.

COMMUNITY FUNCTIONS

Heightened extreme precipitation and flooding can result in impacts on an array of community functions. Flooding may have adverse impacts on businesses (e.g., revenue loss due to closures) and public agency budgets. Increased direct and indirect costs associated with flood mitigation services, clean-up operations, and maintenance and replacement of damaged structures and infrastructure could put considerable strain on local and regional government budgets. If floods cause sustained closures of major roadways, in addition to limited transportation and mobility, there is an array of community functions that may result in limited access, including access to essential services (e.g., grocery stores) and emergency services (e.g., emergency response inhibited by damaged roads). These impacts can also persist, especially if funding for maintenance and repair is limited. The County's MJHMP also notes that while the Napa County Airport itself is not at immediate risk for inundation from coastal flooding due to 1.5 m (4.9 feet) sea level rise, adjacent areas to the west including communities along Milton Road are at increased risk of flooding due to sea level rise. Based on input received from the County and local agencies in the region, high wind events can also worsen the situation of such coastal flooding events.

Flooding events resulting in disruption of communications, utilities (e.g., energy, water, sewage), and related delivery of services, excessive expenditures for emergency response, and general disruption of the normal functions across the county can result in severe economic losses. Additionally, tourism opportunities can be adversely affected by major flood events, as some popular destinations (e.g., wine-tasting spots) tend to overlap with the county's floodplains and areas that are prone to sea level rise and coastal inundation. The ramifications of these effects can be enduring. Once an area gains notoriety in the media for having endured a disaster such as a disastrous flooding event, it can require years of effort to assure people that recovery has occurred and that it is safe and inviting to return. The agricultural sector is also at increased risk of flooding induced by extreme precipitation events, especially as these events become more common because of climate change. The increased likelihood of extreme floods could lead to the destruction of crops, erosion of topsoil, and deposits of debris and sediment on croplands.

2.2.7 Drought and Water Supply

POPULATIONS

As discussed in the County's MJHMP, drought is one of the few hazards with the potential to impact the entire population of Napa County directly or indirectly, be it from water restrictions, higher water and food prices, reduced air or water quality, or restricted access to recreational areas. No portion of the county is immune from drought conditions. The residents of the county rely on healthy watersheds to provide water for domestic and agricultural purposes as well as to support the existence, use, and enjoyment of natural resources. Water shortages during periods of drought can affect access to safe and relatively affordable water, with notably substantial impacts on low-income individuals and communities otherwise burdened with environmental pollution.

BUILT ENVIRONMENT

The built environment in the county will not experience substantial direct impacts associated with drought. However, when combined with other climate stressors, prolonged drought conditions in the future have the potential to cause secondary impacts. For example, heavy precipitation following periods of drought can cause intense flooding, debris flows, landslides, and mudslides. Also, wildfire events are more likely to happen following years of drought. Moreover, according to input received from the County and local agencies in the region, if the severity and geographical extent of subsidence hazard increases in the county in the future, it can also be exacerbated by prolonged drought conditions.

As noted in the County's MJHMP, drought eventually affects groundwater sources but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate, which can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater also affects streams because much of the flow in streams comes from groundwater, especially during the summer when there is less. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

COMMUNITY FUNCTIONS

Drought will significantly impact community functions across the county. For one, the county's agricultural sector and wine industry are especially vulnerable to drought conditions, with the most notable consequences directly related to water availability for crop irrigation. A decrease in water availability could greatly reduce crop yields and overall levels of production in the county and across the San Francisco Bay Area, especially when coupled with extreme heat. Higher soil erosion exacerbated by drought can also decrease agricultural production. Particularly dry soil conditions resulting from low stream flow and groundwater levels can increase the risk of wildfires, another threat to agricultural production. The above factors can lead to higher consumer costs for agricultural products, loss of income for the supply chain, and can reduce regional food security . As noted in the County's MJHMP, the local wine industry and related businesses provide an annual economic impact of more than $9.4 billion locally and nearly $34 billion in the United States. The industry also creates 44,000 jobs in Napa County and nearly 190,000 nationwide. The direct and indirect impacts of drought on the wine industry can be significant.

In addition to agriculture, drought may affect other local businesses and economic sectors. The most significant economic impacts will likely be on industries that use or depend on water for their business or sector. Any water-use restrictions during times of drought can directly impact smaller-scale businesses that provide water-related services (e.g., power-washing). Essential product costs that increase because of drought (e.g., agricultural and energy products) can potentially discourage and reduce discretionary consumer spending in other industries, such as entertainment, dining, and retail. Recreational activities in the county can be diminished as a loss of aquatic species, lower stream flows, increased evapotranspiration, and reduced reservoir and lake level flows lead to less fishing, kayaking, and hiking, among other activities. Overall shifts in the county's economic sectors because of drought can lead to unemployment, increased risk for financial institutions, capital shortfalls, and loss of tax revenue.

Drought can also result in adverse environmental effects. Some effects are short-term, where conditions quickly return to normal following a drought, but others can be long-term, lingering for long periods of time or even becoming permanent. For example, wildlife habitat may be degraded because of drought through the loss of wetlands, lakes, and vegetation, but many species will eventually recover. However, the drought-induced degradation of landscape quality, including decreased soil moisture and high levels of soil erosion, may lead to a more permanent loss of biological productivity. Additionally, drought can influence tree mortality and result in the loss of tree canopy, which in more densely populated areas of the county, can heighten the urban heat island effect. The loss of urban tree canopy can have impacts on the county's overall public health, property values, as well as ecosystem functioning. Furthermore, low streamflow, higher temperatures, and degraded water quality during times of drought can affect aquatic ecosystems, as well as terrestrial wildlife that rely on surface water, floodplains, wetlands, marshes, and surrounding soil and vegetation.

2.2.8 Energy Grid

POPULATIONS

The impacts of climate change on the energy grid can have significant impacts on the population, affecting various aspects of daily life, public safety, and economic stability. Power outages and disruptions can disrupt daily activities, affecting homes, businesses, and essential services that rely on a consistent power supply. Extended power outages can also pose health and safety risks, especially for vulnerable populations such as the elderly, individuals with medical conditions, and those dependent on medical equipment. Lack of power can impact healthcare facilities, hindering medical services and emergency response capabilities. These vulnerabilities were also discussed in detail under other climate change effects such as increased temperature and extreme heat. Moreover, modern communication relies heavily on electricity. Power outages can disrupt communication systems, hindering emergency alerts, public announcements, and the ability of individuals to contact emergency services or critical contacts.

