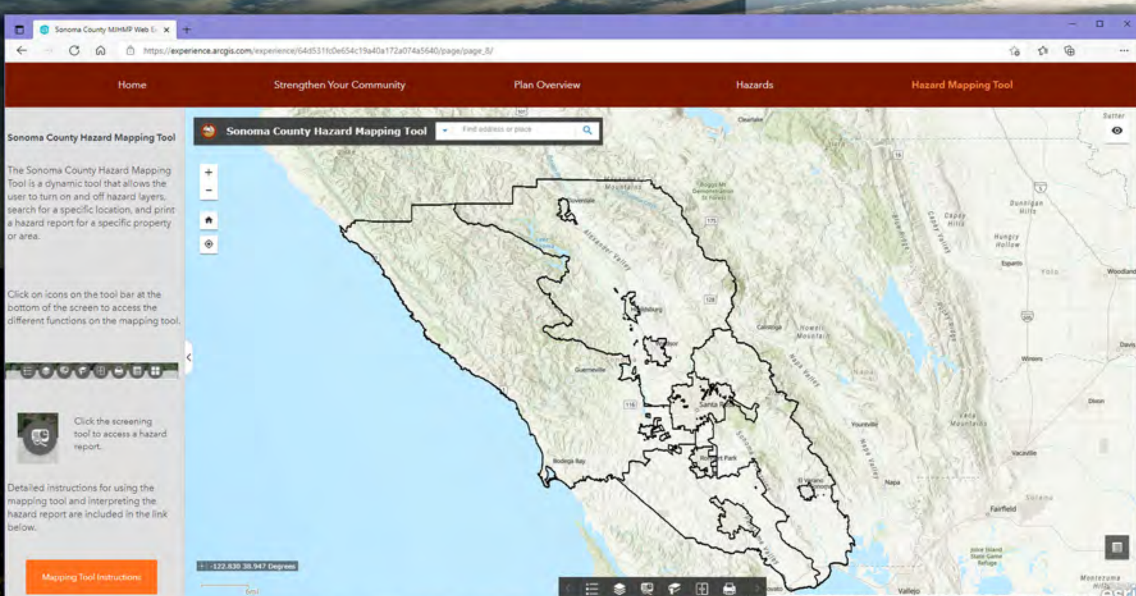
Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Volume 1

Area-Wide Elements

October 2021



TETRA TECH

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Volume 1—Area-Wide Elements

October 2021

PREPARED FOR

Permit Sonoma

2550 Ventura Avenue
Santa Rosa, California 95403

PREPARED BY

Tetra Tech

1999 Harrison Street
Suite 500
Oakland, CA 94612

Phone: 510.302.6300
Fax: 510.433.0830
www.tetratech.com

Tetra Tech Project #103S6990
2021-10-19_SonomaCountyHMP_Vol1_Adoption Draft.docx

CONTENTS

PART 2— RISK ASSESSMENT

PART 3— MITIGATION STRATEGY

Appendices

Tables

Figures

ACKNOWLEDGMENTS

Sonoma County

- Lisa Hulette, Permit Sonoma, Grants Manager
- Domenica Giovannini, Permit Sonoma, Policy Manager
- Shelly Bianchi-Williamson, Permit Sonoma, GIS Supervisor
- Gary Helfrich, Permit Sonoma, Planner III
- Bradley Dunn, Permit Sonoma, PIO
- Steve Mosiurak, Fire Prevention, Interim Fire Marshall
- Chris Godley, Emergency Management, Director
- Hunter McLaughlin, Public Works, Engineer

Consultants (Tetra Tech)

- Rob Flaner, Project Manager
- Bart Spencer, Project Lead Planner
- Carol Baumann, Risk Assessment Lead
- Des Alexander, Profiling Lead
- Cindy Rolli, Public Outreach (Story-map) lead
- Dan Portman, Technical Editor

Stakeholders

- Kimberly Jordan, Town of Windsor, Planner III
- Shari Meads, City of Santa Rosa, City Planner
- Katherine Duran, City of Cotati, Administrative Analyst
- Sheri Emerson, Sonoma County Ag & Open Space District, Program Manager
- Mollie Assay, Sonoma County Water Agency
- Marshall Turbeville, Northern Sonoma County Fire Protection District, Chief
- Scott Westrope, Santa Rosa City Fire, Deputy Chief
- Ben Nicholls, Cal FIRE, Division Chief
- Sarah Newkirk, The Nature Conservancy, Senior Project Director
- Lisa Micheli, PhD, Pepperwood Preserve, President & CEO
- Marc Chadler, Community Development Commission, Env Compliance Manager
- Robert Cantu, Western Builders Association
- Karissa Kruse, Sonoma County Winegrowers Association, Executive Director

Special Acknowledgments

The development of this plan would not have been possible without the dedication and commitment to this process by the Hazard Mitigation Plan Steering Committee. The dedication of the volunteers on this committee to allocate their time to this process is greatly appreciated. Also, the citizens of Sonoma County are commended for their participation in the plan outreach activities. Their involvement sets the course for successful implementation of this plan.

ACRONYMS/ABBREVIATIONS

AB—Assembly Bill

ADA—American with Disabilities Act

ASDSO—Association of State Dam Safety Officials

BLM—Bureau of Land Management

Cal EMA—California Emergency Management Agency

CAL FIRE—California Department of Forestry and Fire Protection

Cal OES—California Governor's Office of Emergency Services

Caltrans—California Department of Transportation

CCR—California Code of Regulations

CDBG-DR—Community Development Block Grant Disaster Recovery

CEQA—California Environmental Quality Act

CFA—California Fire Alliance

CFR—Code of Federal Regulations

CRS—Community Rating System

CWA—Clean Water Act

DFIRM—Digital Flood Insurance Rate Maps

DMA —Disaster Mitigation Act

DWR—Department of Water Resources (California)

EAP—Emergency Action Plan

EPA—U.S. Environmental Protection Agency

EOC—emergency operations center

ESA—Endangered Species Act

EWP—Emergency Watershed Protection

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

FIRM—Flood Insurance Rate Map

GIS—Geographic Information System

Hazus—Hazards, United States

HIFLD—Homeland Infrastructure Foundation-Level Data

HMGP—Hazard Mitigation Grant Program

IA—Individual Assistance

IBC—International Building Code

IPCC—Intergovernmental Panel on Climate Change

LRA—Local Responsibility Areas

mph—Miles per hour

Mw—Moment Magnitude Scale

NASA—National Aeronautics and Space Administration

NEHRP—National Earthquake Hazards Reduction Program

NFIP—National Flood Insurance Program

NIMS—National Incident Management System

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

PA—Public Assistance

PGA—Peak Ground Acceleration

RCPA— Regional Climate Protection Authority

SEMS—Standardized Emergency Management Systems

SFHA—special flood hazard area

SLR—sea-level rise

SRA—State Responsibility Areas

SRL—severe repetitive loss

USDA—U.S. Department of Agriculture

USDM—U.S. Drought Monitor

USGS—U.S. Geological Survey

WUI—wildland/urban interface

EXECUTIVE SUMMARY

Hazard mitigation is the use of long-term and short-term policies, programs, projects, and other activities to alleviate the death, injury, and property damage that can result from a disaster. Sonoma County developed an updated hazard mitigation plan in partnership with the following local governments within the county:

- **Town of Windsor**
- **City of Sonoma**
- **City of Cotati**
- **City of Santa Rosa**
- **Gold Ridge Resource Conservation District**
- **Sonoma Resource Conservation District**
- **Sonoma County Agricultural Preservation & Open Space District**
- **County of Sonoma**
- **Northern Sonoma County Fire Protection District**
- **Rancho Adobe Fire**
- **North Sonoma Coast Fire Protection District**
- **Timber Cove Fire Protection District**
- **Cloverdale Fire Protection District**
- **Sonoma County Fire Protection District**

The hazard mitigation plan defines measures to reduce risks from natural disasters in the Sonoma County Operational Area, which consists of the entire county, including unincorporated areas, incorporated cities, and special purpose districts. The plan complies with federal and state hazard mitigation planning requirements to establish eligibility for funding under Federal Emergency Management Agency (FEMA) grant programs for all planning partners. It updates the County's previous plan, the *2016 Sonoma County Operational Area Hazard Mitigation Plan.*

PLAN DEVELOPMENT APPROACH

Organization

A core planning team consisting of a contract consultant and Sonoma County staff was assembled to facilitate this plan update. A planning partnership was formed by engaging eligible local governments and making sure they understood their expectations for compliance under the updated plan. A steering committee was assembled to oversee the plan update, consisting of both governmental and non-governmental stakeholders within the planning area. Coordination with other local, state, and federal agencies involved in hazard mitigation occurred throughout the plan update process. Organization efforts included a review of the County's 2016 hazard mitigation plan, the California statewide hazard mitigation plan, and existing programs that may support hazard mitigation actions.

Public Outreach

The planning team implemented a multi-media public involvement strategy utilizing the outreach capabilities of the planning partnership that was approved by the Steering Committee. The strategy included public meetings, a hazard mitigation survey, a project website, the use of social media, and multiple media releases.

Plan Document Development

The planning team and Steering Committee assembled a document to meet federal hazard mitigation planning requirements for all partners. The updated plan contains two volumes. Volume 1 contains components that apply to all partners and the broader planning area. Volume 2 contains all components that are jurisdiction-specific. Each planning partner has a dedicated annex in Volume 2.

Adoption

Once pre-adoption approval has been granted by the California Office of Emergency Services and FEMA Region IX, the final adoption phase will begin. Each planning partner will individually adopt the updated plan.

RISK ASSESSMENT

Risk assessment is the process of measuring the potential loss of life resulting from natural hazards, as well as personal injury, economic injury, and property damage, in order to determine the vulnerability of people, buildings, and infrastructure. For this update, risk assessment models were enhanced with new data and technologies. The Steering Committee used the risk assessment to rate risk and to gauge the potential impacts of each hazard of concern in the planning area. The risk assessment included the following:

- Hazard identification and profiling
- Assessment of the impact of hazards on physical, social, and economic assets
- Identification of particular areas of vulnerability
- Estimates of the cost of potential damage.

Based on the risk assessment, hazards were rated for the risk they pose to the overall planning area. Figure ES-1 shows the resulting scores and ratings for the entire Sonoma County planning area. Each planning partner also rated hazards for its own area. Figure ES-2 summarizes how the 14 participating planning partners rated each hazard. The results indicate the following general patterns:

- Almost all planning partners rated earthquake and wildfire in the highest risk category.
- Flooding, severe weather, and landslide/mass movement are the hazards most commonly rated in the medium risk category by individual planning partners, though landslide/mass movement was rated in the highest risk category countywide.
- Sea-level rise and tsunami are the hazards most commonly rated as lowest risk by individual planning partners, though sea-level rise was rated as a medium risk countywide.

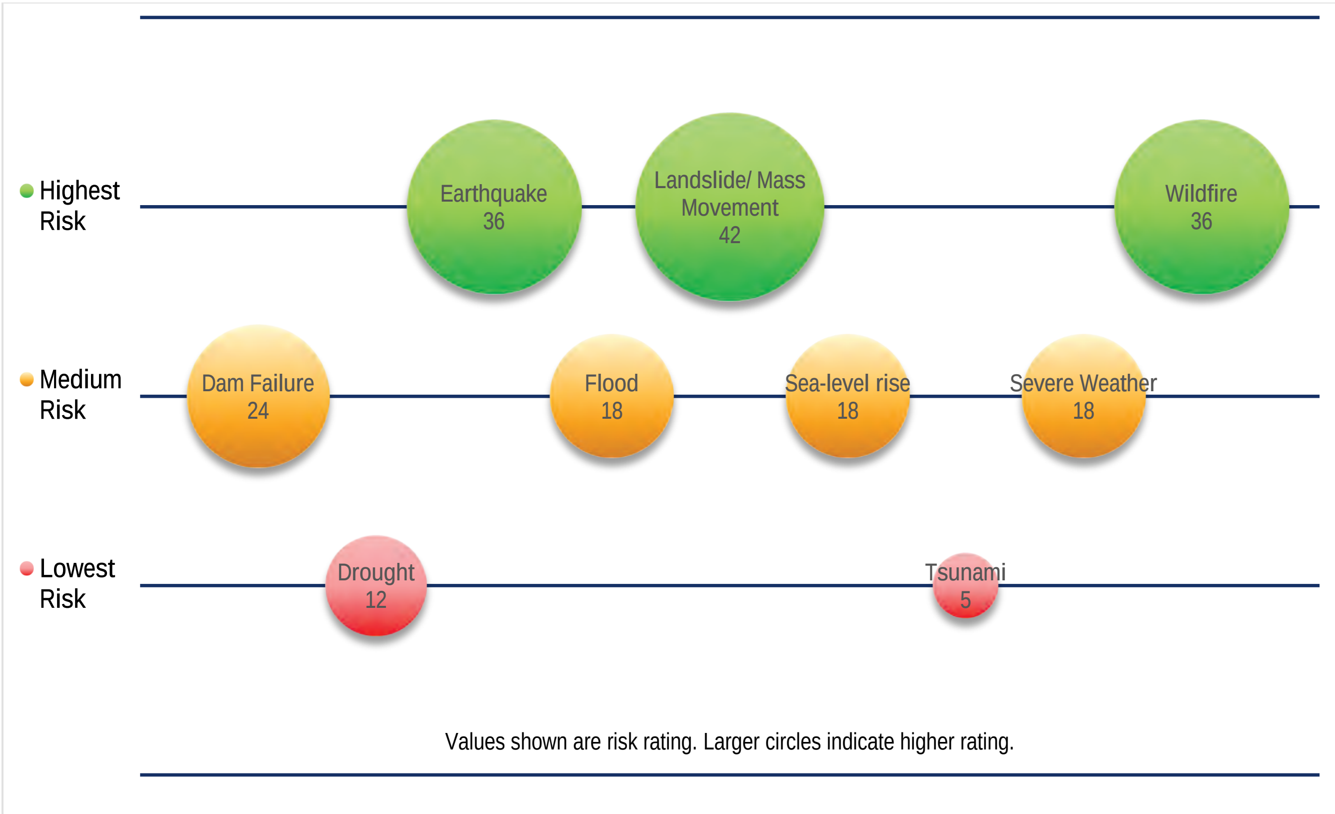


Figure ES-1. Countywide Hazard Risk Rating

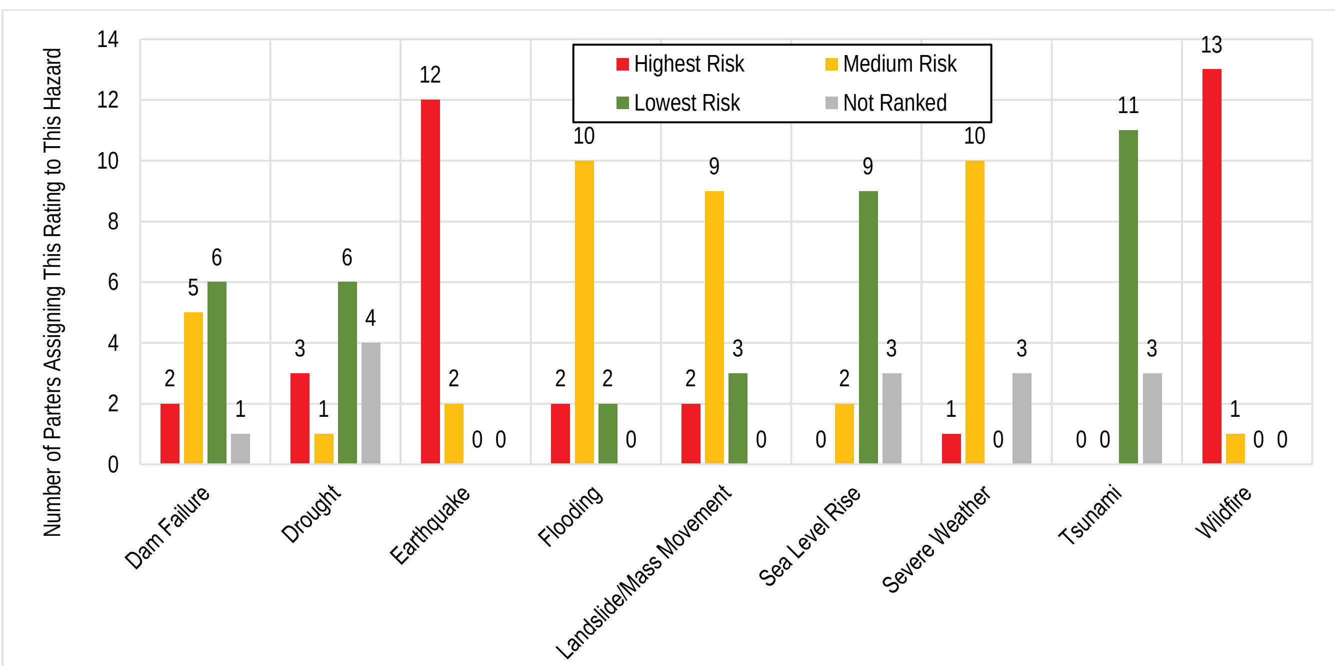


Figure ES-2. Summary of Risk Rating for Individual Planning Partners

MITIGATION GOALS AND OBJECTIVES

The Steering Committee reviewed and made minor updates to the guiding principle, goals, and objectives from the *2016 Sonoma County Operational Area Hazard Mitigation Plan*. The following guiding principle guided the Steering Committee and planning partners in selecting actions contained in this plan update:

> Create a resilient Sonoma County for the whole community.

Goals

The Steering Committee and planning partners established the following goals for the plan update:

1. Protect people and minimize loss of life, injury, and social impacts
2. Minimize potential for loss of property, economic and social impacts, and displacement due to hazards.
3. Minimize potential for environmental impacts and consider a broad-range of mitigation solutions, including nature-based solutions where feasible.
4. Communicate natural hazard risk to the whole community within Sonoma County.
5. Support and inform the development of relevant mitigation policies and programs.
6. Promote an adaptive and resilient Sonoma County that proactively anticipates the future impacts from hazards within the county.
7. Pursue the development and implementation of long-term, cost-effective, and environmentally sound mitigation projects.
8. Enhance the capability/capacity of the Sonoma County planning area to prepare, respond and recover from the impact of natural hazards.

The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

Objectives

Each selected objective meets multiple goals, serving as a stand-alone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives also are used to help establish priorities. The objectives are as follows:

1. Incorporate mitigation best management measures into plans, codes, and other regulatory standards for the private sector, nonprofit agencies, and community-based organizations within the planning area.
2. Maintain established partnerships in the identification and implementation of mitigation measures in the Sonoma County Planning area.
3. Retrofit, purchase, mitigate or relocate structures in high hazard areas, with an emphasis on those subject to repetitive damages.
4. Promote and implement hazard mitigation plans and projects that are consistent with state, regional, and local climate action and adaptation goals, policies, and programs.
5. Improve and expand systems that provide warning and emergency communications to the whole community.
6. Increase resilience and capabilities of community lifelines.

7. Prevent (or discourage) new development in hazardous areas or ensure that if building occurs in high-risk areas that it is done in such a way as to minimize risk
8. At the local government level, continually improve understanding of the location and potential impacts of natural hazards, utilizing the best available data and science
9. Consider the impacts of natural hazards in all planning mechanisms that address current and future land uses within the planning area
10. Minimize adverse impacts from flood risk on vulnerable communities.
11. Through the enforcement of relevant federal, State and local regulations, sustain life and property protection measures for all communities and structures located in the Sonoma County Planning area.
12. All cities, the County, special districts, and tribal organizations will develop, adopt, and implement local hazard mitigation principles that may be integrated with local comprehensive plan safety elements, Community Wildfire Protection Plans, floodplain management plans, facilities master plans, and other local planning initiatives.

MITIGATION ACTION PLAN

The planning partners selected mitigation actions to work toward achieving the goals set forth in this plan update. Mitigation actions presented in this update are activities designed to reduce or eliminate losses resulting from natural hazards. The update process resulted in the identification of 309 mitigation actions for implementation by individual planning partners, as presented in Volume 2 of this plan. In addition, the Steering Committee and planning partners identified countywide actions benefiting the whole partnership, as listed in Table ES-4.

IMPLEMENTATION

The Steering Committee developed a plan implementation and maintenance strategy that includes grant monitoring and coordination, a strategy for continued public involvement, a commitment to plan integration with other relevant plans and programs, and a recommitment from the planning partnership to actively monitoring and evaluating the plan over the five-year performance period.