BUILT ENVIRONMENT

As discussed previously under other climate change effects, critical infrastructure such as power plants, substations, and transmission lines are vulnerable to damage from wildfire, flooding, and extreme weather events. Impacts on the energy grid can result in physical damage, leading to costly repairs, and disruptions in essential services. Critical services in the built environment, such as hospitals, emergency services, water treatment plants, and communication networks, rely on a reliable resilient energy grid. Grid failures can disrupt these services, compromising public safety and well-being. Meanwhile, many buildings utilize advanced energy management systems for heating, ventilation, air conditioning (HVAC), and lighting. Impacts on the energy grid can affect these systems, leading to discomfort for occupants and potential damage to sensitive equipment. Furthermore, grid reliability concerns may necessitate retrofits and upgrades to existing infrastructure to improve grid resilience, as well as investments in alternative power, such as battery storage and generators for solar power. This can be a costly process and may require careful planning to minimize disruptions during construction.

COMMUNITY FUNCTIONS

The failure of the energy grid can be disastrous to the local economy. Commercial and industrial buildings depend on a reliable power supply for operations. Energy grid impacts can lead to business interruptions, affecting manufacturing, production, and other economic activities. This can result in financial losses and impact the overall economic health of a region. Also, modern urban environments increasingly rely on smart technologies for energy management, transportation, and communication. Grid impacts can disrupt these systems, affecting the efficiency and functionality of smart technologies. Moreover, urban planning efforts, including the design of energy-efficient buildings and sustainable neighborhoods, can be hindered by energy grid impacts. Unreliable power sources may limit the feasibility of certain sustainable technologies and strategies. Furthermore, energy grid impacts can challenge the ability of communities to adapt and recover from disruptions, impacting the long-term sustainability and livability of the community.

2.2.9 Summary of Sensitivity and Potential Impacts

Based on guidance from the APG, potential impacts from each climate change effect are rated on a qualitative scale of Low, Medium, or High. A description of each qualitative rating for potential impacts is provided in Table 1 at the beginning of Section 2.

The potential impacts rating for each climate change effect that is anticipated to impact the county is shown in Table 11. This evaluation is based on the exposure analysis and analysis of sensitivities and impacts discussed in the previous sections.

Table 11 Potential Impacts Summary

Climate Change Effect	Potential Impacts Rating
Increased Wildfire Risk	High
Increased Temperatures and Extreme Heat	High
Extreme Precipitation, Sea Level Rise and Flooding	Medium
Drought and Water Supply	High
Energy Grid Resiliency	Medium

Source: Ascent 2024.

2.3 ADAPTIVE CAPACITY

The third step in the VA process is to evaluate the adaptive capacity of the populations, built environment, and community functions to adjust to climate change effects and their associated potential impacts. Adaptive capacity refers to a community's current and future ability to address climate-related impacts. A review of the County, County jurisdictions, and local agencies' existing policies, plans, programs, and resources, as well as those from relevant regional and State agencies and organizations, informed this assessment of the County, County jurisdictions, and local agencies' current ability to minimize vulnerability to hazards and adapt to climate change over the long-term. While there is some level of existing adaptive capacity, these efforts do not comprehensively identify all strategies and actions that will need to be implemented by the County and other local agencies to adequately address the full scope and magnitude of potential impacts from climate change. Climate change will increase the frequency and severity of some hazards in the future, requiring updates to emergency response and land use planning, new policies and programs, and new strategic partnerships.

2.3.1 Existing State, Regional, and Local Planning Efforts

This section summarizes current State, regional, and local planning efforts that address climate-related hazards. It should be noted that though this section is comprehensive, it is not exhaustive, as additional policies, plans, programs, and resources may be available that address climate-related hazards within the county.

2017 CLEAN AIR PLAN: SPARE THE AIR, COOL THE CLIMATE

Prepared by BAAQMD, the *2017 Clean Air Plan: Spare the Air, Cool the Climate* (Clean Air Plan) encompasses the entire San Francisco Bay Area, inclusive of Napa County, and focuses on two closely related goals, which include protecting public health and protecting the climate. The Clean Air Plan describes a multi-pollutant strategy to simultaneously reduce emissions and ambient concentrations of ozone, $PM_{2.5}$, toxic air contaminants, as well as GHGs that contribute to climate change. Additionally, it describes a vision for a thriving region with clean air, a stable climate, a robust natural environment, and a prosperous and sustainable economy (BAAQMD 2017).

ADAPTING TO RISING TIDES, BAY AREA: REGIONAL SEA LEVEL RISE VULNERABILITY AND ADAPTATION STUDY

Prepared in March 2020, *Adapting to Rising Tides, Bay Area: Regional Sea Level Rise Vulnerability and Adaptation Study* (ART Bay Area Report) presents a story of what consequences the San Francisco Bay Area may face as sea levels rise in the absence of coordinated, prioritized adaptation efforts. The ART Bay Area Report represents a commitment by many agencies to proactively manage the functionality and sustainability of critical regional assets in an uncertain future, and it speaks directly to the San Francisco Bay Area's most critical regional transportation and land use plan, *Plan Bay Area 2050* (ART 2020).

CAL FIRE SONOMA-LAKE-NAPA UNIT: 2023 STRATEGIC FIRE PLAN

This Strategic Fire Plan strives for the highest level of fire protection in Colusa, Lake, Napa, Solano, Sonoma, and Yolo counties through constant evaluation of fire problems. The Strategic Fire Plan aims to educate and participate with communities to evaluate fire prevention concerns and exposure, as well as collect data for proper record keeping, to analyze historical values, to benefit from trends associated with weather patterns, fuel contents, and project responsibility within the Strategic Fire Plan. The Strategic Fire Plan will also monitor the effectiveness of Unit programs, projects, and initial fire suppression successes, as well as identify and improve areas of WUI (CAL FIRE 2023).

CALIFORNIA'S FOURTH CLIMATE CHANGE ASSESSMENT: SAN FRANCISCO BAY AREA REGION REPORT

As described in Section 1.4.2, "California's Fourth Climate Change Assessment," the SFBA Report, published in January 2019, is one of a series of nine regional climate vulnerability assessments in California that provides an overview of region-specific climate science and anticipated climate-related changes, specific strategies to adapt to climate impacts, and key research gaps needed to safeguard the region from climate change. The SFBA Report breaks down regional vulnerability by ecosystems and biodiversity, water resources, and communities and provides adaptation strategies applicable to the county (OPR, CEC, and CNRA 2018b).

CALTRANS CLIMATE CHANGE VULNERABILITY ASSESSMENTS: DISTRICT 4 TECHNICAL REPORT

The *Caltrans Climate Change Vulnerability Assessments: District 4 Technical Report* (District 4 Report) was developed in 2018 for Caltrans and summarizes the climate change-specific vulnerabilities of the portion of the State Highway System located in Caltrans District 4, which encompasses the county. The report is divided into sections by climate stressor (e.g., wildfire, temperature, precipitation) and each section presents how that climate stressor is changing, the data used to assess State Highway System vulnerabilities from that stressor, and the methodology for how that data was developed. Additionally, the District 4 Report outlines a recommended framework for prioritizing projects that might be considered by Caltrans in the future (Caltrans 2018).

CITY OF NAPA 2020 URBAN WATER MANAGEMENT PLAN

The City of Napa *2020 Urban Water Management Plan* (UWMP) assesses the availability and reliability of City of Napa's water supplies and current and projected water use to help ensure reliable water service under different conditions, which is critical in the context of climate change and further development and growth. The UWMP is required to be updated every five years under the Urban Water Management Planning Act. The City of Napa sells and distributes treated water to individual water users such as residences and businesses. The City provides water to more than 25,000 customer accounts and a population of more than 85,000. The City serves drinking water to an area encompassing much of the lower Napa Valley and extending up to the foothills on the east and west sides of the valley. In addition, the City exports water to the City of American Canyon, the City of St. Helena, the City of Calistoga, the Town of Yountville, and the California Veterans Home (City of Napa 2022a).

CITY OF NAPA 2022 WATER SHORTAGE CONTINGENCY PLAN

This *2022 Water Shortage Contingency Plan* (WSCP) describes the City of Napa's strategic plan for preparing for and responding to water shortages, including defining water shortage stages and associated shortage response actions. This WSCP provides a guide for the City to proactively prevent catastrophic service disruptions and has been updated to be consistent with the 2018 Water Conservation Legislation requirements. The WSCP includes a water supply reliability analysis and specifies demand reduction actions that correspond to six standard water shortage levels. The WSCP also includes information on communication protocols that the City uses to inform its customers and other interested parties in the event of a water shortage (City of Napa 2022b).

CITY OF NAPA HAZARD MITIGATION PLAN (2021)

The City of Napa Local Hazard Mitigation Plan (LHMP) encompasses approximately 18.2 square miles and covers 11,650 acres. Similar to the County's MJHMP, the goal of the City's LHMP is to identify and profile the broad array of hazards (including those examined in this VA) that face the LHMP planning area (Napa city limits), assess risks posed by those hazards, and develop prioritized strategies to reduce those risks. The City's LHMP also meets the requirements of the Disaster Management Act of 2000 (City of Napa 2022c).

CLIMATE CHANGE AND HEALTH PROFILE REPORT: NAPA COUNTY

Primarily produced by the California Department of Public Health (CDPH), the *Climate Change and Health Profile Report: Napa County* (CCHPR) seeks to provide a county-level summary of information on current and projected risks from climate change and potential health impacts. The CCHPR represents a synthesis of information on climate change and health for communities based on published reports of State agencies and other public data. It is part of a suite of tools developed by CDPH to support local, regional, and statewide efforts of the public health sector to address the challenges of climate change (CDPH 2017).

NAPA COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

The Napa Communities Firewise Foundation (NCFF) completed a new county-wide Community Wildfire Protection Plan (CWPP) in 2021 that serves as a roadmap for fire hazard mitigation and preparedness at both county-wide and neighborhood levels. The CWPP aligns with the County, CAL FIRE, and federal cohesive pre-fire strategies, which include educating homeowners and building an understanding of wildfire, ensuring defensible space clearing and structure ignition resistance, safeguarding communities through fuel treatment, and protecting evacuation corridors. The CWPP also identifies and prioritizes areas for hazardous fuel-reduction treatment, recommends the types and methods of treatment that will reduce damages from wildfire, and recommends measures to reduce the ignitability of structures throughout unincorporated areas of Napa County (NCFF 2021).

NAPA COUNTY DROUGHT RESILIENCE PLAN

CURRENTLY UNDER DEVELOPMENT, THE NAPA COUNTY DROUGHT RESILIENCE PLAN (DRP) IS BEING DEVELOPED IN RESPONSE TO SENATE BILL (SB) 552 TO PROVIDE RESOURCES FOR COUNTY STATE SMALL WATER SYSTEMS (SSWS) AND DOMESTIC WELLS USERS THAT EXPERIENCE WATER SHORTAGE CAUSED BY DRY WELLS OR CONCERNS ABOUT WATER SUPPLY OR WATER QUALITY DURING TIMES OF PROLONGED DROUGHT. SB 552 WAS SIGNED INTO LAW IN SEPTEMBER 2021 BY GOVERNOR GAVIN NEWSOM AS *DROUGHT PLANNING FOR SMALL WATER SUPPLIERS, STATE SMALL WATER SYSTEMS, AND DOMESTIC WELL COMMUNITIES*. TO MEET AND COMPLY WITH SB 552, THE COUNTY FORMED A DROUGHT AND WATER SHORTAGE TASK FORCE (TASK FORCE), WHICH IS COMPRISED OF LOCAL COUNTY REPRESENTATIVES, OWNERS OF INDIVIDUAL DOMESTIC WELLS AND INTERESTED PARTIES. THE DRP WILL DESCRIBE ACTIONS WHICH CAN BE TAKEN TO ASSIST OWNERS OF INDIVIDUAL DOMESTIC WELLS THAT GO DRY AS A RESULT OF DROUGHT. A FINAL DRP IS EXPECTED IN 2025.

NAPA COUNTY EXTREME TEMPERATURE EMERGENCY RESPONSE PLAN (2019)

Prepared by the Napa County Health and Human Services Agency (HHSA), this Plan intends to establish a system for identifying potential extreme temperature events, establish a mechanism for coordinating response to such an event, and provide decision-makers with options that can be used to prepare and respond to extreme temperature events. The Plan

uses a three-phase approach to extreme temperature emergencies consistent with the State of California's contingency plans for extreme cold and excessive heat emergencies. The three phases are seasonal readiness, warning and preparation, and emergency response. Moreover, the Plan delineates detailed response actions, including both activities and the responsible entities, that are designed to respond to extreme heat events during all three different phases (HHSA 2019).