Full implementation of the recommendations of this plan will require time and resources. The measure of the plan’s success will be its ability to adapt to changing conditions. Sonoma County and its planning partners will assume responsibility for adopting the recommendations of this plan and committing resources toward implementation. The framework established by this plan commits all planning partners to pursue actions when the benefits of a project exceed its costs. The planning partnership developed this plan with extensive public input, and public support of the actions identified in this plan will help ensure the plan’s success.

Table ES-1. Area-Wide Hazard Mitigation Actions

Action Number and Description	Priority for Implementation	Priority for Pursuing Grants
CW-1—The County will pursue an "Information Sharing Access Agreement" with FEMA allowing the County to readily access FEMA repetitive loss data for the entire county as needed at a level of detail to study and analyze repetitive flood loss problems in the county	High	N/A
CW-2—Continue to maintain a county-wide hazard mitigation website and the associated Story-Map that will store the hazard mitigation plan and provide the public an opportunity to monitor plan implementation progress. Each planning partner can support this initiative by including an initiative in its action plan of creating a link to the County hazard mitigation website.	High	N/A
CW-3—Leverage public outreach partnering capabilities in the planning area (such as CERT) to promote a uniform and consistent message on the importance of proactive hazard mitigation.	High	N/A
CW-4—Continue to update hazard mapping with best available data and science as it evolves, within the capabilities of the planning partnership. Support FEMA's RiskMAP initiative.	High	Medium
CW-5—Retain a steering committee as a working body over time to monitor progress of the hazard mitigation plan, provide technical assistance to planning partners, manage data, and oversee the update of the plan according to schedule. This body will continue to operate under the ground rules established at its inception.	High	N/A
CW-6—Strive to capture time-sensitive, perishable data—such as high-water marks, extent and location of hazard, and loss information—following hazard events to support future updates to the risk assessment as well as other plans and programs that utilize hazard extent and location data	High	N/A
CW-7—Utilize viable and relevant information, data and tools (Hazus models) developed as part of the update to the risk assessment of this plan update to support training and exercise of the County's preparedness, response and recovery programs	High	N/A

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

PART 1—PLANNING PROCESS AND COMMUNITY PROFILE

1. INTRODUCTION TO HAZARD MITIGATION PLANNING

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

Hazard mitigation is defined as any action taken to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves long- and short-term actions implemented before, during and after disasters. Hazard mitigation activities include planning efforts, policy changes, programs, studies, improvement projects, and other steps to reduce the impacts of hazards.

The federal Disaster Mitigation Act (DMA) of 2000 emphasizes planning for disasters before they occur. The DMA requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Regulations developed to fulfill the DMA's requirements are included in Title 44 of the Code of Federal Regulations (44 CFR).

The responsibility for hazard mitigation lies with many, including private property owners, commercial interests, and local, state and federal governments. The DMA encourages cooperation among state and local authorities in pre-disaster planning. The enhanced planning network called for by the DMA helps local governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk-reduction projects.

The DMA also promotes sustainability in hazard mitigation. To be sustainable, hazard mitigation needs to incorporate sound management of natural resources and address hazards and mitigation in the largest possible social and economic context.

1.1.2 Purposes for Planning

Sonoma County prepared a hazard mitigation plan in compliance with the DMA in 2006 and has updated the plan every five years since then, most recently in 2016. This *Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021* fulfills the ongoing update requirement.

In preparing this update, Sonoma County has partnered with local cities and special-purpose districts. One of the benefits of such multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. The Federal Emergency Management Agency (FEMA) encourages multi-jurisdictional planning under its guidance for the DMA. The recommendations of this update were selected because they best meet the needs of all the planning partners and their citizens.

The 2021 Update will help guide and coordinate mitigation activities throughout the planning area. It was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment of local hazards of concern.
- Meet the planning requirements of FEMA’s Community Rating System (CRS), allowing eligible planning partners to consider participation in the CRS program.
- Coordinate existing plans and programs so that high-priority projects to mitigate possible disaster impacts are funded and implemented.

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All citizens and businesses of Sonoma County are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the planning area. It provides a viable planning framework for all foreseeable natural hazards. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable across the planning area, and the plan’s goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 CONTENTS OF THIS PLAN

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole planning area:

- Volume 1—Volume 1 includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, planning area hazard risk assessment, planning area mitigation actions, and a plan maintenance strategy.
- Volume 2—Volume 2 includes all federally required jurisdiction-specific elements, in annexes for each participating jurisdiction. It includes a description of the participation requirements established by the Steering Committee, as well as instructions and templates that the partners used to complete their annexes. Volume 2 also includes “linkage” procedures for eligible jurisdictions that did not participate in development of this plan but wish to adopt it in the future.

Both volumes include elements required under federal guidelines. Where sections of this plan address specific DMA requirements, the CFR section number in which the requirement is found is cited..

The following appendices provided at the end of Volume 1 include information or explanations to support the main content of the plan:

- Appendix A—Public involvement information used in preparation of this update
- Appendix B—A summary of federal and state programs and regulations relevant to hazard mitigation
- Appendix C—A description of data sources and methods used for mapping hazard areas in the county

- Appendix D—Quantitative results from risk assessment modeling for individual cities and Sonoma County supervisorial districts
- Appendix E—Peak stream flow levels used for Sonoma County Flood Insurance Study
- Appendix F—Plan adoption resolutions from planning partners
- Appendix G—Progress report template

All planning partners will adopt Volume 1 in its entirety and at least the following parts of Volume 2: Part 1; each partner's jurisdiction-specific annex; and the appendices.

2. PLAN UPDATE—WHAT HAS CHANGED

2.1 THE PREVIOUS PLAN

The 2016 update of the Sonoma County Hazard Mitigation Plan, like the 2011 plan before it, focused on earthquake, flood, wildland fire, and landslide hazards as these were considered to be the greatest risk to the county based on past disaster events, future probabilities, and degree of vulnerability. The 2016 Plan also addressed secondary and tertiary hazards such as winter storms, coastal erosion and bluff failure, tsunamis, and post-fire erosion. The 2016 update discussed the implications that climate change may have on hazard trends in Sonoma County and included an expanded discussion of sea level rise and drought. Based on its assessment of these hazards, the 2016 plan recommended 60 mitigation actions that address the following hazards of concern:

- Flood
- Earthquake
- Wildland fire
- Landslide
- Sea level rise

The Sonoma County Board of Supervisors adopted the plan (Resolution No. 17-0168) on April 25, 2017. FEMA issued approval of the plan on May 4, 2017.

2.2 WHY UPDATE?

2.2.1 Federal Eligibility

Under 44 CFR, hazard mitigation plans must present a schedule for monitoring, evaluating, and updating the plan. This provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is not able to pursue elements of federal funding for which a current hazard mitigation plan is a prerequisite.

2.2.2 Changes in Development

Hazard mitigation plan updates must be revised to reflect changes in development within the planning area during the previous performance period of the plan (44 CFR Section 201.6(d)(3)). The plan must describe changes in development in hazard-prone areas that increased or decreased vulnerability for each jurisdiction since the last plan was approved. If no changes in development impacted the jurisdiction’s overall vulnerability, plan updates may validate the information in the previously approved plan. The intent of this requirement is to ensure that the mitigation strategy continues to address the risk and vulnerability of existing and potential development and takes into consideration possible future conditions that could impact vulnerability.

The planning area experienced a 1.55-percent increase in population between 2010 and 2020, an average growth rate of 1.05 percent per year. Sonoma County and its incorporated cities have general plans that govern land-use decisions and policymaking, as well as building codes and specialty ordinances based on state and federal mandates. This plan update assumes that some new development triggered by increased population occurred in hazard areas. Because all such new development would have been regulated pursuant to local programs and codes, it is assumed that vulnerability did not increase even if exposure did. More detailed information on the types and location of new construction over the last five years is available in the city and County annexes in Volume 2 of this plan.

Since the scope and scale of this plan update was significantly different than that of the 2016 plan (multi-jurisdictional vs. single-jurisdictional) and different data and methodologies were applied to community profiling and risk assessment, it was not possible to compare growth demographic data between the two plans. Therefore, this plan update will be treated as the baseline for growth trend comparative analyses for future plan updates that will include the following metrics:

- Change in population over the performance period
- Change in general building stock within the planning area over the performance period
- Change in the value of the general building stock over the performance period
- Change in land-use over the performance period

2.2.3 Multi-Jurisdictional Planning

Unlike the current update, the original Sonoma County hazard mitigation plan and previous updates were prepared for the County only. No municipalities or special purpose districts participated in those earlier versions. This was driven by the fact that most of the eligible local governments within the planning area had developed their own plans or did not see a need for one.

During the performance period of the 2016 plan, extensive outreach within the operational area was performed by Permit Sonoma as well as Sonoma County Emergency Management on the net benefits of working together as a multi-jurisdictional partnership through a collaborative effort. This was spurred by response efforts to the numerous catastrophic wildfires that impacted the operational area during the performance period. Thus, a multi-jurisdictional partnership was formed. While this 2021 plan update does not include all eligible local governments within the Sonoma County Operational Area, it does represent an enhanced effort in collaboration and coordination with these entities.

2.3 THE UPDATED PLAN—WHAT IS DIFFERENT?

The updated plan differs from the initial plan in a variety of ways. Table 2-1 indicates the major changes between the two plans as they relate to 44 CFR planning requirements.

Table 2-1. Plan Changes Crosswalk

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: *(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;* *(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and* *(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.*	The planning process for the 2016 plan is summarized in the introduction section of the plan. The plan update was facilitated through an Oversight Committee made up predominately of County staff. The Oversight Committee developed a public outreach strategy in accordance with FEMA guidelines. This strategy includes coordinated messaging through a variety of mediums to ensure the whole community is informed of the Plan and initiatives. Risks were re-evaluated using updated data. The Mitigations strategies were reviewed and updated as needed. The actions were prioritized according to the same methodology as was used on the 2011 plan.	The scope and scale of the plan was changed from a single jurisdiction scope to a multi-jurisdictional scope. This plan update process built upon the successes of the 2016 planning effort using an approach tied more closely to maximizing credit potential under FEMA's Community Rating System (CRS) program. This included: • Plan update was facilitated through a stakeholder Steering Committee made up of planning partners and other key stakeholders • A two-phase public outreach strategy deployed to gauge the public's perception of risk early in the process, and an opportunity to comment on the draft plan late in the process. • A strategy for agency coordination and inclusion in the plan update process • A comprehensive core capability assessment process designed to identify existing core capabilities that can support or enhance the outcomes of this plan. • All of this is documented in Volume 1, Chapter 3 of the plan update
§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.	The Plan includes a detailed risk assessment of 4 identified hazards of concern (Seismic, Flood, Wildfire and Landslide). Each hazard of concern was profiled to provide the following information: • General description of the hazard including type, location, and extent of all hazards that impact each jurisdiction within the planning area. • Discussion of destructive characteristics from a national and local perspective • Information on historical occurrences of hazard events • The probability of future hazard occurrence	Volume 1 Part 2 presents a risk assessment of 9 hazards of concern. These identified hazards were expanded from the 2016 plan to include Dam Failure, Drought, Severe Weather, Sea-level Rise, and Tsunami as stand-alone hazard profiles. The hazards are profiled as they impact the Sonoma County planning area. Hazard profiles are standardized for each hazard of concern, so that there is uniformity in the discussion of each hazard and the information provided can support rating of risk for each jurisdiction. Other hazards of interest were qualitatively assessed to develop a more complete picture of the hazards facing the planning area. The planning area for this update was expanded from that utilized in the 2016 plan to include the entire Sonoma County operational area.

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(2)(i): [The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.	Each hazard of concern was profiled to include: • Hazard Description • Hazard History • Future Potential • Exposure and Vulnerability • Impact and Loss Estimates • Plans • Codes and Regulations • Mitigation Programs and Activities • Financial Resources Note that the scope of these profiles was for the unincorporated areas of the county only.	Volume 1 Part 2 presents a risk assessment of each hazard of concern. Each chapter includes the following components: • Hazard profile, including maps of extent and location, historical occurrences, frequency, severity, and warning time. • Secondary hazards • Exposure of people, property, critical facilities and environment. • Vulnerability of people, property, critical facilities and environment. • Future trends in development • Scenarios • Issues
§201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i). This description shall include an overall summary of each hazard and its impact on the community	Each hazard profile included a vulnerability component. For the Seismic hazard, Hazus was utilized following the level I protocol. For the other hazards, the loss estimation (vulnerability) was more qualitative with and emphasis on exposure.	Vulnerability was assessed for all hazards of concern. The Hazus risk assessment platform (V 4.2) was used for the dam failure, earthquake, flood, sea level rise and tsunami hazards. These were Level 2 (user defined) analyses using city and County data. Site-specific data on County-identified critical facilities were entered into the Hazus model. Hazus outputs were generated for other hazards by applying an estimated damage function to an asset inventory extracted from Hazus. The risk assessment methodology for this plan update is described in Part 2, Chapter 6 of this volume
§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods	The Flood Hazard chapter of the plan included a profile on repetitive loss properties within the unincorporated areas of the county.	Volume 1, Part 2, Chapter 10, Section 10.5.2 of the plan includes a comprehensive analysis of repetitive loss areas that includes an inventory of the number and types of structures in the repetitive loss area. Repetitive loss areas are delineated, causes of repetitive flooding are cited, and these areas are reflected on maps. This analysis includes all repetitive loss properties within the county.
§201.6©(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.	The 2016 plan does include building exposure counts for each hazard assessed, but it emphasizes County-owned structures and does not include details on the General Building stock. Focus of this analysis is on the unincorporated areas of the county.	The current update used Hazus to model impacts from dam failure, earthquake, flood, sea-level rise and tsunami. A complete inventory of the numbers and types of buildings exposed was generated for each hazard of concern. Critical facilities were defined for the planning area, and these facilities were inventoried by exposure. Each hazard chapter provides a discussion on future development trends.

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) and a description of the methodology used to prepare the estimate.	With the exception for the Earthquake hazard, the 2016 plan does not estimate losses. The focus for this component of the plan is on exposure. The earthquake hazard does include Hazus modeling that includes loss estimation.	Dollar loss estimates were generated for all hazards of concern. These estimates were generated by Hazus for the dam failure, earthquake, flood and Tsunami. For the other hazards, loss estimates were generated by applying a regionally relevant damage function to the exposed inventory. In all cases, a damage function was applied to an asset inventory. The asset inventory was the same for all hazards and was generated in Hazus.
§201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.	The hazard profiles do address land uses within the unincorporated areas of the county. This was done by looking at the County land-use designations in each hazard area.	There is a discussion of the overall land use within the planning area, and a spatial analysis of land use was performed for hazards with a clearly defined extent and location. There is a discussion on future development trends as they pertain to each hazard of concern. This discussion looks predominantly at the existing land use and the current regulatory environment that dictates this land use.
§201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.	The 2016 plan includes mitigation actions developed to minimize the county's vulnerabilities to natural hazards. It sets forth the measures the County will pursue as part of 2016 – 2021 performance period. This strategy Was derived from: • The in-depth consideration of the county's existing hazard vulnerabilities and • The state and County goals and objectives to protect public health and safety, reducing injury, damage, and disruption from disaster events.	The plan contains a mission statement, goals, objectives and actions. The actions are jurisdiction specific and strive to meet multiple objectives. The objectives of this plan are broad but measurable. All objectives meet multiple goals and stand alone as components of the plan. Each planning partner was asked to complete a capability assessment that looks at its regulatory, technical, and financial capabilities.
§201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.	The 2016 plan identified 4 goals and 6 objectives for the plan. These goals and objectives were consistent with goals and objectives within the County General Plan.	A mission statement, eight goals, and 12 objectives are described in Part 3 of this volume. Goals were adapted from those in the 2016 plan. Objectives were identified that meet multiple goals and were used to help establish priorities for the action items identified in the plan. The objectives are measurable components of the plan and are the basis for identifying and prioritizing multi-objective actions.

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.	The 2016 plan identifies a range of mitigation actions under each of the 6 identified objectives for the plan. Actions are identified for each hazard of concern as well as "multi-hazard actions. Actions identified could be applied to both new or existing structures, or both.	Volume 1, Part 3 includes a catalog of mitigation best management practices that was developed through a facilitated process. This catalog identifies actions that manipulate the hazard, reduce exposure to the hazard, reduce vulnerability, or increase mitigation capability. The catalog segregates actions by scale of implementation. A table in each planning partner's action plan analyzes each action by mitigation type to illustrate the range of actions selected.
§201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with the program's requirements, as appropriate.	The 2016 Plan addresses the NFIP in the context of the mapping available within the planning area. The Plan does address the NFIP as a financial resource available to mitigate the impacts of the flood hazard that does profile the Unincorporated County's participation in the NFIP. The Plan did include a mitigation action for the County to initiate an application to the CRS program.	The plan addresses the National Flood Insurance Program and the participation status of all cities within the county. Each municipal planning partner has profiled their NFIP status in their annex in volume 2 of the plan All municipal planning partners that participate in the NFIP identified an action stating their commitment to maintain compliance and good standing under the program.
§201.6(c)(3)(iii): [The mitigation strategy shall describe] how the actions identified in Section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	Multiple factors were considered to determine the mitigation priorities for the implementation period. Criteria considered included: • Greatest potential for protecting life and property in areas of highest risk or vulnerability, • The amount of vulnerability and the frequency of potential hazard occurrence, • Greatest potential to help assure critical County infrastructure, structures and government services remain functional following a disaster, • Cost/benefit assessments or considerations where available, • Compatibility with goals and objectives in the County General Plan Public Safety Element and Hazard Mitigation Plan, • Degree to which mitigation strategies help reduce repetitive flood loss properties and or help assure continued compliance with the NFIP, • Compatibility with goals, and funding priorities of the State Hazard Mitigation Plan, the California Earthquake Loss Reduction Plan and the State Flood Hazard Mitigation Plan • Achievability of social acceptance, technical feasibility, administrative, political, legal, economic and environmental considerations.	Each recommended action was prioritized using a qualitative methodology that looked at the objectives the project will meet, the timeline for completion, how the project will be funded, the impact of the project, the benefits of the project and the costs of the project. This prioritization scheme is detailed in the introduction to Volume 2 of this plan.

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.	The 2016 plan includes a chapter on plan maintenance that calls for: • Ensure the mitigation strategy is implemented according to the plan. • Provide the foundation for ongoing mitigation programs. • Standardize long-term monitoring of hazard-related activities. • Integrate mitigation principles into day-to-day operations throughout the county. • Maintain momentum through continued engagement and accountability.	Volume 1, Part 3 details a plan maintenance strategy for monitoring, evaluating, and updating the mitigation plan within a five-year cycle, that includes annual progress reporting.
§201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.	The plan maintenance strategy for the 2016 plan includes a goal to; "Integrate mitigation principles into day-to-day operations throughout the county".	Volume 1, Part 3 details recommendations for incorporating the plan into other planning mechanisms, such as: • Comprehensive plan • Emergency response plan • Capital improvement programs • Municipal code Specific current and future plan and program integration activities are detailed in each participating jurisdiction's annex in Volume 2.
§201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.	The plan maintenance strategy for the 2016 does not directly define a process for continued public participation.	Volume 1, Part 3 details a comprehensive strategy for continuing public involvement.
§201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commission, Tribal Council).	Adoption documentation and the FEMA approval letter were provided in the plan as appendix.	Volume 1, Appendix E includes all supporting documentation for adoption of the plan by all planning partners

3. PLAN UPDATE APPROACH

3.1 FUNDING

This planning effort was supplemented by a FEMA Hazard Mitigation Assistance grant (DR-4344-0054-P). Permit Sonoma, Sonoma County's land use planning and permitting agency, was the applicant agent for the grant. The grant covered 75 percent of the cost of developing the plan; planning partners covered the balance through in-kind matching.

3.2 DEFINING STAKEHOLDERS

At the beginning of the planning process, the planning team identified stakeholders to engage during the update of the hazard mitigation plan. For this process, "stakeholder" was defined as any person or public or private entity that owns or operates facilities that would benefit from the mitigation actions of this plan, and/or has an authority or capability to support mitigation actions identified by this plan. Stakeholders were separated into two categories:

- **Participatory Stakeholders**—Stakeholders that actively participated in the planning process as planning partners or members of the Steering Committee.
- **Coordinating Stakeholders**—Stakeholders that were not able to commit to actively participating in the process as a participatory stakeholder but were kept apprised of plan development milestones or were able to provide data that was used in the plan development.

3.3 FORMATION OF THE CORE PLANNING TEAM

Permit Sonoma contracted with Tetra Tech, Inc. to assist with development, update, and implementation of the plan. The Tetra Tech project manager managed the overall plan development; Tetra Tech's lead planner was tasked with interacting with the Permit Sonoma grant manager. A core planning team was formed to lead the planning effort, made up of the following members:

- Lisa Hulette, Permit Sonoma, Grants Manager
- Domenica Giovannini, Permit Sonoma, Policy Manager
- Shelly Bianchi-Williamson, Permit Sonoma, GIS Supervisor
- Rob Flaner, Tetra Tech, Project Manager
- Bart Spencer, Tetra Tech, Project Lead Planner
- Carol Baumann, Tetra Tech, Risk Assessment Lead
- Des Alexander, Tetra Tech, Hazard Profiling Lead

3.4 ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Sonoma County opened this planning effort to all eligible local governments within the planning area. The planning team made a presentation at a stakeholder kickoff meeting on June 2, 2020, to introduce the mitigation planning process and solicit planning partners. Key meeting objectives were as follows:

- Provide an overview of the Disaster Mitigation Act
- Describe the reasons for a plan
- Outline the hazard mitigation plan update- work plan
- Outline planning partner expectations
- Seek commitment to the planning partnership
- Seek volunteers for the Steering Committee

Each jurisdiction wishing to join the planning partnership was asked to provide a *letter of intent to participate* that designated a point of contact for the jurisdiction and confirmed the jurisdiction's commitment to the process and understanding of expectations. Linkage procedures have been established (see Volume 2 of this plan) for any jurisdiction wishing to link to this hazard mitigation plan in the future. The planning partners covered under this plan are shown in Table 3-1.

Table 3-1. Hazard Mitigation Planning Partners

Jurisdiction	Point of Contact	Title
County of Sonoma	Lisa Hulette	Department Program Manager
City of Cotati	Damien O'Bid	City Manager
City of Santa Rosa	Shari Meads	City Planner
City of Sonoma	Wayne Wirick	Development Services Director
Town of Windsor	Kim Jordan	Planner III
Cloverdale Fire Protection District	Jason Jenkins	Chief
North Sonoma Coast Fire Protection District	Bonnie Plakos	Chief
Northern Sonoma County Fire Protection District	Marshall Turbeville	Chief
Rancho Adobe Fire Protection District	Andy Taylor	Chief
Sonoma Valley Fire District	Trevor Smith	Fire Marshal
Timber Cove Fire Protection District	Erich Lynn	Chief
Gold Ridge Resource Conservation District	Brittany Heck	Executive Director
Sonoma Resource Conservation District	Valerie Minton	Executive Director
Sonoma County Agricultural Preservation & Open Space District	Sheri Emerson	Stewardship Manager

3.5 DEFINING THE PLANNING AREA

The planning area was defined to consist of the unincorporated county, incorporated cities, and special purpose districts within the geographical boundary of Sonoma County. All partners to this plan have jurisdictional authority within this planning area. A map showing the geographic boundary of the defined planning area for this plan update is provided in Chapter 4, along with a description of planning area characteristics.

3.6 THE STEERING COMMITTEE

Hazard mitigation planning enhances collaboration among diverse parties who can be affected by hazard losses. A key element of the public engagement strategy for this plan update was the formation of a stakeholder steering committee to oversee all phases of the update. The members of this committee included planning partner representatives, citizens, and other stakeholders from within the planning area. The planning team assembled a list of candidates representing interests within the planning area that could have recommendations for the plan or be impacted by its recommendations. The planning partners confirmed a committee at the kickoff meeting. Table 3-2 lists the Steering Committee members and their designated alternates.

Leadership roles and ground rules were established during the Steering Committee's first meeting. The Steering Committee then met about every other month as needed throughout the course of the plan's development. The planning team facilitated each Steering Committee meeting, which addressed a set of objectives based on an established work plan. The Steering Committee met nine times from June 2020 through June 2021. Meeting summaries and attendance logs are provided in Appendix A to this volume. All Steering Committee meetings were open to the public and were advertised as such on the hazard mitigation plan website. Agendas were posted to the website prior to each scheduled Steering Committee meeting, and meeting summaries were posted to the hazard mitigation plan website following their approval by the Steering Committee.

3.7 COORDINATION WITH STAKEHOLDERS AND AGENCIES

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). Agency coordination for this plan was accomplished as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - American Red Cross-Northern California Coastal Region
  - California Department of Water Resources, California State National Flood Insurance Program Coordinator
  - California Office of Emergency Services, Emergency Services Coordinator
  - FEMA Region IX, Lead Community Planner
  - U.S. Geological Survey, Science Advisor
  - California Department of Transportation, Director-District 1
  - Bureau of Land Management, Tribal Relations
  - California Department of Forestry and Fire Protection, Resource Management Division
  - Cloverdale Rancheria
  - Dry Creek Rancheria
  - Federated Indians of Graton Rancheria
  - Kashia Pomo Stewarts Point Rancheria
  - Lytton Rancheria
  - Middletown Rancheria
  - Mishewal Wappo Tribe
  - Torres Martinez Desert Cahuila Indians

Table 3-2. Steering Committee Members

Name	Title	Jurisdiction/Agency
PRIMARY MEMBERS		
Lisa Hulette (committee chair)	Project Manager	County of Sonoma, Permit Sonoma
Gary Helfrich	Planner	County of Sonoma, Permit Sonoma
Shelley Bianchi-Williamson	GIS Supervisor	County of Sonoma, Permit Sonoma
Richard Diaz	Deputy Emergency Coordinator	County of Sonoma, Emergency Management
Hunter McLaughlin	Engineer	County of Sonoma, Public Works
Domenica Giovannini	PIO	County of Sonoma, Permit Sonoma
Kimberly Jordan	Planner	Town of Windsor
Shari Meads	City Planner	City of Santa Rosa
Katherine Duran	Administrative Analyst	City of Cotati
Karen Gaffney	Program Manager	Sonoma County Agricultural Preservation & Open Space District
Mollie Asay	Grants & Funded Projects	Sonoma Water
Marshall Turbeville	District Fire Chief	Northern Sonoma County Fire District
Scott Westrope	Deputy Fire Chief	Santa Rosa City Fire
Ben Nicholls	Division Chief	CAL Fire
Sarah Newkirk	Senior Project Director	The Nature Conservancy
Lisa Micheli	President & CEO	Pepperwood Preserve
Kirsten Larsen	Environmental Compliance Manager	Community Development Commission
Robert Cantu	President/Chair, Construction Coalition Steering Committee	Western Builders
Karissa Kruse	Executive Director	Sonoma County Winegrowers
DESIGNATED ALTERNATES		
John Mack	Natural Resource Manager	County of Sonoma, Permit Sonoma
Cecily Condon	Supervising Planner	County of Sonoma, Permit Sonoma
Caerleon Safford	Fire Inspector	County of Sonoma, Fire Prevention
Lisa Figueroa	Deputy Emergency Services Coordinator	County of Sonoma, Emergency Management
Adrianne Garayalde	Department Analyst	County of Sonoma, Public Works
Mickie Tagle	Senior Management Analyst	Town of Windsor
Amy Lyle	Supervising Planner	City of Santa Rosa
Damian O'Bid	City Manager	City of Cotati
Sheri Emerson	Stewardship Program Manager	Sonoma County Agricultural Preservation & Open Space District
Steve Hancock	Emergency Preparedness & Response Manager	Sonoma Water
Shane Vargas	Fire Captain	CalFire
Chase Beckman	Fire Captain	CalFire
Shane Galvez	Fire Captain	CalFire
Elizabeth Forsburg	Associate Director	The Nature Conservancy
Mark Chandler	Housing Rehabilitation Specialist	Community Development Commission
Kate Piontek	VP of Operations & Sustainability	Sonoma County Winegrowers

These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process and were provided the option to attend meetings. Some agencies supported the effort by attending meetings or providing feedback on issues.

- **Pre-Adoption Review**—All the agencies listed above were provided an opportunity to review and comment on this plan, primarily through the hazard mitigation plan website (see Section 3.9). All were sent an e-mail message informing them that draft portions of the plan were available for review. Upon completion of a public comment period, a complete draft plan was sent to the California Office of Emergency Services for a pre-adoption review to ensure program compliance.

3.8 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). Chapter 5 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation actions. In addition, the following programs can affect mitigation within the planning area:

- California Fire Code
- California Fire Alliance
- 2019 California Building Code
- California State Hazard Mitigation Forum
- Local capital improvement programs
- Local emergency operations plans
- Local general plans
- Local tribal hazard mitigation plans
- Housing elements of general plans
- Safety elements of general plans
- Local zoning ordinances
- Local coastal program policies.
- Sonoma County Operational Area Emergency Operations Plan (2014)—This is an emergency support function-based plan that directs emergency response actions in the planning area
- Sonoma County General Plan 2020 (adopted by resolution, September 2008; amended by resolution, August 2016)—This plan directs land use policy in Sonoma County
- Sonoma County Local Coastal Plan, Bodega Bay Focused Vulnerability Assessment and Adaptation Strategies (September 2019)
- Sonoma County Five-Year Strategic Plan (March 2021)—This plan includes the goals that will shape the County’s priorities over the next five years. It includes *Climate Action and Resiliency* and *Resilient Infrastructure*.
- Regional Climate Protection Authority, Regional Climate Action Plan (2016)
- Sonoma County Community Wildfire Protection Plan (2016)

Assessments of all planning partners’ regulatory, technical, and financial capabilities to implement hazard mitigation actions are presented in the individual jurisdiction-specific annexes in Volume 2. Many of these relevant plans, studies and regulations are cited in the capability assessments.

3.9 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about local needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1). The Community Rating System expands on these requirements by making CRS credits available for optional public involvement activities. For this plan update, “public” has been defined as the general public within the Sonoma County planning area. This includes, but is not limited to:

- Residents
- Tribal members
- Tourists
- Employers within the planning area
- Employees within the planning area
- Students (primary and secondary education levels).

3.9.1 Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Steering Committee.
- Use a survey to determine if the public’s perception of risk and support of hazard mitigation has changed since the initial planning process.
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan, including all planning partners. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. In addition to planning partners and those represented on the steering committee, the planning team invited all potential stakeholders listed in Section 3.7 to actively participate in the plan update process.

Internet

At the beginning of the planning process, a website was created to keep the public posted on plan development milestones and to solicit relevant input (see Figure 3-1). The site’s address was publicized in all press releases, mailings, surveys, and public meetings (https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/Hazard-Mitigation-Update/).

Figure 3-1. Sample Page from Hazard Mitigation Plan Web Site

Each planning partner established a link to this site on its own agency website. Information on the plan development process, the Steering Committee, a plan survey, and drafts of the plan was made available to the public on the site throughout the process. Sonoma County intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

Story Map

A "Story Map" was created, using ESRI Story Map software, to communicate the variety and severity of hazard risks facing Sonoma County (see Figure 3-2). The applicability of the Story Map goes beyond the life of the hazard mitigation plan update, meaning that it will remain with the County (on its own ESRI account) and continue as a template to support visual and data-based communication about the range of hazards relevant in the planning area. New and revised data can be loaded into the platform in the future to compare hazard risk with any other spatial data set (i.e. soft story structure inventory, social vulnerability data, etc.).

During the update process, the Story Map was released to the public and promoted through social media and the project website. It included risk assessment results for all relevant hazards, an interactive hazard mapping tool, and a report function to produce comprehensive hazard exposure summaries for any given property, block, or defined area. The Story Map expanded opportunities for public outreach and the ways in which members of the public could interact with hazard data as the hazard mitigation plan update was underway.

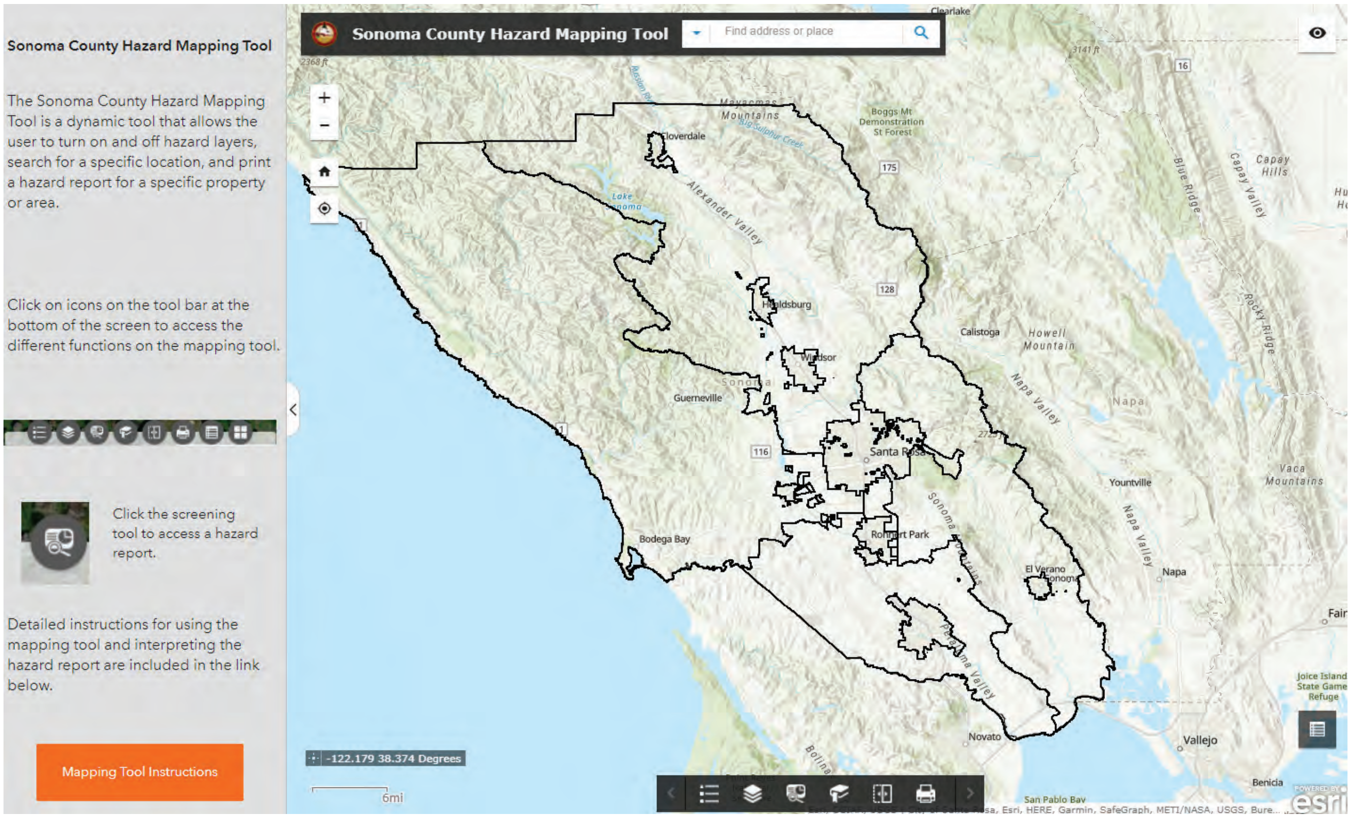


Figure 3-2. Example Story Map Data Page

Survey

A hazard mitigation plan survey (see Figure 3-3) was developed by the planning team with guidance from the Steering Committee. The survey was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards. This survey was designed to help identify areas vulnerable to one or more natural hazards. The answers to its 42 questions helped guide the Steering Committee in selecting goals, objectives and mitigation strategies. The survey was made available on the hazard mitigation plan website and advertised throughout the course of the planning process. During the course of this planning process, 691 completed surveys were submitted. The complete survey and a summary of its findings can be found in Appendix A of this volume.

Public Outreach

The public outreach process for this plan update consisted of general outreach information during various partner meetings and events. A virtual public meeting was held on February 15, 2021 to present the Story Map and describe the hazard mitigation plan update process. The draft plan was made available to the public for comment during a noticed, two-week period, June 14 – 28, 2021. A virtual public meeting was held on the evening of July 21, 2021. The format of the meeting was a short overview of the planning process, plan content and how to comment, followed by breakout rooms sponsored by each municipal planning partner to allow for jurisdiction-specific public comment opportunities. The meeting gave the public an opportunity to comment on the draft plan update prior to its submittal to the California Governor’s Office of Emergency Services (Cal OES) and FEMA. The principle avenue for public comment on the draft plan was the website established for this plan update.

Sonoma County 2020 Hazard Mitigation Plan Survey

Survey Introduction

A partnership of local governments and stakeholders in Sonoma County are working together to update the Sonoma County Multijurisdictional Hazards Mitigation Plan. This will enable the jurisdictions to use pre- and post-disaster financial assistance to reduce the exposure of County residents to risks associated with hazards.

To better identify and plan for future disasters, we need your assistance. This questionnaire is designed to help us gauge the level of knowledge local citizens already have about disaster issues and to find out from local residents about areas vulnerable to various types of natural disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of 30 questions plus an opportunity for any additional comments at the end. The survey should take less than 10 minutes to complete and is anonymous. When you have finished the survey, please click "Done" on the final page.

The Sonoma County Hazard Mitigation Planning Partnership thanks you for taking the time to participate in this information-gathering process.

* 1. Where in Sonoma County do you live or generally stay?

Sonoma	Rohnert Park	Windsor
Petaluma	Santa Rosa	unincorporated area of the County
Cotati	Cloverdale	I don't live in Sonoma County
Healdsburg	Sebastopol	

Other (please specify)

Figure 3-3. Sample Page from Survey Distributed to the Public

In order to engage non-English-speakers in the outreach, all social media posts and the agendas and minutes for Steering Committee meetings were posted in English and Spanish, and a translator was available during the virtual meetings to interpret the presentation and discussion into Spanish. The translator service was advertised in meeting announcements and as each meeting was underway. Spanish-speaking participants could take advantage of this service by joining a break-out room of the virtual meeting. No participants chose to use this service.

3.9.2 Public Involvement Results

Survey

Detailed analysis of the survey findings is presented in Appendix A; a summary is as follows:

- 691 surveys were completed.
- Surveys were received from each planning partner.
- Survey respondents ranked the wildland fire as the hazard of greatest concern, followed by climate change, drought, earthquake, severe weather, sea-level rise, and flood.
- 81 percent of respondents reported having experienced an evacuation, over 76 percent reported having experienced a wildland fire, and more than 70 percent reported having experienced drought.
- Most respondents (75.71 percent) felt that personal experience with one or more natural hazards/disasters provided useful hazard and disaster preparedness information to the public, followed by emergency preparedness information from government sources (federal, state, or local) (75.39 percent).
- Most respondents (39.81 percent) stated that they could survive for 4 to 7 days following a natural hazard event based on their preparedness. 8 to 15 days (24.01 percent), 1 to 3 days (19.43 percent), and 16 days or more (15.80 percent) were the next most common responses. Only 0.95 percent of respondents stated they would survive 0 days.

Survey results were provided to the Steering Committee for use in support of confirming the guiding principle, goals, objectives and county-wide actions for this plan update. Additionally, the survey results were included in the toolkit provided to each planning partner through the jurisdictional annex process described in Volume 2. Each planning partner was able to use the survey results to help identify actions as follows:

- Gauge the public’s perception of risk and identify what citizens are concerned about.
- Identify the best ways to communicate with the public.
- Determine the level of public support for different mitigation strategies.
- Understand the public’s willingness to invest in hazard mitigation.

Public Outreach Events

The public involvement strategy used for this plan update introduced the concept of mitigation to the public and provided the Steering Committee with feedback to use in developing the plan. All citizens of the planning area were provided ample opportunities to provide comment during all phases of this plan update process. Details of attendance and comments received from the public outreach events are summarized in Table 3-3.

Table 3-3. Summary of Public Outreach Events

Date	Location	Number of Attendees
2/25/2021	Virtual Public Meeting (Story Map Presentation)	109
Presentations at Meetings of Community Organizations		
4/7/2021	Windsor Senior Citizens Advisory Committee	24
5/10/2021	Bodega Bay Community Emergency Response Team	16
5/11/2021	Oakmont Citizens Advisory Committee	92
5/11/2021	Cotati City Council Meeting	56
5/12/2021	Town of Windsor Parks and Recreation	44
5/12/2021	Mark West Community Advisory Committee	72
5/17/2021	North County Citizens Organized to Prepare for Emergency	~25
5/20/2021	California Wildfire Recovery Roundtable	~70
5/25/2021	Springs Citizens Organized to Prepare for Emergency	~50
5/25/2021	Town of Windsor Planning Commission	17
6/14 – 28/2021	Open Public Comment Period	N/A
7/21	Virtual Public meeting to present the draft plan and to allow opportunity for public comment	49
Total		~624

3.10 PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

Table 3-4 summarizes important milestones in the plan update process.