GENERAL PLAN SAFETY ELEMENTS

The purpose of a general plan safety element is to reduce the risk of death, injury, property damage, environmental damage, and economic and social dislocation associated with natural and human-caused hazards. Safety elements are included in the general plans of all jurisdictions in the county. These safety elements address existing hazards, including drought, flooding, severe weather, and wildfire, which are also addressed in this VA, and provide goals and policies to address these hazards. As noted in Section 1.3 (Regulatory Setting), some of the local safety elements have been updated to address SB 379 climate adaptation requirements.

NAPA COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN (2020)

The development of the MJHMP was a collaborative effort by the County, City of American Canyon, City of Calistoga, City of St. Helena, Town of Yountville, Napa County Flood and Water Conservation District, Napa County Office of Education, Napa Valley College, and Howell Mountain Mutual Water Co. The planning area for the MJHMP is the entire area within Napa County. Note that the City of Napa was not a participating jurisdiction of the MJHMP. The goal of the MJHMP is to identify and profile the broad array of hazards (including those examined in this VA) that face the MJHMP planning area, assess risks posed by those hazards, and develop prioritized strategies to reduce those risks. The MJHMP meets the requirements of the Disaster Management Act of 2000 (Napa County 2020).

SAN FRANCISCO BAY AREA INTEGRATED REGIONAL WATER MANAGEMENT PLAN

The *San Francisco Bay Area Integrated Regional Water Management Plan* (IRWMP), most recently updated in October 2019, aims to improve water supply reliability, protect water quality, manage flood protection, and protect habitat and watershed resources across the nine-county region, inclusive of Napa County. The Bay Area IRWMP provides a valuable venue for regional collaboration across agencies to improve responsiveness to regional needs and priorities, helps to effectively integrate water resources management activities, and serves as a platform to secure state and federal funding (IRWMP 2019).

SAN FRANCISCO BAY SHORELINE ADAPTATION ATLAS – WORKING WITH NATURE TO PLAN FOR SEA LEVEL RISE USING OPERATIONAL LANDSCAPE UNITS

As the climate continues to change, San Francisco Bay shoreline communities will need to build social and ecological resilience to rising sea levels. Given the complex and varied nature of the Bay shore, a science-based framework is essential to identify effective adaptation strategies that are appropriate for their particular settings and that take advantage of natural processes. This report proposes such a framework—Operational Landscape Units (OLU) for San Francisco Bay. The framework provided in this report divides the Bay shoreline into 30 OLUs—connected geographic areas that share common physical characteristics and that would accordingly benefit from being managed as individual units. A key purpose of the OLU framework is to identify where nature-based approaches, such as beaches, marshes, and subtidal reefs, can help create a resilient shoreline with multiple benefits. Napa County belongs to the Napa-Sonoma OLU (SFEI and SPUR 2019).

SUMMARY OF EXISTING PLANS AND REPORTS

Table 12 identifies the specific climate change effects covered under each of the plans and reports presented above. As shown in the table, multiple planning efforts address the climate-related impacts that are expected to affect the county. Most of the policies provided in existing plans are broad-based strategies to reduce risk from climate change.

Thus, it is important to note that an emphasis on specific and targeted policies should continue to be developed to improve the resilience of the most vulnerable populations and assets in the county.

Table 12 Summary of Existing Plans and Reports

Plan or Report	Prepared By	Climate Change Effects				
		Increased Wildfire Risk	Increased Temperatures and Extreme Heat	Extreme Precipitation, Sea Level Rise and Flooding	Drought and Water Supply	Energy Grid Resiliency
2017 Clean Air Plan: Spare the Air, Cool the Climate	BAAQMD	✓	✓		✓	
Adapting to Rising Tides, Bay Area: Regional Sea Level Rise Vulnerability and Adaptation Study	BCDC			✓		
CAL FIRE Sonoma-Lake-Napa Unit: 2023 Strategic Fire Plan	CAL FIRE	✓			✓	
California's Fourth Climate Change Assessment: San Francisco Bay Area Region Report	OPR, CEC, and CNRA	✓	✓	✓	✓	
Caltrans Climate Change Vulnerability Assessments: District 4 Technical Report	Caltrans	✓	✓	✓		
City of Napa 2020 Urban Water Management Plan	City of Napa			✓	✓	
City of Napa 2022 Water Shortage Contingency Plan	City of Napa				✓	
City of Napa Hazard Mitigation Plan (2021)	City of Napa	✓	✓	✓	✓	
Climate Change and Health Profile Report: Napa County	CDPH	✓	✓	✓	✓	✓
Napa County Community Wildfire Protection Plan	NCFF	✓				
Napa County General Plan Safety Element	County	✓	✓	✓	✓	✓
Napa County Multi-Jurisdictional Hazard Mitigation Plan (2020)	County	✓	✓	✓	✓	
Napa County Extreme Temperature Emergency Response Plan	HHSA		✓			
Napa Valley Drought Contingency Plan	County				✓	
San Francisco Bay Area Integrated Regional Water Management Plan	Collaborative Effort; No Distinct Author			✓	✓	
San Francisco Bay Shoreline Adaptation Atlas – Working with Nature to Plan for Sea Level Rise Using Operational Landscape Units	SFEI & SPUR			✓		
Napa County Emergency Operations Plan	County	✓	✓	✓	✓	

Notes: BAAQMD = Bay Area Air Quality Management District; BCDC = Bay Conservation and Development Commission; CAL FIRE = California Department of Forestry and Fire Protection; Caltrans = California Department of Transportation; County = Napa County government; CDPH = California Department of Public Health; HHSA: Napa County Health and Human Services Agency; NCFF: Napa Communities Firewise Foundation; OPR, CEC, and CNRA = California Governor's Office of Planning and Research, California Energy Commission, and California Natural Resources Agency; SFEI & SPUR: San Francisco Estuary Institute & San Francisco Bay Area Planning and Urban Research Association.

Source: Ascent 2024.

The following sections, organized by climate change effect, provide a snapshot of current adaptive efforts in place to address the impacts of climate change, and thus, may not represent the entirety of adaptive efforts. These evaluations serve to analyze and ultimately score adaptive capacity related to each climate change effect. Based on a combination of the adaptation initiatives outlined in the documents described above and additional adaptive efforts that have been pursued, the County, County jurisdictions, and local agencies' adaptive capacity for each climate change effect can be rated "Low," "Medium," or "High." High adaptive capacity indicates that sufficient measures are already in place to address the points of sensitivity and impacts associated with climate change, while a Low score indicates a community is unprepared and requires major changes to address hazards. Adaptive capacity ratings are defined in Table 2.

2.3.2 Adaptive Efforts Related to Increased Wildfire Risk

The three primary documents/resources that highlight wildfire adaptive efforts carried out by the County and local agencies in the region are the CAL FIRE Sonoma-Lake-Napa Unit: 2023 Strategic Fire Plan, the Napa County CWPP, and the Napa CWPP Hub Site, which are discussed further below.

CAL FIRE SONOMA-LAKE-NAPA UNIT: 2023 STRATEGIC FIRE PLAN

The Sonoma-Lake-Napa Unit (LNU) has primary responsibility for more than 2 million acres of CAL FIRE Direct Protection Area (DPA) lands. LNU has the third largest population living within CAL FIRE DPA, and also has had the largest number of reported total acres burned. LNU also has the largest SRA in the state. Regarding pre-fire management priorities and tactics, it is noted in the Strategic Plan that LNU prioritizes projects that enhance life safety, reduce ignition and fire spread, and improve structure resilience over any projects that address tactical containment and control of wildfires. LNU project priorities include the following six categories: (1) public arterial and collector road fuel reduction projects; (2) supporting defensible space and home hardening efforts; (3) WUI community fuel breaks; (4) landscape-level fuel reductions; (5) emergency responder incident response planning and ingress progress; (6) tactical ridgetop fuel breaks. Moreover, the Strategic Plan mentions that each year LNU updates programs, trainings, curriculums, and tech services to accommodate their personnel and improve resources and suppression efforts, which are discussed in the Strategic Plan in detail. Furthermore, the Plan notes that the need for accurate and thorough investigations on ignitions and initial attack successes is a priority for LNU (CAL FIRE 2023).

NAPA COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

The CWPP intends to serve as a companion to the Napa Firewise Hub Site compiled by the NCFF (see the next heading below). The CWPP aggregates projects from individual community-level Fire Safe Councils (FSCs) and other interested parties county-wide that address community engagement and education, fuel management, installation of address signs, and more. The priorities for this Napa County CWPP are evacuation corridors and containment, community perimeter fuel break and forest health projects, projects that protect drinking water, critical infrastructure and landscape-scale projects, and all other projects that are focused on life safety, property damage reduction, and natural resources preservation. Furthermore, these projects are organized into an Action Plan that sets the stage for implementation. There are five major categories of projects in the Action Plan: 1. Fuel management, 2. Wildfire response support, 3. Community education and outreach; 4. Critical infrastructure; and 5. Planning. The CWPP and Action Plan contain tables that show the project types of these five categories, respectively. Project details are also further included in the CWPP.

The City of Napa is currently developing a CWPP in 2024 that is specific to the City of Napa.

NAPA COUNTY COMMUNITY WILDFIRE PROTECTION PLAN HUB SITE

This website presents information as part of the Napa County CWPP spearheaded by the NCFF. In addition to the CWPP report itself, the related priority projects and Action Plan, which are mentioned above, this hub site also contains various GIS-based products (ArcGIS StoryMaps, interactive mapping platform, etc.) where users can dive into the details of the proposed CWPP projects, as well as the wildfire hazard and risk assessment that NCFF carries out for the county. Users can also download the geodatabase of all the projects identified in the CWPP, as well as other data layers shown in the hub site from the site, for further exploration on their own. This hub site can be accessed via this link: https://cwpp-napafirewise.hub.arcgis.com/.

OTHER EFFORTS

In addition to the CAL FIRE Strategic Fire Plan and the County's CWPP as foundational wildfire planning documents, the County's MJHMP also identifies numerous existing wildfire mitigation-related planning mechanisms, including the County's adoption of the 2019 California Fire Code and California Building Standards Code (Napa County 2020). The County's 2023 General Plan Safety Element goal for wildfire hazard mitigation is to "effectively manage forests and watersheds to protect homes and businesses from fire and wildfire and minimize potential losses of life and property." The Safety Element includes a total of 27 wildfire mitigation policies, which include working with other agencies and organizations to implement the CWPP and the MJHMP, as well as coordinating with fire agencies such as CAL FIRE to plan for fire prevention and suppression needs (Napa County 2023). Moreover, as outlined on the NCFF's website, the County's fire department provides a free chipping service to all Napa County residents who live in a designated fire hazard zone, meaning most all of rural Napa. The program intends to encourage residents to comply with the defensible space requirements of both the State and County. Furthermore, the County's MJHMP proposes 26 mitigation actions for wildfire mitigation. These actions include but are not limited to ignition control providing technical and financial assistance to private property owners and developing and conducting defensible space community education programs. Also, as noted in the County's MJHMP, the County has a NIXLE alert system in place that provides trustworthy and important neighborhood-level public safety and community event notifications (Napa County 2020). Moreover, ALERT Napa County is a system that enables the agencies within Napa County to provide residents with critical and non-critical information in a variety of situations. This includes situations such as severe weather, planned and unexpected road closures, missing persons, evacuations, natural disasters, and public health concerns. Many agencies across Napa County, including Emergency Services and local jurisdictions use ALERT Napa County to communicate with the public.

ADAPTIVE CAPACITY RATING: HIGH

The County and local agencies in the region have a wide range of robust plans, programs, and tools established that are intended to reduce the risk of wildfires in the county from a variety of standpoints, including prevention, preparedness, response, and recovery. Additionally, The County and local agencies acknowledge that climate change may increase the risk of wildfires in the future and have developed plans and intend to implement additional mitigation actions in accordance with this. Though the potential impacts associated with wildfire in the context of climate change are severe, and certain limitations are prevalent in existing plans, the County and partner agencies and organizations have demonstrated a high level of commitment to making the county more resilient to wildfires and know that implementation of related plans and programs must be consistently evaluated and revised, as needed. The high levels of community engagement that have been conducted, and are still ongoing, for current wildfire plans and programs display the County and local agencies' devotion and sense of responsibility towards protecting its citizens and visitors. The County and local agencies should continue expanding this engagement and emphasizing equity to ensure that all populations can provide input to inform future iterations of plans and programs, including those who are most vulnerable and who have not yet been reached by routine communication efforts. Because of the reasons described, the adaptive capacity rating for increased wildfire risk is high.

2.3.3 Adaptive Efforts Related to Increased Temperatures and Extreme Heat

NAPA COUNTY GENERAL PLAN SAFETY ELEMENT

In addition to the County's Extreme Temperature Emergency Response Plan prepared by HHSA in 2019, the County's General Plan Safety Element also addresses extreme heat together with extreme weather. One relevant policy is to provide resources to protect farm workers (e.g., facilities, education) in the event of an emergency situation such as a wildfire, extreme heat, extreme weather, flooding, or an earthquake (Napa County 2023). Besides, the County's MJHMP proposes a few mitigation actions towards extreme heat events, such as developing an air conditioning replacement/reimbursement program for low-income and elderly residents, as well as supporting risk assessments about warmer climate and related effects on the agriculture and wine industries (Napa County 2020). The County's MJHMP and the City of Napa's HMP also mention that few formal regulations pertain directly to severe weather events, including extreme heat events.