Table 3-4. Plan Development Chronology/Milestones

Date	Event	Description	Attendance
2020			
4/21	Organize Resources	County selects Tetra Tech as its technical assistance contractor to facilitate the plan update process.	N/A
4/23	Organize Resources	Sonoma County Board of Commissioners approves contract with Tetra Tech and authorizes the notice to proceed on work for the update.	N/A
6/2	Project Kickoff Meeting	• Review work plan • Discuss planning partner expectations • Organize Steering Committee • Risk assessment data needs • Discuss public involvement strategy • Homework: review prior plan and state plan	24
6/26	Core Planning Team Meeting #1	• Finalize planning partnership roster • Discuss risk assessment data needs • Finalize agenda for Steering Committee meeting #1	6
7/20	Public Outreach	• Hazard mitigation plan website adapted for information on 2021 plan update process.	N/A
7/23	Steering Committee Meeting #1	• Homework report out: Review Sonoma County chapter of state hazard mitigation plan • Project overview • Role of the Steering Committee • Introduce Phase 1 jurisdictional annex process • Confirm ground rules and charter • Discuss public outreach strategy	25

Date	Event	Description	Attendance
7/23	Steering Committee Debrief	• Detail wrap-up from 1st Steering Committee meeting • Discuss future meeting interactivity • Discuss facilitation • GIS needs	4
Aug.	Sonoma County Wildfires	• Sonoma County wildfires caused postponing of core planning team and Steering Committee meetings	
9/10	Core Planning Team Meeting #2	• Phase 1 instructions and forms • GIS meeting • Inclusion of tribal communities in planning process • Goals and Objectives • Mission Statement • Agenda for next Steering Committee Meeting	7
9/21	Core Planning Team Meeting #3	• GIS Roundtable • Review existing and pending hazard data sources • Identify data gaps	13
9/24	Steering Committee Meeting #2	• Confirm Steering Committee rules, mission statement • Review homework: previous County hazard mitigation plan and State hazard mitigation plan • Confirm hazards of concern • Public involvement strategy	25
10/15	Core Planning Team Meeting #4	• GIS Roundtable • Focused on flood/tsunami/sea level rise risk assessment scenarios	13
10/21	Core Planning Team Meeting #5	• Clarification on Phase 1 annex process • Discuss critical facilities	6
10/22	Steering Committee Meeting #3	• Planning Process • Community Lifelines framework • Jurisdictional Annex Process • Public Involvement Strategy	24
11/5	Core Planning Team Meeting #6	• GIS Roundtable • Dam Failure, Earthquakes, and Landslide/Mass Movement data needs	13
11/19	Phase II Annex Meeting	• Overview of Phase 2 process • Critical facilities discussion	11
11/19	Steering Committee Meeting #4	• Finalize goals and objectives • Survey review • Public engagement	19
12/8	Core Planning Team Meeting #7	• Story Map • Phase 2 Annex Status • Survey release	6
11/19	Public Outreach	• Hazard mitigation plan survey released	N/A
11/19	Planning Process	• Workshop for planning partners to work together to complete Phase 2 of the jurisdictional annex process. Remote technical support provided by Tetra tech	12
12/17	Steering Committee Meeting #5	• Confirm objectives • Overview of Phase 3 process • Survey status • Public engagement	21

Date	Event	Description	Attendance
2021			
1/11	Core Planning Team Meeting #8	• Phase 2 annexes • Story Map • Survey	6
1/19	Core Planning Team Meeting #9	• Phase 2 jurisdictional annex status report • Phase 3 workshops • Hazard analysis status • Survey status and responses	8
1/28	Steering Committee Meeting #6	• Phase 2 jurisdictional annex process status • Phase 3 workshop schedule • Development of action items • Public engagement updates	24
2/11	Core Planning Team Meeting #10	• Discuss March public meeting	6
2/23	Public Meeting Practice Run	• Discuss zoom protocol • Show Story Map to Sonoma County core planning team	6
2/25	Steering Committee Meeting #7	• Plan progress report • Upcoming Phase 3 workshops • Discuss plan maintenance strategy • Discuss public meeting	18
2/25	1st Public Meeting	• Discuss hazard mitigation plan process and plan • Show Sonoma County Story Map to the public	109
4/22	Steering Committee Meeting #8	• Discuss plan progress • Draft plan release date • Public comment period • Next public meeting date	20
5/12	Core Planning Team Meeting #11	• Public comment process	6
4/27 – 5/25	Public Outreach	Meeting with community groups to provide information about hazard mitigation plan	~650
6/1 – 6/24	Stakeholder Draft Review	Tetra Tech sent draft hazard mitigation plan and corresponding annexes to Steering Committee, planning partners, and core planning team	N/A
7/12	Public Outreach	Opening of the 2-week public comment period	N/A
7/21	Public Outreach	Virtual Public Meeting to present the Draft Plan	49
7/30	Public Outreach	Closure of the 2-week public comment period	N/A
8/6	Plan Submittal	Pre-adoption review draft of the plan submitted to Cal OES.	N/A
9/27	APA	Approval Pending Adoption (APA) provided by FEMA	N/A
10/26	Adoption	Adoption window opens for planning partnership	N/A
12/14/2021	FEMA Final Approval	Final Plan approval issued by FEMA Region IX	N/A

4. SONOMA COUNTY PROFILE

4.1 GEOGRAPHIC OVERVIEW

Sonoma County, the most northerly of the nine counties in the San Francisco Bay Region, is located along the Pacific coastline about 40 miles north of San Francisco and the Golden Gate Bridge. At just over 1,500 square miles, it is the largest of the nine Bay Area counties. Sonoma County is bordered by the Pacific Ocean on the west, Marin County and San Pablo Bay to the south, Solano, Napa and Lake Counties to the east, and Mendocino County to the north (see Figure 4-1).

The major population centers in Sonoma County are the incorporated cities of Cloverdale, Cotati, Healdsburg, Petaluma, Rohnert Park, Santa Rosa, Sebastopol, Sonoma, and Windsor. Unincorporated communities include Annapolis, Bodega, Bodega Bay, Cazadero, Duncans Mills, Forestville, Fort Ross, Geyserville, Glen Ellen, Graton, Guerneville, Kenwood, Jenner, Monte Rio, Occidental, Salmon Creek, and The Sea Ranch. Santa Rosa, centrally located in the county, is the county seat and most populous city.

U.S. Highway 101 is the main highway in the county, running north to south through the county's center. Highway 1 follows the coastline along most of the county's western boundary. Other major roadways are State Highways 12, 37, 116, 121 and 128. Airports include Charles M. Schulz–Sonoma County Airport in Santa Rosa and the Sonoma Valley Airport and Sonoma Skypark in the City of Sonoma. Sonoma County Transit buses run countywide. The SMART Train (Sonoma–Marin Area Rail Transit) carries passengers from the Charles M. Schulz–Sonoma County Airport to Larkspur in Marin County; future extensions as far north as Cloverdale are planned.

The Sonoma County Board of Supervisors sits as the governing board of Sonoma County and of various special jurisdictions such as the Sonoma County Water Agency, the Northern Sonoma County Air Pollution Control District, the Agricultural Preservation and Open Space District, County Sanitation Districts, and the Community Development Commission. The Board is composed of five supervisors elected from supervisorial districts for four year terms. The risk analysis for this hazard mitigation plan assessed risk both countywide and for each supervisorial district. The boundaries of these districts are included on Figure 4-1.

Figure 4-1. Sonoma County Planning Area

4.2 HISTORICAL OVERVIEW

Early peoples began to settle in Sonoma Valley roughly 12,000 years ago, attracted by fertile soil, water, game, fish, wild oats, berries, acorns, and other natural resources. The name Sonoma may have derived from an indigenous word for “many moons,” or may come from “noma,” a Miyakmah word for town (Sonomavalley.com 2021). Eventually, these early resident numbered about 5,000 people across a number of tribes:

- Miwoks along the coast
- Wintuns, Wapo and Miyakmahs in the north near the Mayacamas Mountain Range
- Pomos in the lower valley
- Koskiwok near the edge of San Pablo Bay
- Patwins in the southeast corner

These early peoples lived in long, multi-family grass- and tule-thatched huts with communal cooking areas. Life focused on gathering and preparing food and tribal celebrations—religious and otherwise. Their activities included trade between tribes and clearing land (by burning) to expose game.

In 1812, Russians established the short-lived Fort Ross along the coast north of the Russian River. In the early 19th century, Spanish explorers and missionaries arrived, looking for land and converts and hoping to set up a bulwark against the Russians, who had advanced down the coast from the north. In 1823, Franciscan missionaries established the mission San Francisco Solano de Sonoma. The Mission regime was harsh, and a rebellion in 1826 caused mission founder Fr. Jose Altamira to flee Sonoma Valley. A memorial outside Sonoma’s restored mission bears the names of the native people who died there.

Sonoma became the county’s first town, a pueblo, under General Mariano Vallejo. Sections of the county were transformed into land-grant ranchos, such as Vallejo’s holdings that extended from today’s Petaluma to the town of Sonoma (County of Sonoma n.d.). The continual encroachment of European and American settlers overwhelmed the native population. By the late 1800s, indigenous tribes had all but vanished as a society. Many died from smallpox and measles; others were sent north to reservations or absorbed into the burgeoning new pueblo of Sonoma.

Sonoma County was one of the original counties when California achieved statehood on September 9, 1850. The county seat of Sonoma County was moved to Santa Rosa in 1854 (City of Sonoma 2017). After statehood, logging along the coast hills, cattle ranching, wheat and potato farming, and the early development of the wine industry supported the sparsely settled county. During the 1860s to the 1890s, Petaluma, at the head of navigation on the Petaluma Creek, enjoyed rapid economic growth that fueled the construction of its downtown.

Later, the railroads facilitated the movement of goods and people, leading to the establishment of processing plants and factories along the rail lines. Around the turn of the century, the Russian River developed as a vacation resort, a destination for those in the San Francisco Bay Area. During this time, Santa Rosa saw an increase in population and importance as the center of finance and county government. Until World War II, the poultry industry, the processing of local fruit, and the production of hops sustained the economy throughout the county. In 1935, Sonoma County ranked tenth in the nation in overall agricultural production.

Today the southwestern part of the county continues to support cattle grazing and dairy farms. Toward the north, many of the ranches and orchards have been replaced with acres of vineyards and thriving winery operations.

Over the years many of the poultry farms, fruit growers, and dairy operations have relocated to the Central Valley. In their place, small specialty farms and ranches now operate sustainable and organic endeavors. Dotting the countryside throughout the county are modern residences where rural homesteads used to be. The Russian River area still caters to vacationers. The cities along the freeway continue to expand to provide housing and services with new subdivisions, business parks, and strip-mall shopping centers.

4.3 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration makes federal recovery programs available to help public entities, businesses, and individuals. Some disaster assistance programs are partially matched by state programs. Review of presidential disaster declarations helps establish the probability of reoccurrence for each hazard and identify targets for risk reduction. Table 4-1 shows the declared disasters that have affected Sonoma County through 2020 (records date back to 1964).

Table 4-1. Historical Sonoma County Natural Hazard Events

Year	Event Name	Dates	County EOC[a] Activated	Governor s Declaration	Presidential Declaration
1964	Heavy Rains and Flooding	Dec. 24			X
1969	Severe Storms, Flooding	Jan. 26			X
1981-1982	Severe Storms, Flood, Mudslides, High Tide	Dec. 19 – Jan. 8			X
1983	Coastal Storms, Floods, Slides, Tornadoes	Jan. 21 – Mar. 30			X
1986	Severe Storms, Flooding	Feb. 12 – Mar. 10			X
1990-1991	Freeze of ‘91	Dec. 90–Feb. 91		X	X
1993	Flood of ‘93	Jan. 20-25	X	X	X
1994	Fishing Emergency	May–Sep.		X	X
1995	Flood of ‘95, Part 1	Jan. 8-31	X	X	X
1995	Flood of ‘95, Part II	Mar. 7-15	X	X	X
1995	December Winter Storm	Dec. 11-12	X		
1996	February Winter Storm	Feb. 4-5	X		
1996	Cavedale Fire	Jul. 31–Aug. 20	X		
1996	Jenner Sandbarrier	Jul. 31–Aug. 20			
1996	Porter Creek Fire	Oct. 27-28	X		
1996-1997	New Year’s Flood	Dec. 30, 1996–Jan. 4, 1997	X	X	X
1997	Superbowl Flood	Jan. 25	X		
1998-2000	Flood of ‘98/ Rio Nido Debris Flow	Feb. 2, 1998–Jan. 4, 2000	X	X	X
1999	February Winter Storm	Feb. 8-10		X	
2002-2003	December Winter Storms	Dec. 17, 02–Apr. 8, 03			
2004	Geysers Fire	Sept. 3-8	X		
2005-2006	New Year’s Floods	Dec. 31, 05–Jan. 3, 06	X	X	X
2006	Late Spring Storms	Mar. 29-Apr. 16		X	X
2007	SF Oil Spill	Nov. 7		X	
2009	H1N1 Influenza Pandemic	Apr.-May			
2011	Great Tohoku Tsunami	Mar. 11	X	X	X

Year	Event Name	Dates	County EOC[a] Activated	Governor s Declaration	Presidential Declaration
2012	Holiday Decoration Flood	Dec. 2	X		
2013	Lopez Protests	Oct. 29 and Nov. 5	X		
2014-2016	Drought	Feb. 25		X	
2014	South Napa Earthquake	Aug. 24	X	X	X
2014	December Winter Storm	Dec. 11-12	X		
2015	Valley Fire	Sep. 12-25	X	X	X
2017	Severe Winter Storms, Flooding, and Mudslides	Jan. 3-12	X		X
2017	Severe Winter Storms, Flooding, Mudslides	Feb. 1-23	X		X
2017	LNU Complex Fires	October	X		
2017	Wildfires	Oct. 8-31			X
2018	PG&E Power Shutoff	October	X		
2019	Severe Winter Storms, Flooding, Landslides, Mudslides	Feb. 24 – Mar. 1	X		X
2019	PG&E Power Shutoff	October	X		
2019	Kincade Fire	Oct. 23 – Nov. 7	X	X	
2020	COVID-19 Pandemic	Jan. 20 – present	X	X	X
2020	Wildfires	Aug. 14 – Sept. 26			X
2020	Wildfires	Sept. 4 – Nov. 17			X

a. EOC = Emergency Operations Center
Sources: Sonoma County Department of Emergency Management, www.gov.ca.gov, www.fema.gov/disaster

4.4 PHYSICAL SETTING

4.4.1 Topology and Surface Waters

The broad, flat Santa Rosa Plain, which lies between the Sonoma Mountains on the east and low coastal hills on the west, contains the cities of Santa Rosa, Rohnert Park, and Cotati. The sparsely settled coastal area of the county includes redwood and mixed conifer forests in the north and rolling oak woodland, dairy lands, and coastal prairies in the south. The Mayacamas Range forms the eastern boundary of the county. The Mayacamas and Sonoma Mountain ranges enclose the Sonoma Valley or “Valley of the Moon,” which extends from near Santa Rosa southeast to the City of Sonoma and San Pablo Bay. In the north, the Mayacamas Range and Mendocino Highlands surround the farming regions of Alexander and Dry Creek Valleys. In the far northeast, the remote interior of the Mayacamas Range contains the Geysers geothermal steam field.

Topography in the county is varied and includes mountainous areas, rolling hills and broad flat river valleys, and bay flats. The valleys and foothills are predominantly in agricultural uses with some urbanized areas and with a dense population. The county contains numerous watersheds, but the Russian River is the largest and most significant, draining over 1,485 square miles as it flows south from Mendocino County to the Pacific Ocean. The Russian River is the primary water supply and a key attraction to many communities along its banks. The Petaluma River connects to San Pablo Bay and thence to the San Francisco Bay in the south. Lake Sonoma is a dam-created reservoir on Dry Creek in the northwest part of the county.

Sonoma County is on the coast of the Pacific Ocean, north of San Francisco Bay. Santa Rosa lies in the county's central valley near the junction of the Mantazas and Santa Rosa Creeks, which flow to the west from hills that surround a large central valley (U.S. Soil Conservation Service 1972).

In general, the northern half of the county is made up of small, rugged mountains that begin at the coast and rise to an elevation of 3,500 to 4,400 feet. The Russian River flows from Mendocino County in a southeasterly direction through the north-central half of Sonoma County and then turns west a few miles south of Healdsburg. Eventually, after passing through the large resort and recreational areas surrounding Guerneville and Monte Rio, this river empties into the Pacific Ocean.

The western part of the southern half of Sonoma County generally is low, rolling grassy hills at an elevation of 500 to 600 feet. The cities of Petaluma and Sonoma are in long narrow valleys in the southwestern and southeastern parts of the county, respectively. East of the Sonoma Plains and on both sides of the Sonoma Valley are grass-covered hills that rise to about 2,000 feet. Tidal flats reclaimed from the San Pablo Bay are at the lower ends of Sonoma and Petaluma Valleys and the Petaluma plains area.

4.4.2 Soils

Sonoma County has over a dozen unique soil associations (U.S. Soil Conservation Service 1972). Table 4-2 lists each association, along with descriptions and percent of soil occupation.

4.4.3 Climate

Sonoma County's Mediterranean climate is characterized by a summer dry season followed by a winter rainy season, generally extending from November to April. Rainfall varies throughout the county from 70 to 20 inches annually in the north central and the southeastern sections of the county. The quantity of rainfall in the county increases with elevation, with the greatest precipitation occurring over the highest ridges. The valleys, where most of the water users are located, receive considerably less rainfall with some areas averaging just over 20 inches of precipitation annually.

In the Russian River Watershed, approximately 93 percent of the annual precipitation normally falls during the wet season, October to May, with a large percentage of the rainfall typically occurring during three or four major winter storms. These major storms often come in the form of an atmospheric river, the horizontal transport of large amounts of water vapor through the atmosphere along a narrow corridor. Although brief, atmospheric rivers can produce 30 to 50 percent of the region's annual precipitation in a matter of a few days.

Except for areas immediately along the coast, the weather from May through October is generally warm and dry during the day, with peak summer day temperatures of 80° to 100° F, and relative humidity ranging between 20 and 35 percent. Gradient winds are generally out of the south/southwest at 5 to 10 mph, strengthening to 10 to 15 mph in late afternoon and diminishing by dark. Strong and dry northeast "Santa Ana" or "Foehn" winds often occur in the fall months.

Coastal onshore flow, often accompanied by fog, frequently prevails after sunset, allowing for good nighttime relative humidity recovery in the warm inland areas. In the inland valleys, fog usually dissipates by 11:00 am. Fog in the county usually is seen at elevations between 1,000 and 1,500 feet. Elevations above this often do not experience fog or receive the same nighttime cooling and moisture recovery as lower elevations.

Table 4-2. Sonoma County Soil Types

Soil Association	Soil Description	Portion of County	Distribution of Soil Types
Clear Lake-Reyes	Poorly drained, nearly level to gently sloping clays to clay loams; in basins and on tidal flats	6%	50% Clear Lake soils, 40% Reyes soils, 10% Wright / Yolo soils
Haire-Diablo	Moderately well drained and well drained, gently sloping to steep fine sandy loams to clays; on terraces and uplands	4%	45% Haire soils, 45% Diablo soils, 10% Arbuckle / Clear Lake / Raynor / Zamora soils
Huichica-Wright-Zamora	Somewhat poorly drained to well drained, nearly level to strongly sloping loams to silty clay loams; on low bench terraces and alluvial fans	6%	35% Huichica soils, 30% Wright soils, 25% Zamora soils, 10% Clear Lake / Yolo / Pajaro / Cole / Cortina soils
Pajaro	Somewhat poorly drained, nearly level to gently sloping fine sandy loams to clay loams; on low terraces and flood plains	1%	90% Pajaro soils, 10% Blucher / Goldridge / Steinbeck / Los Osos soils
Yolo-Cortina Pleasanton	Well-drained to excessively drained, nearly level to moderately sloping very gravelly sandy loams to clay loams; on flood plains, alluvial fans, and low terraces	3%	60% Yolo soils, 15% Cortina soils, 15% Pleasanton soils, 10% Arbuckle / Manzanita / Pajaro / Positas / Zamora soils
Spreckels-Felta	Well-drained, gently sloping to very steep very gravelly loams to clay loams; on mountain foothills and on high terraces	4%	50% Spreckels soils, 40% Felta soils, 10% Laniger / Toomes / Guenoc soils
Yorkville-Suther	Moderately well drained, moderately sloping to very steep loams and clay loams; on uplands	8%	40% Yorkville, 40% Suther soils, 20% Hugo / Josephine / Laughlin soils
Goulding-Toomes-Guenoc	Well-drained, gently sloping to very steep clay loams to loams; on uplands	8%	70% Goulding soils, 10% Toomes soils, 10% Guenoc soils, 10% Boomer / Henneke / Josephine / Red Hill / Spreckels / Supan soils
Kidd-Forward-Cohasset	Somewhat excessively drained and well-drained, moderately sloping to very steep gravelly and stony loams; on uplands	2%	30% Kidd soils, 30% Forward soils, 20% Cohasset soils, 20% Laniger / Red Hill / Spreckels / Supan soils and Rock land
Los Gatos-Henneke-Maymen	Well-drained to excessively drained, moderately sloping to very steep loams, gravelly loams, and gravelly sandy loams; on mountains	75	50% Los Gatos soils, 20% Henneke soils, 20% Maymen soils, 10% Boomer / Huse / Hugo / Josephine / Montara soils
Hugo-Josephine-Laughlin	Well-drained, gently sloping to very steep gravelly loams and loams; on mountains	33%	55% Hugo soils, 20% Josephine soils, 15% Laughlin soils, 10% Boomer / Hely / Maymen / Sites / Suther / Yorkville soils
Steinbeck-Los Osos	Moderately well drained and well drained, gently sloping to steep loams and clay loams; on uplands	6%	65% Steinbeck soils, 25% Los Osos soils, 10% Cotati / Diablo/ Goldridge soils and Kneeland sandy variant
Goldridge-Cotati-Sebastopol	Moderately well drained and well drained, gently sloping to steep fine sandy loams and sandy loams; on coastal terraces and uplands	6%	60% Goldridge soils, 20% Cotati soils, 10% Sebastopol soils, 10% Clear Lake / Diablo / Steinbeck soils
Kneeland-Rohnerville-Kinman	Well drained and moderately well drained, nearly level to steep loams to clay loams; on coastal benches, terraces, and uplands	3%	30% Kneeland soils, 25% Rohnerville soils, 25% Kinman soils, 20% Baywood / Laughlin / Los Osos / Noyo / Yorkville soils
Empire-Caspar-Mendocino	Well drained and moderately well drained, strongly sloping to steep sandy loams to sandy clay loams; on coastal uplands and terraces	3%	35% Empire soils, 30% Caspar soils, 20% Mendocino soils, 15% Goldridge / Hugo / Josephine soils

Source: (U.S. Soil Conservation Service 1972)

4.5 SENSITIVE RESOURCES

Sonoma County boasts scenic vistas, fertile agricultural lands, impressive redwood forests, a sizeable meandering river, and 50 miles of rocky coastline. In addition to these natural resources, there are cultural landscapes that illustrate the county's historic past with a broad array of properties that mirror the passage of time.

4.5.1 Cultural Resources

Historic building surveys for the coastal, Sebastopol, Healdsburg, and Sonoma Valley areas provide an inventory of Sonoma County's historic resources, some of which may be threatened by development or by a lack of maintenance. With reference to residential, commercial, and industrial architecture, many of the towns still retain excellent examples of both high style and vernacular building examples from the 19th and early 20th centuries.

Archaeological sites provide information on the history and culture of the county's earliest residents. Heritage and landmark trees enhance the quality of the environment and have historical significance (County of Sonoma 2013).

4.5.2 Scenic Resources

Coastal bluffs, vineyards, San Pablo Bay, the Laguna de Santa Rosa, and other landscapes are of special importance to Sonoma County. Preservation of these scenic resources is important to the quality of life of county residents and the tourists and agricultural economy. Other features such as the Mayacamas and Sonoma Mountains provide scenic backdrops to communities. As the county urbanizes, the openness of these areas provides important visual relief from urban densities. These landscapes have little capacity to absorb development without significant visual impact. Major Scenic Landscape Units have been identified as follows (County of Sonoma 2013):

- The Coast—The Sonoma coast is a scenic resource vital to the county. Three basic types of landscapes are included, the flat terraces south of the Russian River, the hillier terraces from Fort Ross northward, and the cliffs and landslide areas in between.
- Oat Valley—Oat Valley and the hillsides above it provide the scenic northern entrance to the county near Cloverdale.
- Alexander and Dry Creek Valleys—Protection of these agricultural valleys' scenic beauty is not only important from an aesthetic standpoint, but also from an economic one as agricultural marketing is closely tied to the area's scenic image. The hills along Highway 101 and above the valley floor are particularly sensitive.
- Hills East of Windsor—These hills provide a scenic backdrop to the Santa Rosa Plain. North of Windsor the area extends into the plain and adjoins the low, rolling hills that form part of the Windsor-Healdsburg Community Separator.
- Eastside Road—This area of rolling hills is an important transition between the community of Windsor and the rich agricultural and mineral resource areas of the Russian River Valley.
- River Road—This area provides a variety of landscapes, including valleys planted in vineyards, orchard covered hillsides, and redwood groves adjacent to the Russian River.
- Laguna de Santa Rosa—This area consists primarily of the scenic lowlands and floodplain around the Laguna de Santa Rosa marsh, swamp, and riparian forest. It also includes hills between Forestville, Sebastopol, and Meacham Hill. It defines the eastern boundary of Sebastopol and associated rural residential development.

- Bennett Valley—Bennett Mountain forms a scenic backdrop from Bennett Valley Road. This area defines Santa Rosa's southeastern boundary and abuts Annadel State Park.
- Highway 116—The view corridor along Highway 116 contains unique views of orchards, redwood groves, and the Russian River. This area also defines the community boundaries of Forestville, Guerneville, and Monte Rio and their adjacent rural residential development.
- Atascadero Creek—This area consists primarily of the lowlands and floodplains along Atascadero Creek and the hills along Occidental Road. The area defines the western boundary of Sebastopol and its adjacent rural residential development, separates Sebastopol and Graton, and creates a visual connection to the Laguna de Santa Rosa.
- Coleman Valley—The Coleman Valley Road area contains unique views of forests, canyons, grazing lands, and the ocean.
- Sonoma Mountains—These are highly valuable scenic lands, clearly defining the eastern edge of the Santa Rosa Plain between Petaluma and Sonoma.
- Hills South of Petaluma—The open grassy hillsides and ridgelines of the area are extremely sensitive. Located at the Marin County border, this area serves as a gateway to the county.
- Sonoma Valley/Mayacamas Mountains—Included in this area are the Sonoma-Napa Mountains that provide a backdrop to the valley and agricultural areas bordering the valley. These areas define the boundaries of the urban and rural communities and are very sensitive because of their small size and the unobstructed view of them from roads and adjoining urban areas.
- South Sonoma Mountains—These hillsides are an important part of the south county landscape with a simple landform, minimal vegetation, and a clear widespread viewing area. Pasture and forage lands along the Highway 37 corridor are included to preserve views of the San Pablo Bay.

4.5.3 Natural Resources

Sonoma County's varied natural landscapes range from the marine environments of the coast to the forests, woodlands and grasslands of the Coast Range to the vernal pools and freshwater marshes of the Santa Rosa Plain and other valley floors to the extensive marshlands along San Pablo Bay. Areas of natural vegetation support many native plant and animal species and encompass habitat for special status species, wetlands, and sensitive natural communities. The vegetative cover also helps reduce surface runoff, protect water quality, maintain air quality, retain soil, increase recharge, and maintain stream channels. These areas together create a varied natural environment important to the quality of life and the unique character of the county. The background and policies below are separated into a Biotic Habitat Areas section that addresses protection of several types of biotic habitat in the county and a section that focuses on one type of habitat, the Riparian Corridor.

4.6 DEVELOPMENT PROFILE

4.6.1 Land Ownership and Use

The Sonoma County General Plan and Land Use Maps govern the types of land uses and development that may occur in different areas of the unincorporated county. Figure 4-2 indicates the breakdown of land use as of the 2008 Land Use Element of the General Plan; that element is scheduled to be updated in 2021. Current land use policies promote city and community centered growth, and limit new development to levels consistent with adequate infrastructure and services, including public safety considerations.

Source: (County of Sonoma 2017)

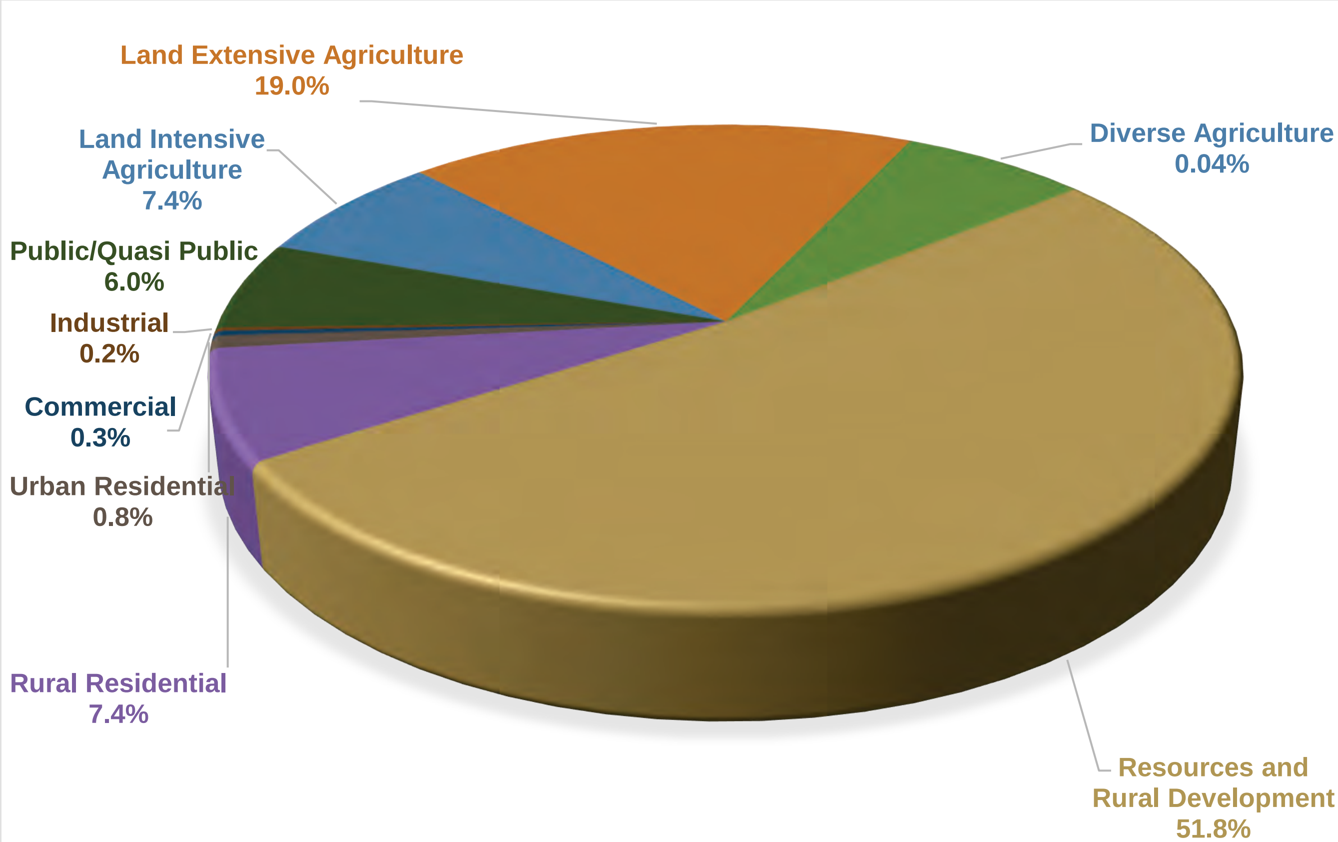


Figure 4-2. Chief Characteristics of Land within Sonoma County

Approximately half of the county is in rugged rural areas with limited access. Most of the development in these areas is limited to open space and timber/natural resource production.

4.6.2 Building Count, Occupancy Class and Estimated Replacement Value

Table 4-2 presents planning area building counts by building occupancy class. Table 4-3 summarizes estimated replacement value for building structures and contents combined.

4.6.3 Critical Facilities

Critical facilities are those that are essential to the health and welfare of the population. These become especially important after any hazard event. Also included are facilities that hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare during a hazard event. The risk assessment for each hazard in this plan discusses that hazard's potential impact on critical facilities.

Table 4-2. Planning Area Building Counts by Occupancy Class

	Number of Buildings							
	Residential	Commercial	Industrial	Agricultural	Religion	Government	Education	Total
Cloverdale	2,914	166	16	20	8	22	12	3,158
Cotati	2,450	149	34	7	5	27	10	2,682
Healdsburg	4,047	346	46	50	15	32	16	4,552
Petaluma	18,275	999	137	39	25	91	43	19,609
Rohnert Park	11,284	387	40	14	14	37	14	11,790
Santa Rosa	50,372	2,396	142	136	75	308	118	53,547
Sebastopol	2,489	285	8	9	12	21	8	2,832
Sonoma	4,109	397	12	22	14	44	7	4,605
Windsor	8,017	272	55	36	9	43	12	8,444
Unincorporated								
1st Supervisorial Dist.	12,473	447	48	2,045	19	92	17	15,141
2nd Supervisorial Dist.	5,684	217	25	1,487	16	79	21	7,529
3rd Supervisorial Dist.	745	106	17	97	1	17	3	986
4th Supervisorial Dist.	6,601	439	144	3,705	24	105	26	11,044
5th Supervisorial Dist.	21,736	805	63	4,475	71	356	59	27,565
Total	151,196	7,411	787	12,142	308	1,274	366	173,484

Table 4-3. Estimated Replacement Value of Planning Area Buildings

Jurisdiction	Estimated Total Replacement Value (Structure and Contents)[a]
Cloverdale	$2,499,664,593
Cotati	$2,163,132,258
Healdsburg	$4,803,401,892
Petaluma	$18,679,915,783
Rohnert Park	$9,749,459,659
Santa Rosa	$44,098,486,212
Sebastopol	$2,676,395,901
Sonoma	$3,658,235,342
Windsor	$6,407,101,168
Unincorporated	$123,838,778,174
Total	$218,574,570,981

For some hazards, potential damage to critical facilities was estimated using the Hazards U.S. (Hazus) computer model developed by FEMA. For this reason, the list of critical facilities was categorized using categories that are defined in the Hazus model:

- **Safety and Security**—Law Enforcement/Security, Search and Rescue, Fire Services, Government Service, Responder Safety, and Imminent Hazard Mitigation
- **Food, Water and Sheltering**—Evacuations, Schools, Food/Potable Water, Shelter, Durable Goods, Water Infrastructure, and Agriculture
- **Health and Medical**—Medical Care/Hospitals: Patient Movement, Public Health, Fatality Management, Health Care, and Supply Chain

- **Energy**—Power (Grid), Temporary Power and Fuel
- **Communications**—Infrastructure, Alerts, Warnings, Messages, 911 and Dispatch, Responder Communications and Financial Services
- **Transportation**—Highway/Roadway, Mass Transit, Railway, Aviation, Maritime and Pipeline
- **Hazardous Materials**—Facilities, Hazardous Debris, Pollutants and Contaminants

Table 4-4 summarizes the number of critical facilities by Hazus-defined category, based on the best data available on critical facilities at the time of this plan update. The County and its planning partners consider this information to be subject to change as new information about critical facilities become available during the performance period for this plan. Due to the sensitivity of this information, a detailed list of facilities is not provided. General locations of critical facilities in the planning area are shown in Figure 4-3 and Figure 4-4.

Table 4-4. Planning Area Critical Facilities

	Number of Facilities							
	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	2	1	5	29	4	15	2	58
Cotati	1	0	0	45	4	17	1	68
Healdsburg	10	0	5	45	10	20	2	92
Petaluma	20	2	11	128	22	70	6	259
Rohnert Park	10	2	4	191	9	34	1	251
Santa Rosa	55	3	37	354	93	209	5	756
Sebastopol	7	0	3	27	13	19	0	69
Sonoma	11	1	3	65	11	19	0	110
Windsor	6	0	6	105	9	16	1	143
Unincorporated								
1st Supervisorial Dist.	25	5	11	431	10	45	63	590
2nd Supervisorial Dist.	7	8	7	340	4	31	45	442
3rd Supervisorial Dist.	3	1	1	65	1	5	1	77
4th Supervisorial Dist.	17	44	16	703	10	48	89	927
5th Supervisorial Dist.	17	7	22	581	19	102	169	917
Total	191	74	131	3,109	219	650	385	4,759

4.6.4 Development Trends

The municipal planning partners have adopted general plans that govern land use decision and policy making for their jurisdictions. Decisions on land use will be governed by these programs. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area. All municipal planning partners will incorporate this hazard mitigation plan update in their general plans by reference. This will ensure that future development trends can be informed by the information on risk and vulnerability to natural hazards identified in this plan. County land use policies help reduce the potential impact of new development on hazard vulnerability within the unincorporated areas of Sonoma County.