In addition to the above adaptive efforts to increased temperatures and extreme heat, the County provides an array of resources across its various websites that serve as reliable extreme heat-related information sources for residents and visitors, including information on how to prevent heat-related injury, immediate medical attention symptoms and greater risk group. Additionally, while PSPS events were identified as a potential impact for increased temperature and extreme heat, especially to vulnerable populations, they may be necessary during periods of sustained extreme heat and increased wildfire risk to reduce the risk of accidental wildfire ignition. Utilities usually provide updates in anticipation of and during a PSPS event regarding when power will be turned off and when power will be restored so affected individuals can plan accordingly. Moreover, similar to wildfire alerts, extreme heat alerts are issued through ALERT Napa County, which county residents and visitors can opt into.

ADAPTIVE CAPACITY RATING: MEDIUM

Through several planning mechanisms, the County and local jurisdictions acknowledge and demonstrate their understanding of the risk of increased temperatures and extreme heat presents, especially to the county's populations. These plans can help build resilience among populations that are particularly vulnerable to the impacts of extreme heat. However, extreme heat is a problem that will likely grow exponentially over time, and this is especially concerning for residents who may not have access to air conditioning (e.g., lack of air conditioning system, financial barriers) or awareness of nearby cooling centers, along with vulnerable buildings and infrastructure that are not constructed for higher temperatures and community functions that are particularly susceptible to the impacts of extreme heat (e.g., agriculture). Acknowledging the County and local agencies' current efforts to address extreme heat, further efforts will be needed in the context of climate change, as current adaptive efforts may not be enough to address extreme heat in the future, not only to protect vulnerable populations but also the county's built environment and community functions. For these reasons, the adaptive capacity rating for increased temperatures and extreme heat is medium.

2.3.4 Adaptive Efforts Related to Extreme Precipitation, Sea Level Rise and Flooding

As noted on the Napa County official website, the Napa County Flood Control and Water Conservation District (District) is the local sponsor for the award-winning Napa River Flood Management Plan and administers water supply contracts, watershed management, and stormwater management programs throughout Napa County. The District's mission is the conservation and management of flood and storm waters to protect life and property; the maintenance of the county's watersheds using the highest level of environmentally sound practices; and to provide coordinated planning for water supply needs for the community. As discussed previously in Section 2 Vulnerability Assessment, a significant portion of the floodplains in the county are along the Napa River. The District's Napa River

and Creek Flood River Project is returning the Napa River to its natural floodplain, which requires a creative blend of ecology and engineering. Once an integral part of the river, floodplains are being re-established at two levels to aid the passage of flood waters. A dry bypass allows raging flood waters to safely shortcut the oxbow, returning only when the river subsides. Yet, to ensure 100-year flood protection, the project also includes new levees, dikes, culverts, bridge replacements, and floodwalls in the most vulnerable areas (Napa County n.d.).

SAN FRANCISCO BAY AREA INTEGRATED REGIONAL WATER MANAGEMENT PLAN

Zooming out, as mentioned above, the San Francisco Bay Area IRWMP contains discussions on regional floodplains and flood zones, flood protection infrastructure, and flood protection challenges. The IRWMP also discusses strategies to improve flood management, including the use of integrated flood risk management. Some of the existing Bay Area flood mitigation efforts noted in the IRWMP include but are not limited to the employment of collaborative approaches and innovative multi-benefit projects.

ADAPTING TO RISING TIDES, BAY AREA: REGIONAL SEA LEVEL RISE VULNERABILITY AND ADAPTATION STUDY

The ART Bay Area Report serves as one of the foundational plans for the region, particularly related to the risks posed by sea level rise, including coastal flooding. It provides an array of adaptation responses that require coordination with local and regional interests, should be initiated by regional interests or through a regional process, or consist of best practices for local jurisdictions to help address the common, regionally significant vulnerabilities identified within the report (ART 2020). The San Francisco Bay Shoreline Adaptation Atlas – Working with Nature to Plan for Sea Level Rise Using Operational Landscape Units report also offers insights on how Napa County as part of the Napa-Sonoma OLU can leverage nature-based approaches to mitigate coastal flooding and sea level rise.

NATIONAL FLOOD INSURANCE PROGRAM

The County joined the National Flood Insurance Program (NFIP) on February 1, 1980. The NFIP aims to reduce the impact of flooding on residential and nonresidential buildings by providing insurance to property owners and encouraging communities to adopt and enforce floodplain management regulations. All five incorporated cities in Napa County participate in the NFIP. The County and cities are currently in good standing with all provisions of the NFIP. In addition, both Napa County and the City of Napa are participants of the Community Rating System (CRS), which is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote awareness of flood insurance. For participating communities, flood insurance premium rates are discounted in increments of 5 percent according to the community's classification (Napa County 2020). As of the preparation of this VA (February 2024), according to FEMA's Community Status Book Report, both Napa County and the City of Napa are currently Class 7 and receive a 15 percent premium discount.

The County's MJHMP identifies an array of recommended mitigation actions related to county flooding and sea level rise issues. For flooding, the County proposes 13 actions for the unincorporated county and four actions for Napa County Flood Control and Water Conservation District. Such actions include but are not limited to constructing/improving stormwater basins countywide to accomplish 100-year protection and maintaining a countywide Storm Watch system. For sea level rise, the County proposes to support ongoing analysis of sea level rise data and create a comprehensive outreach strategy that informs residents in potentially affected areas of the county to protect and increase community resiliency to sea level rise (Napa County 2020).

Moreover, the County's municipal code has a specific chapter that is designated to floodplain management. The County's General Plan Safety Element also addresses flooding hazards and proposes 17 policies for flooding mitigation, such as evaluating new construction in floodplains and maintaining areas subject to flooding in agricultural or open

spaces (Napa County 2023). Also, similar to wildfire and extreme heat alerts, flood alerts are issued through ALERT Napa County, which county residents and visitors can opt into.

ADAPTIVE CAPACITY RATING: HIGH/MEDIUM

The County and local agencies in the region have adequately assessed the risks of extreme precipitation and flood events. The County and/or regional partners also have developed, adopted, and enforced a variety of robust plans, policies, and programs that will serve to mitigate impacts associated with increased intensity and frequency of floods in the future, and substantial flood mitigation operations are currently in place. Though the potential impacts associated with extreme precipitation, flooding and sea level rise in the context of climate change can get more severe in the future, and certain limitations are prevalent in existing plans, the County and partner agencies and organizations have demonstrated a high level of commitment in making the county more resilient to such hazards and know that the implementation of related plans and programs must be consistently evaluated and revised, as needed. The high levels of public engagement that have been conducted, and are still ongoing, for current flood control plans and programs display the County and local agencies' devotion and sense of responsibility towards protecting its citizens and visitors. The County and local agencies should continue expanding this engagement and emphasizing equity to ensure that all populations can provide input to inform future iterations of plans and programs, including those who are most vulnerable. Because of the reasons described, the adaptive capacity rating for extreme precipitation, sea level rise, and flooding is high/medium.

2.3.5 Adaptive Efforts Related to Drought and Water Supply

Water suppliers/wholesalers of the County, such as the Cities of Napa and American Canyon, have developed urban water management plans and water shortage contingency plans to ensure that customers have sustainable and reliable water supplies, even in the context of climate change and the existence of prolonged regional droughts.

SAN FRANCISCO BAY AREA INTEGRATED REGIONAL WATER MANAGEMENT PLAN

The San Francisco Bay Area IRWMP also aims to improve water supply reliability and quality, as well as protect and improve watershed health and function and Bay water quality. The IRWMP gives an overview of the regional water supplies in the Bay Area and discusses water demand and conservation by water suppliers, including the City of Napa. The IRWMP mentions that while the City of Napa is the largest water agency in Napa County, more than 6,000 AFY in additional municipal demands are met by the cities of American Canyon, St. Helena, and Calistoga and the Town of Yountville. Each has its own water supply portfolio including local reservoirs, groundwater, retail purchases, or State Water Project entitlements. The IRWMP then discusses regional issues, needs, and challenges, including but not limited to regulatory compliance challenges and dependence on the Sacramento-San Joaquin Delta. Furthermore, the IRWMP offers resource management strategies covering various aspects, including but not limited to strategies to reduce water demand and increase water supply (IRWMP 2019).

NAPA COUNTY WATER CONSERVATION WEBSITE HUB

Moreover, based on input received from the County and local agencies in the region, the County, its municipalities, and the agriculture and winery industry also have been spearheading various water conservation efforts. For example, the County's official website has a webpage that is dedicated to water conservation: https://www.countyofnapa.org/1295/Water-Conservation. This website notes that the County encourages all residents in Napa County to embrace wise water use as a daily habit, whether or not the county is experiencing a year of heavy or meager rain. The website also contains an exhaustive list of links to other state resources on drought and water supply, reservoir and precipitation levels, water-wise landscaping, as well as municipal water conservation links for the County's five incorporated cities. These municipal water conservation links demonstrate the cities' dedication to water conservation and drought preparedness.

NAPA COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

The County's MJHMP provides additional resources on the County's existing capability in drought mitigation and water supply support. The County enforces drought-tolerant landscaping requirements. Executive Order B-37-16 is also mentioned. Directive #10 specified that "For areas not covered by a Water Shortage Contingency Plan, California Department of Water Resources shall work with counties to facilitate improved drought planning for small water suppliers and rural communities." As noted in the MJHMP that was finished in 2020, all of the Napa Valley governments, including Napa County, were working towards completing a new regional study. In 2022, the County, its municipalities, and the Napa Sanitation District worked on and published the Napa Valley Drought Contingency Plan, which aims to help the region understand hydrologic risks and uncertainties that exacerbate and/or affect drought as well as how will drought affect the region and how communities can prepare for the next drought. Moreover, the MJHMP proposes five mitigation actions that target drought mitigation, including but not limited to installing water monitoring devices on government-owned facilities and drought tolerant landscaping at government-owned facilities, as well as adopting a new water conservation ordinance for commercial and residential land uses limiting outdoor watering (Napa County 2020).

NAPA COUNTY GENERAL PLAN SAFETY ELEMENT

Moreover, the County's General Plan Safety Element profiles drought hazards and mentions that the Napa County Groundwater Sustainability Agency (GSA) developed a Groundwater Sustainability Plan (GSP) for the Napa Valley Subbasin, which was adopted on January 11, 2022. The GSP identifies programs and projects that get the basin to sustainability and defines how the GSP will be implemented and how the GSA will measure progress over time. The five municipalities offer rebates for water-saving appliances and practices, including the popular "Cash For Grass" lawn removal incentive. In addition, the Safety Element proposes seven policies for drought mitigation, including but not limited to developing a public water conservation campaign and investing in water use efficiency and conservation (Napa County 2023).

ADAPTIVE CAPACITY RATING: MEDIUM

The County and local agencies in the region understand the implications of drought on water supplies and other associated impacts. The undertaking of urban water management plans, water shortage contingency plans, and other plans and programs will assist the County and local agencies in building resilience to future drought conditions. These plans and programs have taken necessary steps to mitigate the risk of inadequate water supplies, although it will be important for the County and local agencies to continue and increasingly plan for drought, as drought is likely going to be exacerbated by climate change in the future. The potential impacts of drought, especially on community functions, can be severe and long-lasting. However, because of the County and local agencies' plans and programs already in place, along with their demonstrated understanding of measures they can or should take in the future related to drought, the adaptive capacity rating for drought and water supply is medium.

2.3.6 Adaptive Efforts Related to Energy Grid

As discussed in Section 2 Vulnerability Assessment, both wildfire and flooding events can have severe impacts on the reliability and safety of the energy grid. Because adaptive capacity for wildfire and flooding events is discussed above, this section focuses on capacities that are directly related to the County and local agencies' existing planning mechanisms and programs regarding energy grid reliability.

NAPA GREEN & RISE PROGRAM

Napa Green, a winery and vineyard certification program, launched the NAPA Resilience, Innovation, Sustainability, Empowerment program (RISE) program in 2022, which is intended to enable the Napa County wine industry to leverage its powerful platform and set a standard for sustainability and climate action that galvanizes the global wine

industry. This program includes a three-week series of events that is designed to accelerate meaningful sustainability and climate action transformation across the entire industry and culture of wine. The most recent events happened in 2023 and were organized around the six pillars of sustainable winegrowing leadership, one of which is regarding energy efficiency & savings. During the energy efficiency & savings workshop, speakers talked about EV charger installation and available rebates and incentives, as well as carbon capture off fermentation tanks and market resale (NAPA RISE 2022). Moreover, according to the input received from the County and local agencies in the area, the RISE program is also a mentorship program that helps wineries and vineyards set pathways to reduce impacts and become more climate resilient. The Napa Green program is also a tool and serves as an incentive to help the local wine industry improve its energy efficiency and resilience.