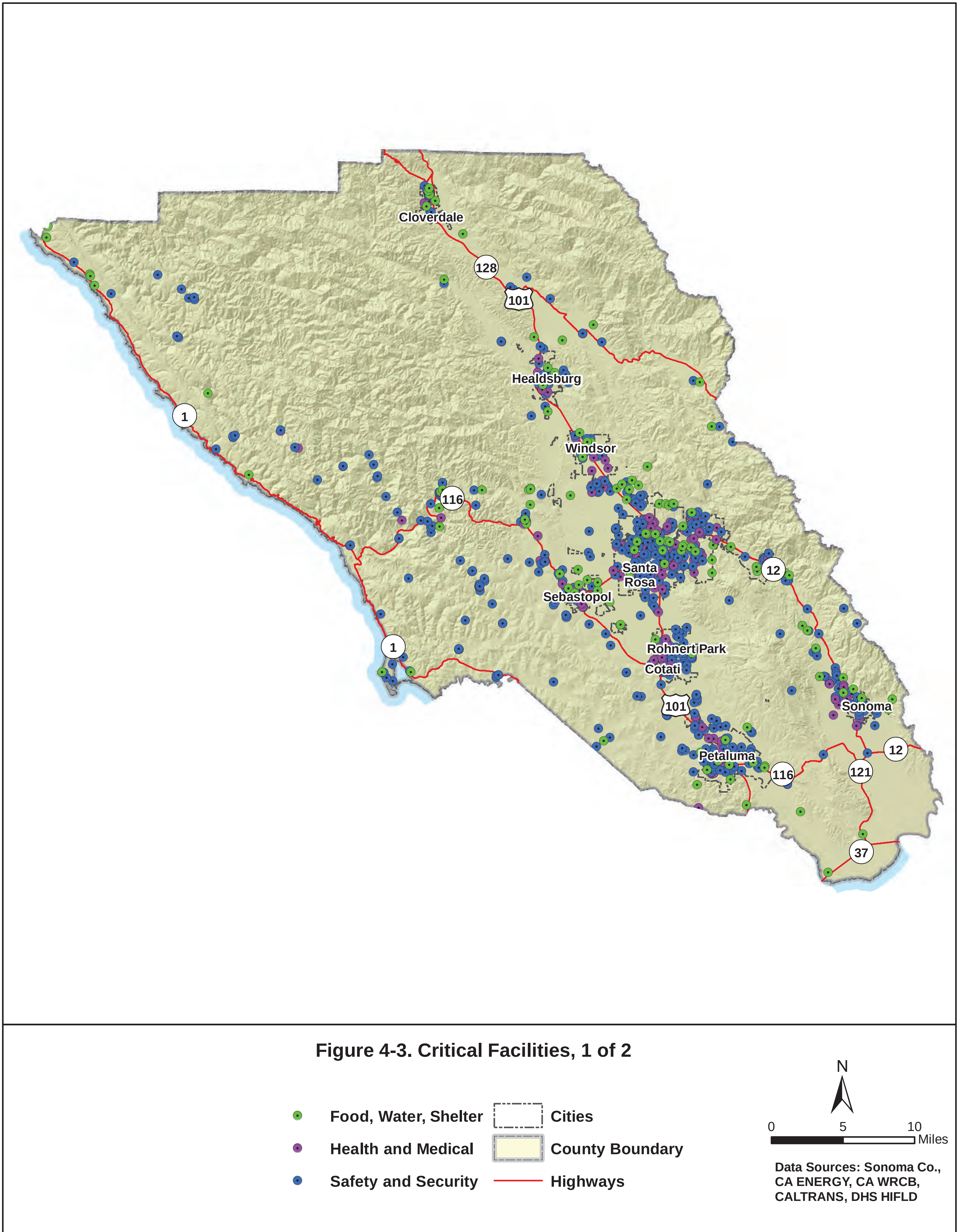


Figure 4-3. Critical Facilities, 1 of 2

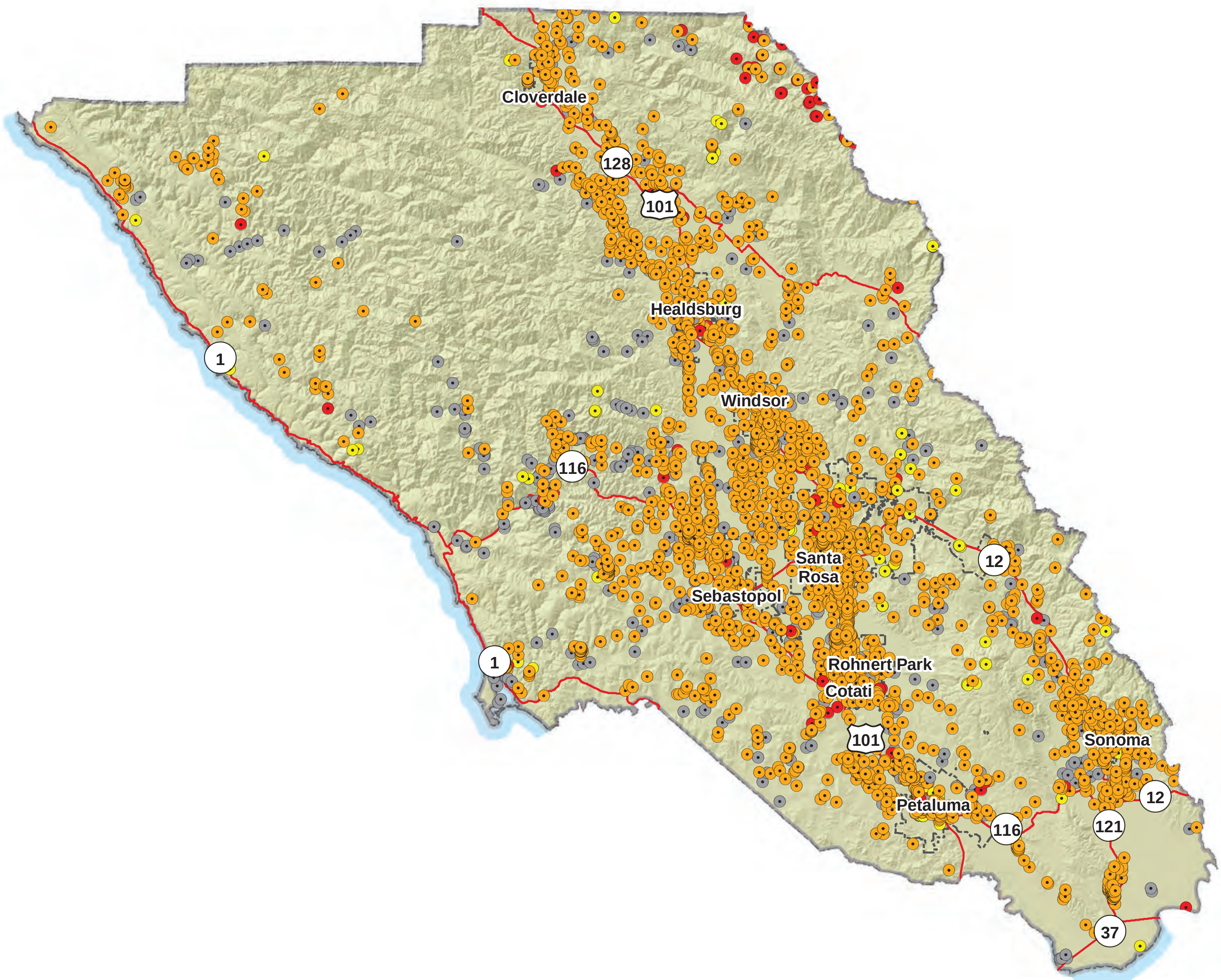
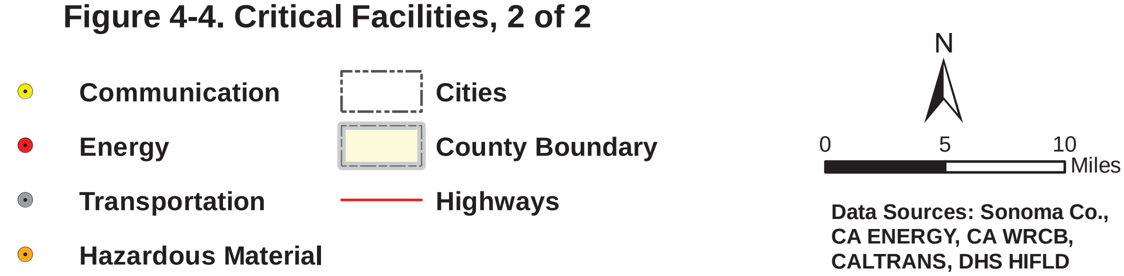


Figure 4-4. Critical Facilities, 2 of 2



Data Sources: Sonoma Co., CA ENERGY, CA WRCB, CALTRANS, DHS HIFLD

Sonoma County was in the process of updating its General Plan at the time of this hazard mitigation plan update. The following development trends from the previous General Plan (*Sonoma County General Plan 2020*) are likely to change when the General Plan update is completed:

- The number of housing units increased by 21,419 units between 2000 and 2010, with 16.6 percent of the increase in unincorporated county areas.
- Household growth was projected to grow about 38,490 units between 2000 and 2020 period, an average growth rate of 1,920 households per year.
- About 80 percent of 2000 – 2020 projected growth was expected to occur within city urban service areas, with the remainder in unincorporated areas outside of the cities.

4.7 DEMOGRAPHICS

The vulnerability of people and groups to hazard events is dynamic, varying with physical location as well as economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors. The impacts of a hazard event on individuals and communities can depend on factors such as wealth, education, race, ethnicity, religion, gender, age, access and functional needs, and health status. The capacity to anticipate, cope with, and adapt to a hazard is an important factor of vulnerability (Cardona et al. 2012). These factors often overlap spatially, so spatial analysis to locate areas where there are higher concentrations of people experiencing different vulnerabilities can help to extend focused public outreach, education, and resources to these residents. Understanding communities' makeup and demographic changes over time is important to making decisions that may impact these communities future, such as land used decisions that affect housing, industry, stores, public facilities and services, and transportation.

4.7.1 Total Population Estimates

Current Population

Sonoma County is the 17th largest of California's 58 counties. The U.S. Census Bureau estimates the population at 494,336 as of 2019.

Historical Population Trends

Population changes are useful socio-economic indicators. A growing population can indicate a growing economy, and a decreasing population may signify economic decline. Figure 4-5 shows the population growth trend in Sonoma County from 1960 to 2019 compared to that of the State of California. Since the 1960s, the county has seen slow and declining growth rates (less than 5 percent per decade); the state growth rate has declined to about 7 percent over the 9-year period from 2000 to 2010.

Table 4-5 shows the population of incorporated municipalities and the combined unincorporated areas in Sonoma County from 2000 to 2018. The portion of the planning area's residents living outside incorporated areas has gradually decreased over that period, changing from about 32.7 percent in 2000 to about 28.3 percent in 2018. Overall growth in the incorporated areas from 2000 to 2018 was approximately 4 percent.

Source: California Department of Finance

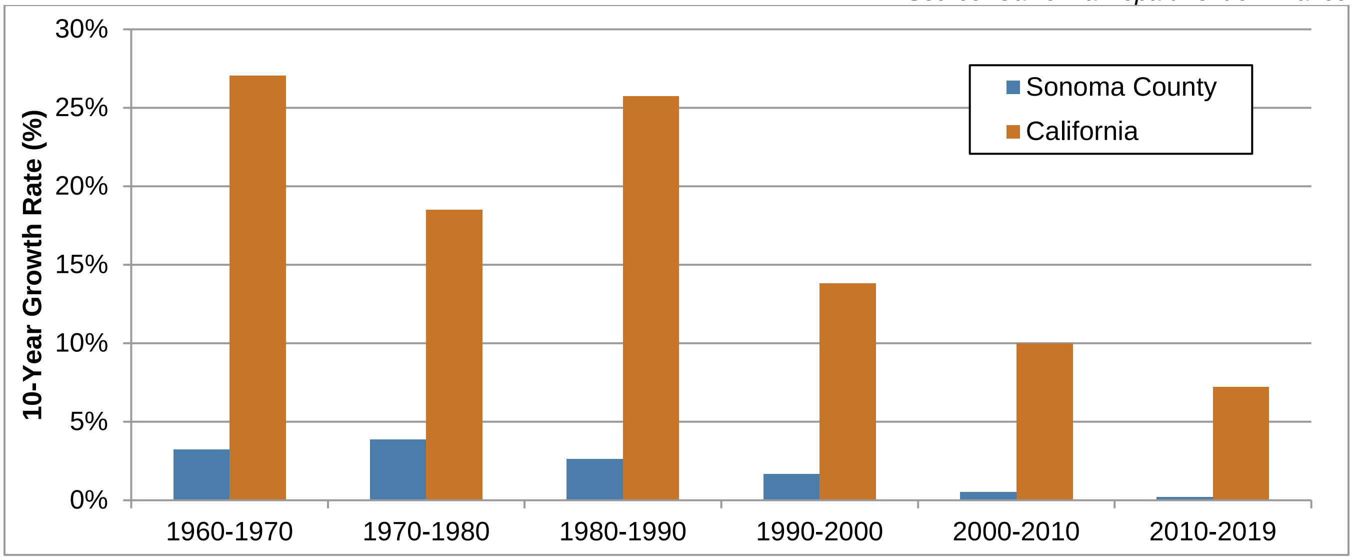


Figure 4-5. California and Sonoma County Historical Population Growth Rates

Table 4-5. Population Growth Data

	Population					
	April 1, 2000	April 1, 2010	January 1, 2015	January 1, 2016	January 1, 2017	January 1, 2018
Cloverdale	6,831	8,618	8,893	8,927	8,988	9,134
Cotati	6,471	7,265	7,371	7,376	7,453	7,716
Healdsburg	10,915	11,254	11,707	11,734	11,757	12,061
Petaluma	54,550	57,941	60,953	61,488	61,657	62,708
Rohnert Park	42,236	40,794	42,325	42,586	42,490	43,598
Santa Rosa	147,595	167,815	175,693	176,937	178,064	178,488
Sebastopol	7,774	7,379	7,593	7,609	7,624	7,786
Sonoma	9,275	10,648	10,906	10,929	11,072	11,390
Windsor	22,744	26,801	27,364	27,445	27,492	28,060
Unincorporated	150,223	145,363	147,278	147,444	148,016	142,391
Total	458,614	483,878	500,083	502,475	504,613	503,332

Source: California Department of Finance

Projected Future Population

According to population projections by the California Department of Finance, Sonoma County's population should decrease to 485,017 by 2040. This represents a 3.8 percent decrease from the 2018 population.

4.7.2 Age Distribution

Although advanced age by itself does not create vulnerability to hazards, certain problems that are more common in old age can increase vulnerability. They include decreased strength, poor tolerance of physical activity, functional limitations, and decreased sensory awareness. The severity of the impact of disasters on older people depends on the specific characteristics of the elderly and their environments, the type and severity of the hazard, disaster management systems, and interactions between all of these (Pan American Health Organization 2012).

Children are particularly vulnerable during natural disasters and experience increased problems regarding their physical health, mental health, and learning after exposure. Compared to adults, children suffer more severe physical effects from disasters because they breathe more air per pound of their weight, have thinner skin, are at greater risk in cases of fluid loss, and are more likely to lose body heat. Disasters also can harm children indirectly. When a disaster affects parents and other adults (such as teachers), children's care, protection, and support systems are eroded. Beyond the immediate trauma and harm caused by natural disaster exposure, children also may suffer longer-term physical, psychological, and educational deficits (Society for Research in Child Development 2020).

The overall age distribution for the planning area is illustrated in Figure 4-6. Based on U.S. Census data, 19.6 percent of the planning area's population is 65 years or older, and 22.2 percent of the population is 19 years or younger. According to U.S. Census data, 6.7 percent of the over-65 years population have incomes below the poverty level. Of children under 18 years, 13.9 percent live below the poverty level.

Source: American Fact Finder, American Community Survey

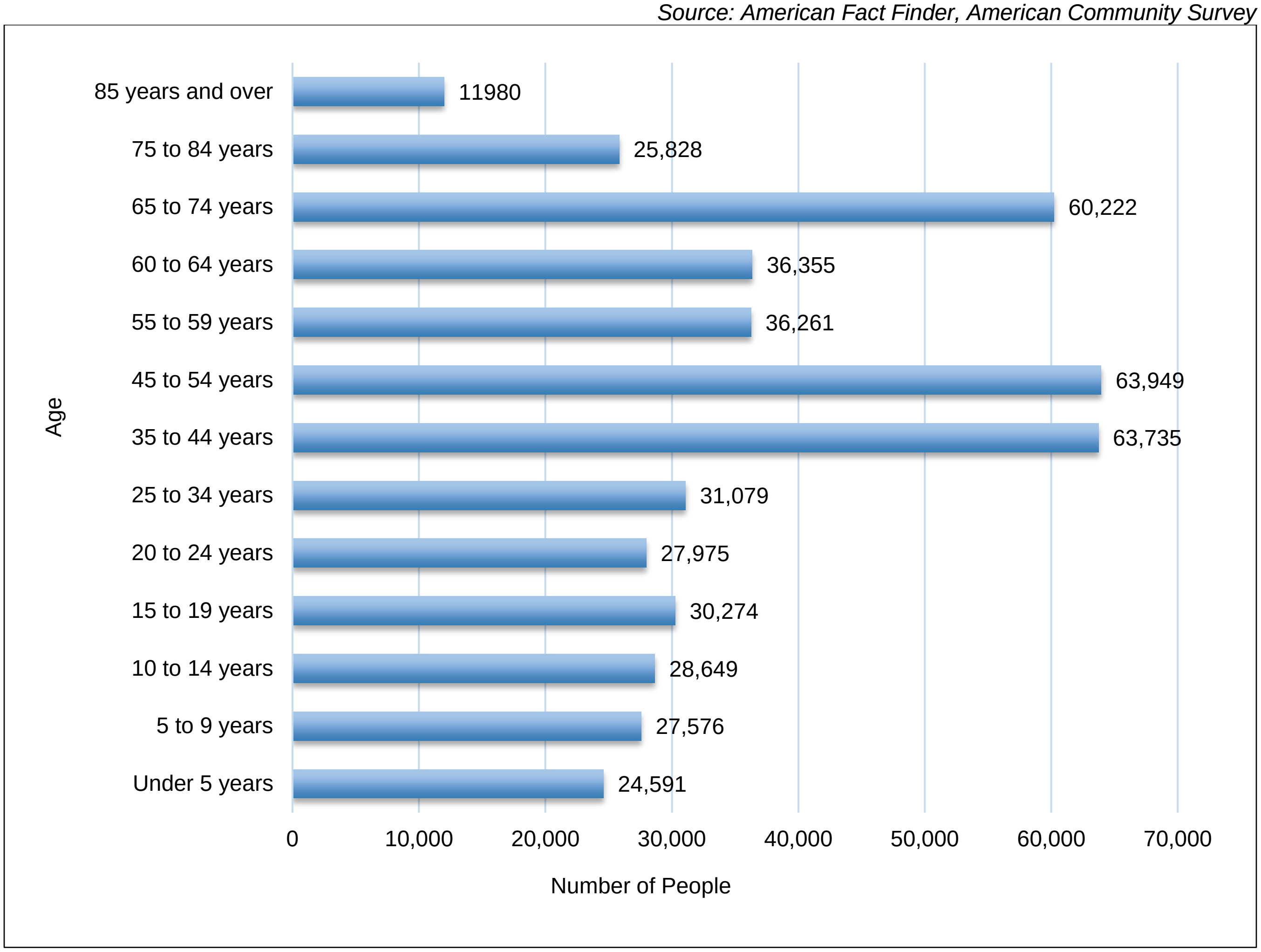


Figure 4-6. Planning Area Age Distribution

4.7.3 Race, National Origin, and Language

Research shows that communities of color are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Higher proportions of communities of color live below the poverty line than the white population, so these communities have fewer resources to prepare for disasters in advance or recover afterwards.

The U.S. Census Bureau's 2019 American Community Survey reports the following data on race and national origin in Sonoma County:

- The racial composition of the planning area is predominantly white, at about 74.8 percent. This percentage has fallen steadily since 1980, when the white population made up 89.1 percent of the county total (MTC and ABAG, 2021).
- The largest racial categories in the 2019 Census data other than white, as self-reported by respondents, are "some other race" at 12.9 percent and "two or more races" at 5.4 percent.
- The planning area has 26.7 percent Hispanic or Latino population across all races, which has risen steadily from a percentage of only 6.9 percent in 1980 (MTC and ABAG, 2021).

About U.S. Census Data on Race and National Origin

The U.S. Census Bureau collects race data in accordance with guidelines provided by the U.S. Office of Management and Budget, and these data are based on self-identification. The racial categories included in the census questionnaire generally reflect a social definition of race recognized in the Unites States, not an attempt to define race biologically, anthropologically, or genetically. The categories of the race item include racial and national origin or sociocultural groups. People may choose to report more than one race to indicate their racial mixture, such as "American Indian" and "White." People who identify their origin as Hispanic, Latino, or Spanish may be of any race.

The concept of race is separate from the concept of Hispanic origin. Percentages for the various race categories add to 100 percent, and should not be combined with the percent Hispanic.

Source: U.S. Census 2021a

Figure 4-7 shows the 2019 racial distribution in the planning area; results may differ in the newest U.S. Census data, which was still being processed at the time this plan was developed.

The planning area has a 16.9 percent foreign-born population. The most spoken language in the county other than English is Spanish. The census estimates 52.3 percent of the residents speak English "less than very well."

4.7.4 Individuals with Disabilities or with Access and Functional Needs

People with disabilities are more likely than the general population to have difficulty responding to a disaster. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available to provide services needed by those with access and functional needs. The last full U.S. Census (from 2010) estimated that one in five Americans with live with disabilities in the United States. According to U.S. Census data, 30.5 percent of the over-65 population in the planning area has disabilities of some kind, as well as 7.2 percent of those under 65.