Marin Clean Energy (MCE) is the largest electricity supplier in Napa County, followed by PG&E. MCE is a not-for-profit public agency that has set the standard for clean energy since 2010. MCE offers more renewable power at stable rates, significantly reducing energy-related greenhouse emissions and reinvesting millions of dollars in local energy programs. MCE provides electricity service and cutting-edge energy programs to more than 1.5 million residents and businesses in 37 member communities across four Bay Area counties: Contra Costa, Marin, Napa, and Solano. MCE buys and builds cleaner energy and PG&E still delivers energy and maintains lines. Therefore, the potential impacts from hazards on PG&E's energy grid still pose a threat to the county's overall energy resiliency. As noted in the County's MJHMP, the County proposes quite a few mitigation actions that are related to energy resiliency, including but not limited to: construct/install back up power generators for fire stations, pump houses, emergency shelters and cooling centers; develop microgrids to provide emergency power during natural disasters; procure backup generators in the event that public meeting spaces such as community centers or town halls will be used as emergency command centers; and perform regular maintenance on generators at water treatment plants (Napa County 2020). Moreover, according to input received from the County and local agencies in the region, the City of Calistoga also has been looking at developing a microgrid to increase energy resilience.

Furthermore, regarding PSPS events, PG&E has a comprehensive list of relevant support resources on its website, including but not limited to what to expect during PSPS events, a fact sheet about PSPS events, and seven-day PSPS forecast. The website also contains translation resources. There are also resources for businesses, such as large and small business emergency preparedness checklists (PG&E n.d.).

ADAPTIVE CAPACITY RATING: MEDIUM

The County and local agencies understand the energy resiliency issues that can be caused by wildfire and flooding events, and the County and local agencies have abundant capacities to mitigate such hazards, as well as a few planning mechanisms that directly target energy grid resiliency, such as the mitigation actions proposed in the County's MJHMP. The county's major utility also has capacities in place to mitigate PSPS events. These existing plans and programs will assist the County and local agencies in building resilience against future energy grid challenges, although it will be important for the County and local agencies to continue and increasingly improve energy grid resiliency, as wildfire and flooding hazards are likely going to be exacerbated by climate change in the future. The potential impacts of energy grid failure can be unexpected and severe. However, because of the County and local agencies' existing capacities regarding not only energy resiliency but also wildfire and flooding hazard mitigation, along with their demonstrated understanding of measures it can or should take in the future to improve energy grid resiliency, the adaptive capacity rating for energy grid resiliency is medium.

2.3.7 Summary of Adaptive Capacity

Table 13 summarizes the County, County jurisdictions, and local agencies' adaptive capacity regarding each climate change effect. Like the potential impacts rating evaluation, the scoring of adaptive capacity allows the County, County jurisdictions, and local agencies to better understand priority areas where there are gaps in preparing for and adapting to climate change. Adaptive capacity scoring is described in Table 2 at the beginning of Section 2.

Table 13 Adaptive Capacity Summary

Climate Change Effect	Adaptive Capacity Rating
Increased Wildfire Risk	High
Increased Temperatures and Extreme Heat	Medium
Extreme Precipitation, Sea Level Rise, and Flooding	High/Medium
Drought and Water Supply	Medium
Energy Grid Resiliency	Medium

Source: Ascent 2024

2.4 VULNERABILITY SCORING

The final step in the VA process is to characterize the county's vulnerability to each climate change effect, which is based on the magnitude of risk to and potential impacts on populations, the built environment, and community functions, while considering the current adaptive capacity in place to mitigate these impacts. Based on the ratings of potential impacts and adaptive capacity, an overall vulnerability score on a scale of 1 to 5 can be determined for each climate change effect. As noted at the beginning of Section 2, higher vulnerability scores (5 being the highest) indicate that a climate change effect should be prioritized sooner than those with lower scores (1 being the lowest). This scoring can be used to inform the development and prioritization of adaptation strategies included in the RCAAP, and it can also help the County, County jurisdictions, and local agencies understand which effects pose the greatest threats and should be emphasized in future planning efforts. Table 3 in Section 2 summarizes the overall vulnerability scores based on the ratings for potential impacts and adaptive capacity.

Vulnerability scoring for each climate change effect identified and evaluated in Sections 2.1 through 2.3 is included in Table 14 below. Table 14 shows that increased temperatures and extreme heat, as well as drought and water supply, are assigned a vulnerability score of 4, which means these two climate effects should be a high priority for the county. Increased wildfire risk and energy grid resiliency are both assigned a vulnerability score of 3, which means they should be prioritized next in the County, County jurisdictions, and local agencies' adaptation- and planning-related efforts. These climate change effects could potentially have significant impacts on the county's populations, built environment, and community functions in the near-term to mid-term, and although a variety of adaptive efforts related to both climate change effects are already in place, the magnitude or risks posed by these hazards contributes to higher vulnerability in the county. Extreme precipitation, sea level rise, and flooding is characterized as having a vulnerability rating of 2-3. This climate change effect is currently being addressed adequately based on existing conditions, but as extreme precipitation events potentially become more frequent and sea level rise becomes more severe in future years, additional adaptation and resilience planning will be required in the future to mitigate potential impacts and protect the county.

Table 14 Vulnerability Scoring Summary

Climate Change Effect	Vulnerability Score		
	Adaptive Capacity	Potential Impact	Vulnerability
Increased Wildfire Risk	High	High	3
Increased Temperatures and Extreme Heat	Medium	High	4
Extreme Precipitation, Sea Level Rise, and Flooding	High/Medium	Medium	2-3
Drought and Water Supply	Medium	High	4
Energy Grid Resiliency	Medium	Medium	3

Source: Ascent 2024.

2.5 CONCLUSION

The County, County jurisdictions, local agencies and other interest groups have already implemented a variety of initiatives to address climate change in the county through existing plans, policies, programs, and actions. As climate change continues to exacerbate risks and impacts from various hazards, the County, County jurisdictions, and local agencies must continue to develop and implement adaptation strategies to mitigate these risks. The RCAAP will include adaptation and resilience strategies based on the findings of this report, and the County, County jurisdictions, and local agencies should work together to prioritize strategies that will be effective, feasible, cost-appropriate, and include additional social, environmental, economic, and technological benefits.

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