Source: (U.S. Census Bureau 2021)

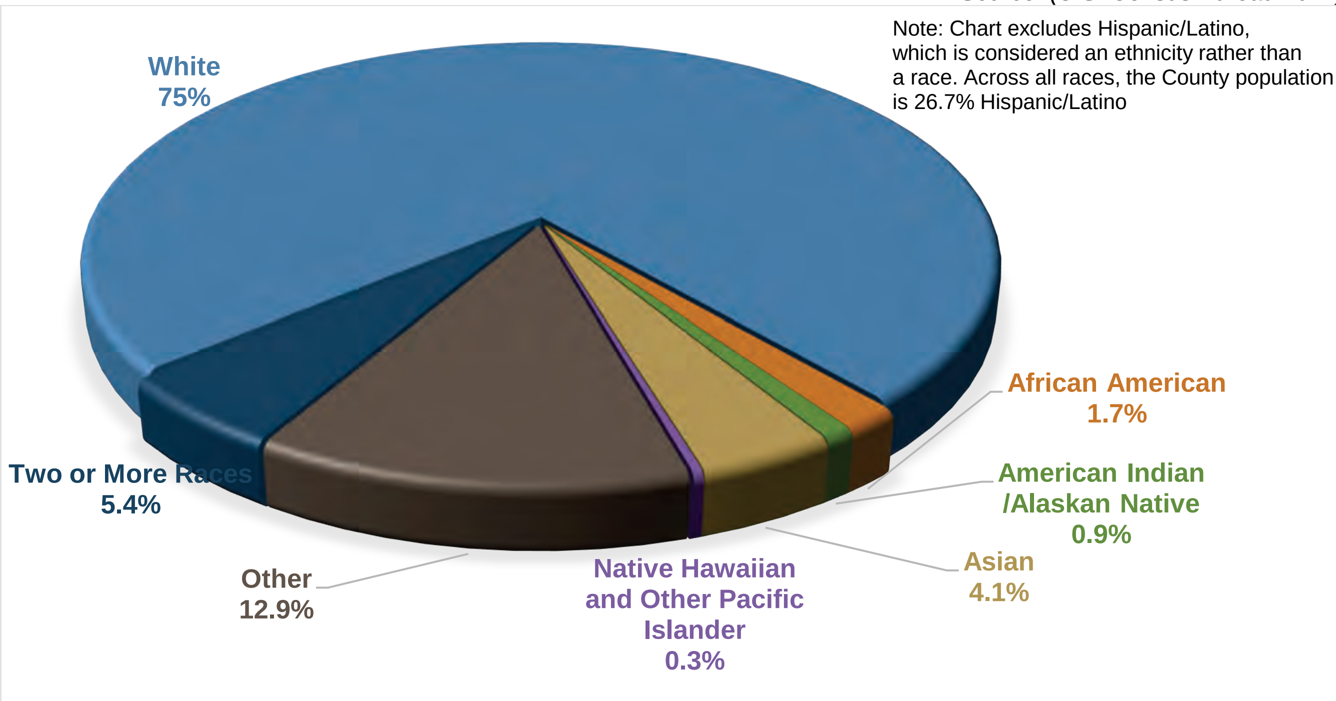


Figure 4-7. Planning Area Race Distribution

4.8 ECONOMY

Over 25,000 large and small businesses call Sonoma County home. Business startups are discovering Sonoma County as an ideal place to launch and grow, with some of the most affordable housing costs in the San Francisco Bay Area and a more competitive cost-of-doing-business. *Nerdwallet.com* recently ranked the cities of Healdsburg and Sonoma in the top 20 places to start a business. Sonoma County has also been recognized as one of the top 10 places for supporting minority-owned businesses and Latino entrepreneurs (County of Sonoma 2021).

4.8.1 Income

In the United States, individual households generally use private resources to prepare for, respond to and recover from disasters to some extent. Households living in poverty have less access to time and resources to plan for and respond to hazards. Low-income households also typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage than other types of housing. In urban areas, families living in poverty often live in older houses and apartments, which are more likely to be made of a building type that is susceptible to earthquake damage. Residents below the poverty level are less likely to have insurance to compensate for losses from natural disasters, and federal aid is designed to restore property to owners, not renters (Howell and Elliott 2018). Personal household economics also significantly impact people's decisions on evacuation.

Based on U.S. Census Bureau estimates, per capita income in the planning area in 2018 was $39,929, and the median income of all households was $76,753. It is estimated that 18.8 percent of households receive an income between $100,000 and $149,999 per year and 10.6 percent of household incomes are above $150,000 annually.

The Census estimates that 9.3 percent of all families in the planning area have incomes below the poverty level. To analyze the hazard exposure of socially vulnerable populations, the risk assessment in this hazard mitigation plan identified low-income households as follows:

- County data for 2021 show "low income" (defined as 80 percent of the area median income) as $74,450 for two-person households and $83,750 for three-person households (County of Sonoma 2021).
- The U.S. Census shows an average of 2.6 persons per household in Sonoma County
- The Hazus model used for risk assessment allows analysis of households by income at four levels: $50,000, $60,000, $75,000, or $100,000.
- The $75,000 household income level was chosen as closest to the low-income level for the average Sonoma County household size.

4.8.2 Industry, Businesses, and Institutions

Table 4-6 lists the top employers in the planning area in 2021 as identified by the California Employment Development Department. Figure 4-8 shows the breakdown of employment by industry type in the planning area, according to the State of California Employment Development Department.

4.8.3 Employment Trends and Occupations

The U.S. Census estimates a civilian labor force in Sonoma County of 268,068. According to the American Community Survey, about 65 percent of the planning area's working-age population (16 and over) is in the labor force. Figure 4-9 compares California's and Sonoma County's unemployment trends from 2010 through July 2021. The county and state rates both declined steadily after the 2008-2009 recession until the COVID pandemic in spring of 2020. Although both rates have fallen sharply since the pandemic peak, neither has yet returned to pre-pandemic levels.

Table 4-6. Top Employers for the Planning Area

Employer Name	Location	Industry
1,000-4,999 Employees		
Aabalat Fine & Rare Wines	Petaluma	Wineries
Medtronic Inc	Santa Rosa	Surgical Instruments-Manufacturers
Santa Rosa Memorial Hospital	Santa Rosa	Hospitals
Sonoma Developmental Ctr	Eldridge	Hospitals
US Coast Guard	Petaluma	Federal Government-National Security
500 - 999 Employees		
Amys Kitchen	Santa Rosa	Frozen Food Processors
Fairmont Sonoma Msn Inn & Spa	Sonoma	Hotels & Motels
Kaiser Permanente Santa Rosa	Santa Rosa	Hospitals
Protransport-1	Cotati	Transportation Services
Scoe Employee Ctr	Santa Rosa	County Government-Education Programs
Sonoma County Dept-Fire	Santa Rosa	Fire Departments
Sonoma County Sheriff	Santa Rosa	Government Offices-County
Sutter Santa Rosa Regl Hosp	Santa Rosa	Hospitals
250 - 499 Employees		
Army National Guard Recruiter	Santa Rosa	Government Offices-State
First Security Svc	Rohnert Park	Security Guard & Patrol Service
Flex Products Inc	Santa Rosa	Coatings-Vacuum Deposition
Freeman Toyota	Santa Rosa	Automobile Dealers-Used Cars
Ghilotti Construction	Santa Rosa	Excavating Contractors
La Torilla Factory	Santa Rosa	Factory Outlets
Macy's	Santa Rosa	Department Stores
Petaluma City Passports	Petaluma	Government Offices-City/Village & Township
Petaluma Valley Hospital	Petaluma	Hospitals
Press Democrat	Santa Rosa	Newspapers
Santa Rosa Police Dept	Santa Rosa	Police Departments
Walmart	Windsor	Department Stores

Source: California Employment Development Department 2021 (using data from *America's Labor Market Information System (ALMIS) Employer Database*, 2021 1st Edition)

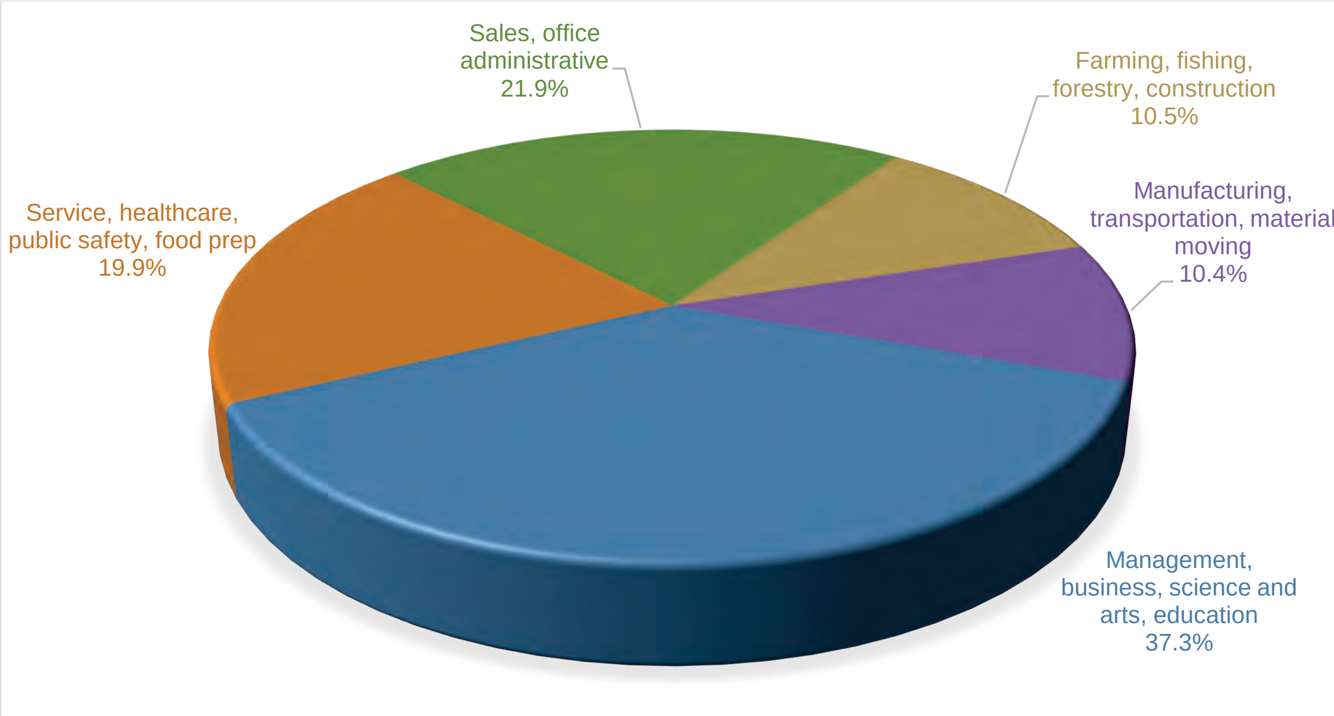


Figure 4-8. Industry in the Planning Area

Source: (Federal Reserve Bank of St. Louis 2021)

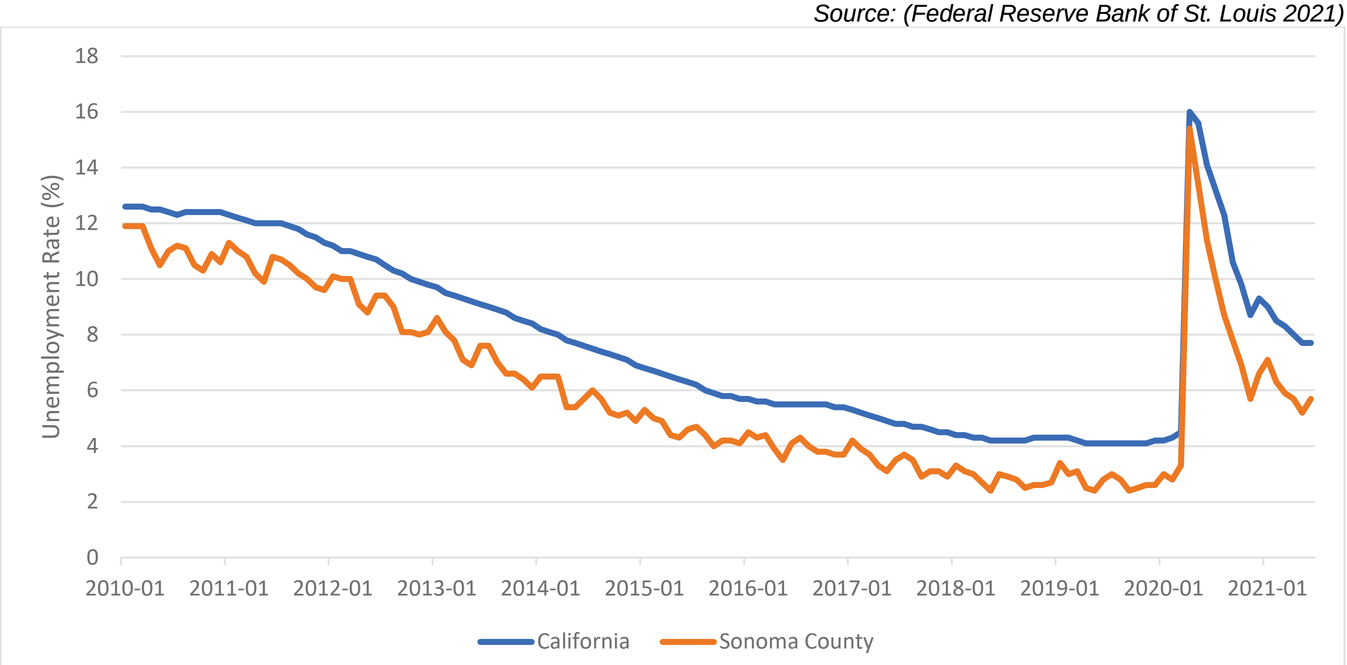


Figure 4-9. California and Sonoma County Unemployment Rate

5. REGULATIONS AND PROGRAMS

Existing regulations, agencies and programs at the federal, state, and local level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). Information presented in this section can be used to review local capabilities to implement the action plan this hazard mitigation plan presents. Individual review by each planning partner of existing local plans, studies, reports, and technical information is presented in the annexes in Volume 2.

5.1 RELEVANT FEDERAL AND STATE AGENCIES, PROGRAMS AND REGULATIONS

State and federal regulations and programs that need to be considered in hazard mitigation are constantly evolving. For this plan, a review was performed to determined which regulations and programs are currently most relevant to hazard mitigation planning. The findings are summarized in Table 5-1 and Table 5-2. Short descriptions of each program are provided in Appendix B.

5.2 LOCAL PLANS, REPORTS AND CODES

Plans, reports, and other technical information were identified and provided directly by participating jurisdictions and stakeholders or were identified through independent research by the planning consultant. These documents were reviewed to identify the following:

- Existing jurisdictional capabilities.
- Needs and opportunities to develop or enhance capabilities, which may be identified within the local mitigation strategies.
- Mitigation-related goals or objectives considered during the development of the overall goals and objectives.
- Proposed, in-progress, or potential mitigation projects, actions and initiatives to be incorporated into the updated jurisdictional mitigation strategies.

Table 5-1. Summary of Relevant Federal Agencies, Programs and Regulations

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
Americans with Disabilities Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Bureau of Land Management	Wildfire Hazard	The Bureau funds and coordinates wildfire management programs and structural fire management and prevention on its lands.
Civil Rights Act of 1964	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Clean Water Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Community Development Block Grant Disaster Resilience Program	Action Plan Funding	This is a potential alternative source of funding for actions identified in this plan.
Community Rating System	Flood Hazard	This voluntary program encourages floodplain management activities that exceed the minimum National Flood Insurance Program requirements.
Disaster Mitigation Act	Hazard Mitigation Planning	This is the current federal legislation addressing hazard mitigation planning.
Emergency Relief for Federally Owned Roads Program	Action Plan Funding	This is a possible funding source for actions identified in this plan.
Emergency Watershed Program	Action Plan Funding	This is a possible funding source for actions identified in this plan.
Endangered Species Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Federal Energy Regulatory Commission Dam Safety Program	Dam Failure Hazard	This program cooperates with a large number of federal and state agencies to ensure and promote dam safety.
Federal Wildfire Management Policy and Healthy Forests Restoration Act	Wildfire Hazard	These documents mandate community-based collaboration to reduce risks from wildfire.
National Dam Safety Act	Dam Failure Hazard	This act requires a periodic engineering analysis of most dams in the country
National Environmental Policy Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
National Fire Plan (2001)	Wildfire Hazard	This plan calls for joint risk reduction planning and implementation by federal, state and local agencies.
National Flood Insurance Program	Flood Hazard	This program makes federally backed flood insurance available to homeowners, renters, and business owners in exchange for communities enacting floodplain regulations
National Incident Management System	Action Plan Development	Adoption of this system for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards is a prerequisite for federal preparedness grants and awards
Presidential Executive Order 11988 (Floodplain Management)	Flood Hazard	This order requires federal agencies to avoid long and short-term adverse impacts associated with modification of floodplains
Presidential Executive Order 11990 (Protection of Wetlands)	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable presidential executive orders.
U.S. Army Corps of Engineers Dam Safety Program	Dam Failure Hazard	This program is responsible for safety inspections of dams that meet size and storage limitations specified in the National Dam Safety Act.
U.S. Army Corps of Engineers Flood Hazard Management	Flood Hazard, Action Plan Implementation, Action Plan Funding	The Corps of Engineers offers multiple funding and technical assistance programs available for flood hazard mitigation actions

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
U.S. Fire Administration	Wildfire Hazard	This agency provides leadership, advocacy, coordination, and support for fire agencies and organizations.
U.S. Fish and Wildlife Service	Wildfire Hazard	This service's fire management strategy employs prescribed fire throughout the National Wildlife Refuge System to maintain ecological communities.

Table 5-2. Summary of Relevant State Agencies, Programs and Regulations

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
AB 9: Fire safety: Wildfires: Fire Adapted Communities	Wildfire Hazard	Establishes the Regional Forest and Fire Capacity Program to support regional leadership to build local and regional capacity and develop, prioritize, and implement strategies and projects that create fire adapted communities and landscapes by improving watershed health, forest health, community wildfire preparedness, and fire resilience.
AB 32: The California Global Warming Solutions Act	Action Plan Development	Establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020
AB 38: Fire safety: Low-Cost Retrofits: Regional Capacity Review: Wildfire Mitigation	Wildfire Hazard	Directs the California Natural Resources Agency to review the regional capacity of each county that contains a very high fire hazard severity zone and establishes a comprehensive wildfire mitigation and assistance program.
AB 70: Flood Liability	Flood Hazard	A city or county may be required to partially compensate for property damage caused by a flood if it unreasonably approves new development in areas protected by a state flood control project
AB 162: Flood Planning	Flood Hazard	Cities and counties must address flood-related matters in the land use, conservation, and safety and housing elements of their general plans.
AB 267: California Environmental Quality Act: Exemption: Prescribed Fire, Thinning, and Fuel Reduction Projects.	Wildfire Hazard	Extends to January 1, 2026, the exemption from requirements of the California Environmental Quality Act for prescribed fire, thinning, or fuel reduction projects on federal lands to reduce the risk of high-severity wildfire that had been reviewed under the National Environmental Policy Act.
AB 380: Forestry: Priority Fuel Reduction Projects	Wildfire Hazard	Requires the Department of Forestry and Fire Protection to identify priority fuel reduction projects annually and exempts the identified priority fuel reduction projects from certain legal requirements.
AB 431: Forestry: Timber Harvesting Plans: Defensible Space: Exemptions	Wildfire Hazard	Extends to January 1, 2026, the exemption from a requirement to complete a timber harvest plan for maintaining defensible space between 150 feet and 300 feet from a habitable structure.
AB 497: Forestry and Fire Protection: Local Assistance Grant Program: Fire Prevention Activities: Street and Road Vegetation Management	Wildfire Hazard	Appropriates funds for local assistance grants for fire prevention activities with priority for projects that that manage vegetation along streets and roads to prevent the ignition of wildfire.
AB 575: Civil Liability: Prescribed Burning Activities: Gross Negligence	Wildfire Hazard	Provides that a private entity engaging in a prescribed burning activity that is supervised by a person certified as burn boss is liable for damages to a third party only if the prescribed burning activity was carried out in a grossly negligent manner.
AB 642: Wildfires	Wildfire Hazard	This bill is an omnibus fire prevention bill that makes various changes to support cultural and prescribed fire, including the creation of a Cultural Burning Liaison at the Department of Forestry and Fire Protection, and requires a proposal for creating a prescribed fire training center.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
AB 747: General Plans—Safety Element	Hazard Mitigation Planning	The safety elements of cities' and counties' general plans must address evacuation routes and include any new information on flood and fire hazards and climate adaptation and resiliency strategies.
AB 800: Wildfires: local general plans: safety elements: fire hazard severity zones.	Wildfire Hazard	This Bill has provisions for wildfire hazard mapping and applications for that mapping in the Safety elements General plans within the state.
AB 1255: Fire prevention: Department of Forestry and Fire Protection: Grant Programs	Wildfire Hazard	Requires the Natural Resources Agency to develop a guidance document that describes goals, approaches, opportunities, and best practices in each region of the state for ecologically appropriate, habitat-specific fire risk reduction. Requires consultation with counties related to the Department of Forestry and Fire Protection's local fire prevention grant program.
AB 1295: Residential development Agreements: Very High-Risk Fire Areas	Wildfire Hazard	Prohibits the legislative body of a city or county from entering into a residential development agreement for property in a very high fire risk area as designated by a local agency or a fire hazard severity zone classified by the director of CAL FIRE.
AB 1439: Property Insurance Discounts	Wildfire Hazard	Requires residential or commercial property insurance policies to include a discount if a local government where the insured property is located funds a local wildfire protection or mitigation program.
AB 1500: Safe Drinking Water, Wildfire Prevention, Drought Preparation, Flood Protection, Extreme Heat Mitigation, and Workforce Development Bond Act of 2022.	Drought, Flood, Extreme Heat and Wildfire Hazards	If approved by the voters, would authorize the issuance of bonds to finance projects for safe drinking water, wildfire prevention, drought preparation, flood protection, extreme heat mitigation, and workforce development programs.
AB 2140: General Plans—Safety Element	Hazard Mitigation Planning	This bill enables state and federal disaster assistance and mitigation funding to communities with compliant hazard mitigation plans.
AB 2800: Climate Change—Infrastructure Planning	Action Plan Development	This act requires state agencies to take into account the impacts of climate change when developing state infrastructure.
Alquist-Priolo Earthquake Fault Zoning Act	Earthquake Hazard	This act restricts construction of buildings used for human occupancy on the surface trace of active faults.
California Coastal Management Program	Flood, Landslide/Mass Movement, Tsunami and Wildfire Hazards	This program requires coastal communities to prepare coastal plans and requires that new development minimize risks to life and property in areas of high geologic, flood, and fire hazard.
Board of Forestry and Fire Protection Fire Safe Regulations	Wildfire Hazard	The Fire Safe Regulations set the floor for fire safety standards for perimeters and access to residential, commercial, and industrial building construction.
California Department of Forestry and Fire Protection (CAL FIRE)	Wildfire Hazard	CAL FIRE has responsibility for wildfires in areas that are not under the jurisdiction of the Forest Service or a local fire organization.
California Department of Parks and Recreation	Wildfire Hazard	State Parks Resources Management Division has wildfire protection resources available to suppress fires on State Park lands.
California Department of Water Resources	Flood Hazard	This state department is the state coordinating agency for floodplain management.
California Division of Safety of Dams	Dam Failure Hazard	This division monitors the dam safety program at the state level and maintains a working list of dams in the state.
California Environmental Quality Act	Action Plan Implementation	This act establishes a protocol of analysis and public disclosure of the potential environmental impacts of development projects. Any project action identified in this plan will seek full California Environmental Quality Act compliance upon implementation.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
California Fire Alliance	Wildfire Hazard	The alliance works with communities at risk from wildfires to facilitate the development of community fire loss mitigation plans.
California Fire Plan	Wildfire Hazard	This plan's goal is to reduce costs and losses from wildfire through pre-fire management and through successful initial response.
California Fire Safe Council	Wildfire Hazard	This council facilitates the distribution of National Fire Plan grants for wildfire risk reduction and education.
California Fire Service and Rescue Emergency Mutual Aid Plan	Wildfire Hazard	This plan provides guidance and procedures for agencies developing emergency operations plans, as well as training and technical support.
California General Planning Law	Hazard Mitigation Planning	This law requires every county and city to adopt a comprehensive long-range plan for community development, and related laws call for integration of hazard mitigation plans with general plans.
California Multi-Hazard Mitigation Plan	Hazard Mitigation Planning	Local hazard mitigation plans must be consistent with their state's hazard mitigation plan.
California Residential Mitigation Program	Earthquake Hazard	This program helps homeowners with seismic retrofits to lessen the potential for damage to their houses during an earthquake.
California State Building Code	Action Plan Implementation	Local communities must adopt and enforce building codes, which include measures to improve buildings' ability to withstand hazard events.
Disadvantaged and Low-Income Communities Investments	Action Plan Funding	This is a potential source of funding for actions located in disadvantaged or low-income communities.
Division of the State Architect's AB 300 List of Seismically At-Risk Schools	Earthquake Hazard, Action Plan Development	The Division of the State Architect recommends that local school districts conduct detailed seismic evaluations of seismically at-risk schools identified in the inventory that was required by AB 300.
Governor's Executive Order S-13-08 (Climate Impacts)	Action Plan Implementation	This order includes guidance on planning for sea level rise in designated coastal and floodplain areas for new projects.
Office of the State Fire Marshal	Wildfire Hazard	This office has a wide variety of fire safety and training responsibilities.
Senate Bill 12: Local government: planning and zoning: wildfires.	Wildfire Hazard	Requires the safety element to be reviewed and updated as necessary to include a comprehensive retrofit strategy to reduce the risk of property loss and damage during wildfires. Requires the planning agency to submit the adopted strategy to the Office of Planning and Research for inclusion into a central clearinghouse.
Senate Bill 92: Dam Emergency Action Plans; Public Resources Portion of Biennial Budget Bill	Dam Failure Hazard	This bill requires dams (except for low-risk dams) to have emergency action plans that are updated every 10 years and inundation maps updated every 10 years, or sooner if specific circumstances change.
Senate Bill 97: Guidelines for Greenhouse Gas Emissions	Action Plan Implementation	This bill establishes that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for California Environmental Quality Act analysis.
Senate Bill 99: General Plans: Safety Element: Emergency Evacuation Routes	Action Plan Implementation	This bill requires the safety element must include information to identify residential developments in hazard areas that do not have at least two emergency evacuation routes.
Senate Bill 182: Local Government: Planning and Zoning: Wildfires	Wildfire Hazard	This bill made a number of changes to state law regarding planning for and permitting development in areas designated as very high fire risk areas.
Senate Bill 379: General Plans: Safety Element—Climate Adaptation	Action Plan Implementation	This bill requires cities and counties to include climate adaptation and resiliency strategies in the safety element of their general plans.
Senate Bill 1000: General Plan Amendments—Safety and Environmental Justice Elements	Action Plan Implementation	Under this bill, review and revision of general plan safety elements are required to address only flooding and fires (not climate adaptation and resilience), and environmental justice is required to be included in general plans.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
Senate Bill 1241: General Plans: Safety Element—Fire Hazard Impacts	Wildfire Hazard	This bill requires cities and counties to make findings regarding available fire protection and suppression services before approving a tentative map or parcel map.
Standardized Emergency Management System	Action Plan Implementation	Local governments must use this system to be eligible for state funding of response-related personnel costs.
Western Governors Association Ten-Year Comprehensive Strategy	Wildfire Hazard	This strategy implementation plan prepared by federal and Western state agencies outlines measures to restore fire-adapted ecosystems and reduce hazardous fuels.

The following local regulations, codes, ordinances, and plans were reviewed to develop complementary and mutually supportive goals, objectives, and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms:

- General plans (land use, housing, safety, and open space elements)
- Building codes
- Zoning and subdivision ordinances
- NFIP flood damage prevention ordinances
- Stormwater management plans
- Emergency management and response plans
- Land use and open space plans
- Climate action plans.
- Community wildfire protection plans
- Tribal hazard mitigation plans.

5.3 LOCAL CAPABILITY ASSESSMENT

All participating jurisdictions compiled an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of a jurisdiction's mission, programs and policies, and evaluates its capacity to carry them out. This assessment identifies potential gaps in the jurisdiction's capabilities.

The planning partnership views all core jurisdictional capabilities as fully adaptable to meet a jurisdiction's needs. Every code can be amended, and every plan can be updated. Such adaptability is itself considered to be an overarching capability. If the capability assessment identified an opportunity to add a missing core capability or expand an existing one, then doing so has been selected as an action in the jurisdiction's action plan, which is included in the individual annexes presented in Volume 2 of this plan.

Capability assessments for each planning partner are presented in the jurisdictional annexes in Volume 2. The sections below describe the specific capabilities evaluated under the assessment.

5.3.1 Legal and Regulatory Capabilities

Jurisdictions can develop policies and programs and to implement rules and regulations to protect and serve residents. Local policies are typically identified in a variety of community plans, implemented via a local ordinance, and enforced through a governmental body.

Jurisdictions regulate land use through the adoption and enforcement of zoning, subdivision, and land development ordinances, building codes, building permit ordinances, floodplain, and stormwater management ordinances. When effectively prepared and administered, these regulations can lead to hazard mitigation.

5.3.2 Fiscal Capabilities

Assessing a jurisdiction's fiscal capability provides an understanding of the ability to fulfill the financial needs associated with hazard mitigation projects. This assessment identifies both outside resources, such as grant-funding eligibility, and local jurisdictional authority to generate internal financial capability, such as through impact fees.

5.3.3 Administrative and Technical Capabilities

Legal, regulatory, and fiscal capabilities provide the backbone for successfully developing a mitigation strategy; however, without appropriate personnel, the strategy may not be implemented. Administrative and technical capabilities focus on the availability of personnel resources responsible for implementing all the facets of hazard mitigation. These resources include technical experts, such as engineers and scientists, as well as personnel with capabilities that may be found in multiple departments, such as grant writers.

5.3.4 NFIP Compliance

Flooding is the costliest natural hazard in the United States and, with the promulgation of recent federal regulation, homeowners throughout the country are experiencing increasingly high flood insurance premiums. Community participation in the NFIP opens up opportunity for additional grant funding associated specifically with flooding issues. Assessment of the jurisdiction's current NFIP status and compliance provides planners with a greater understanding of the local flood management program, opportunities for improvement, and available grant funding opportunities.

5.3.5 Public Outreach Capability

Regular engagement with the public on issues regarding hazard mitigation provides an opportunity to directly interface with community members. Assessing this outreach and education capability illustrates the connection between the government and community members, which opens a two-way dialogue that can result in a more resilient community based on education and public engagement.

5.3.6 Participation in Other Programs

Other programs, such as the Community Rating System, Storm/Tsunami Ready, and Firewise USA, can enhance a jurisdiction's ability to mitigate, prepare for, and respond to natural hazards. These programs indicate a jurisdiction's desire to go beyond minimum requirements set forth by local, state and federal regulations in order to create a more resilient community. These programs complement each other by focusing on communication, mitigation, and community preparedness to save lives and minimize the impact of natural hazards on a community.

5.3.7 Development and Permitting Capability

Identifying previous and future development trends is achieved through a comprehensive review of permitting since completion of the previous plan and in anticipation of future development. Tracking previous and future growth in potential hazard areas provides an overview of increased exposure to a hazard within a community.

5.3.8 Adaptive Capacity

An adaptive capacity assessment evaluates a jurisdiction’s ability to anticipate impacts from future conditions. By looking at public support, technical adaptive capacity, and other factors, jurisdictions identify their core capability for resilience against issues such as sea level rise. The adaptive capacity assessment provides jurisdictions with an opportunity to identify areas for improvement by ranking their capacity high, medium or low.

5.3.9 Integration Opportunity

The assessment looked for opportunities to integrate this mitigation plan with the legal/regulatory capabilities identified. Capabilities were identified as integration opportunities if they can support or enhance the actions identified in this plan or be supported or enhanced by components of this plan. Planning partners considered actions to implement this integration as described in their jurisdictional annexes.

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

PART 2—RISK ASSESSMENT

6. IDENTIFIED HAZARDS OF CONCERN AND RISK ASSESSMENT METHODOLOGY

The risk assessments in this plan describe the risks associated with each identified hazard of concern. The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard**—The following information is given for each hazard:
  - A summary of past events that have impacted the planning area
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity descriptions
  - Warning time likely to be available for response.
- **Determine exposure to each hazard**—Exposure was assessed by overlaying hazard maps with an inventory of structures, facilities, and systems to decide which of them would be exposed to each hazard.
- **Assess the vulnerability of exposed facilities**—Vulnerability of exposed structures and infrastructure was evaluated by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and Hazus were used for this assessment for the dam failure, earthquake, flood, and tsunami hazards. Outputs similar to those from Hazus were generated for other hazards, using data generated through GIS.

The risk assessments performed for this plan evaluated risk countywide and for individual incorporated areas.

6.1 IDENTIFIED HAZARDS OF CONCERN

The Steering Committee considered the full range of natural hazards that could affect the planning area and then listed hazards that present the greatest concern. The process incorporated a review of state and local hazard planning documents as well as information on the frequency of, magnitude of, and costs associated with hazards that have struck the planning area or could do so. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. Based on the review, this plan addresses the following hazards of concern (presented in alphabetical order; the order of listing does not indicate the hazards' relative severity):

- Dam failure
- Drought
- Earthquake
- Flooding
- Landslide/mass movement

- Sea level rise
- Severe weather
- Tsunami
- Wildfire

The hazard mitigation plan includes a discussion of climate change, but it is not treated as a stand-alone hazard. Instead, a review is provided on the ways in which climate change could affect the planning area's exposure and vulnerability to the other identified hazards of concern.

An additional chapter provides a profile of "hazards of concern," defined as hazards that may impact the planning area but whose risk is difficult to quantify due to a lack of data or well-established assessment parameters. That chapter provides a profile of these hazards but does not assess them to the same level of detail as the primary hazards of concern. The hazards of interest are not included in the risk rating for this plan.

6.2 RISK ASSESSMENT TOOLS

6.2.1 Mapping

National, state, county, and city databases were reviewed to locate available spatially based data relevant to this planning effort. Maps were produced using geographic information system (GIS) software to show the spatial extent and location of hazards when such datasets were available. These maps are included in the hazard profile chapters of this document and the jurisdiction-specific annexes in Volume 2. Details regarding the data sources and methodologies employed in these mapping efforts is located in Appendix C.

6.2.2 Hazus

Overview

In 1997, FEMA developed the standardized Hazards U.S., or Hazus, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology with new models for estimating potential losses from hurricanes, floods, and tsunamis.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, community lifelines, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.

- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

Hazus provides default data for inventory and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

6.3 RISK ASSESSMENT APPROACH

6.3.1 Hazard Profile Development

Hazard profiles were developed through web-based research and review of previously developed reports and plans, including community general plans and state and local hazard mitigation plans. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others.

6.3.2 Exposure and Vulnerability

Dam Failure, Earthquake, and Flood

Community exposure and vulnerability to the following hazards were evaluated using Hazus:

- **Dam Failure and Flood**—A Level 2 user-defined analysis was performed for general building stock and for community lifelines using the flood module. Current mapping for the planning area was used to delineate hazard areas for flood and dam failure, and estimate potential losses. To estimate damage that would result from these inundation-based hazards, Hazus uses pre-defined relationships between water depth at a structure and resulting damage, with damage given as a percent of total replacement value. Curves defining these relationships have been developed for damage to structures and for damage to typical contents within a structure. By inputting inundation depth data and known property replacement cost values, dollar-value estimates of damage were generated.
- **Earthquake**—A Level 2 analysis was performed to assess earthquake exposure and vulnerability for four scenario events and one probabilistic event:
  - A Magnitude-7.57 event on the Hayward Fault with an epicenter 16 miles southeast of Petaluma.
  - A Magnitude-7.55 event on the Maacama Fault with an epicenter 26 miles north-northwest of Cloverdale.

- A Magnitude-7.19 event on the Rodgers Creek and Healdsburg Faults with an epicenter 3 miles north-northeast of Santa Rosa.
- A Magnitude-8.04 event on the San Andreas Fault with an epicenter 16 miles west of Sebastopol.
- The standard Hazus 100-year probabilistic event.

Landslide/Mass Movement, Sea Level Rise, Severe Weather, Tsunami, and Wildfire

Historical datasets were not adequate to model future losses for most of the hazards of concern. However, areas and inventory susceptible to some of the hazards of concern were mapped by other means to evaluate exposure. A qualitative analysis was conducted for other hazards using the best available data and professional judgment.

Drought

The risk assessment methodologies used for this update focus on damage to structures. Because drought does not impact structures, the risk assessment for this hazard was more limited and qualitative than the assessment for the other hazards of concern.

6.4 SOURCES OF DATA USED IN MODELING AND EXPOSURE ANALYSIS

6.4.1 Building and Cost Data

Replacement cost is the cost to replace the entire structure with one of equal quality and utility. Replacement cost is based on industry-standard cost-estimation models published in the 2020 *RS Means Square Foot Costs*. It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure from the tax assessor data. The construction class and number of stories for single-family residential structures also factor into determining the square foot costs.

Replacement cost values and detailed structure information derived from parcel and tax assessor data provided by Sonoma County were loaded into Hazus. When available, an updated inventory was used in place of the Hazus defaults for community lifelines.

6.4.2 Hazus Data Inputs

The following hazard datasets were used for the Hazus Level 2 analysis conducted for the risk assessment:

- **Flood**—Flood hazards areas were delineated using a combination of the effective Digital Flood Insurance Rate Map (DFIRM), the preliminary FIRM, and the County's Russian River flood stage inundation areas. Potential losses for the FEMA 1-percent-annual-chance and 0.2-percent-annual-chance (100- and 500-year) flood events, and the equivalent stages in the Russian River data, were estimated. The 47-foot flood stage and the 51-foot flood stage, both as measured at the Guerneville stream gage, were considered equivalent to the FEMA 1-percent-annual chance and 0.2-percent-annual-chance events respectively. Using the DFIRM and preliminary FIRM floodplain boundaries and base flood elevation information, and the County's 3-foot digital elevation model (DEM), flood depth grids were generated and integrated into the Hazus model. The flood depth grids, included as part of the Russian River inundation areas were included as part of the County's original flood stage dataset.
- **Dam Failure**—Dam failure inundation area boundaries data for Annadel No. 1, Cook No. 2, Delta Pond, Dutcher Creek, Fern Lake, Foothill Regulating Park, Foss Creek North Area, Lagunita, Lake Helen,

Lytton, Mallacomes, Matanzas Creek, Merlo, Middle Fork Brush Creek, Piner Creek, Santa Rosa Creek Reservoir, and Suttenfield were provided by the California Department of Water Resources. Associated inundation depth grid data were also provided for all dams except Delta Pond. Inundation area boundaries data for Azalea, Fountaingrove, Lake Ralphine, and Warm Springs Dam provided by the County. Depth grids for Delta Pond and the dams provided by the County were created using the inundation area boundaries and the 3-foot DEM data. The individual dam depth grids were combined using the maximum depth where the dam inundation areas overlapped, and the combined depth grid was integrated into the Hazus model.

- **Earthquake**—Earthquake ShakeMaps and probabilistic data prepared by the U.S. Geological Survey (USGS) were used for the analysis of this hazard. A National Earthquake Hazard Reduction Program (NEHRP) soils map from the California Department of Conservation, the USGS's liquefaction susceptibility data, and susceptibility to deep-seated landslide data from the California Geological Survey were also integrated into the Hazus model.

6.4.3 Other Local Hazard Data

Locally relevant information on hazards was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others. Data sources for specific hazards were as follows:

- **Flood**—Additional areas called "flood awareness areas" were delineated using the County's "functional riparian channels and floodplains" data. The mapped areas overlap with the FEMA and Russian River data in some areas but also include streams not mapped by FEMA.
- **Landslide/Mass Movement**—Susceptibility to deep-seated landslides data were provided by the California Geological Survey. Areas categorized as very high and high susceptibility (categories X, XI, VIII, and VII) were used in the exposure analysis.
- **Sea Level Rise**—USGS's Coastal Storm Modeling System sea level rise data were provided by Our Coast Our Future. Sea level rises of 200 cm (no storm) and 200 cm with a 100-year storm were used for the exposure analysis.
- **Severe Weather**—No GIS format severe weather area datasets were identified for Sonoma County.
- **Tsunami**—Tsunami inundation area data were provided by the California Department of Conservation.
- **Wildfire**—Sonoma County Wildfire Hazard Index data were provided by Sonoma County. Areas categorized as very high and high relative hazard were used in the exposure analysis.

6.4.4 Data Source Summary

Table 6-1 summarizes the data sources used for the risk assessment for this plan.

Table 6-1. Hazus Model Data Documentation

Data	Source	Date	Format
Property parcel data including building information (use code, square footage, year built)	Sonoma County	2020	Digital (GIS)
Building footprints (Sonoma County Vegetation Mapping & LiDAR Program)	Sonoma County	Unknown	Digital (GIS)
Building replacement (square foot) costs	RS Means	2020	Digital (pdf)
Sonoma County Supervisorial District boundaries	Sonoma County	Downloaded 2021	Digital (GIS)
Population data	FEMA Hazus version 4.2 SP03	2010	Digital (GIS and tabular)
CA State dam breach inundation maps (inundation boundaries and depth grids)	California Department of Water Resources	2018-20	Digital (GIS)
Dam inundation areas	Sonoma County	Unknown	Digital (GIS)
ShakeMap—Hayward RC+HN+HS M7.57	USGS	2017	Digital (GIS)
ShakeMap—Maacama M7.55	USGS	2017	Digital (GIS)
ShakeMap—Rodgers Creek-Healdsburg M7.19	USGS	2017	Digital (GIS)
ShakeMap—San Andreas SAO+SAN+SAP+SAS M8.04	USGS	2017	Digital (GIS)
NEHRP soils (VsMapV3_Geology)	California Department of Conservation	2015	Digital (GIS)
Liquefaction susceptibility	USGS (provided by Sonoma County)	2006	Digital (GIS)
Digital Flood Insurance Rate Map (DFIRM)—Sonoma County effective 3/7/2017, latest Letter of Map Revision effective 6/19/2020	FEMA	2020	Digital (GIS)
Preliminary FIRM—Sonoma County dated 5/15/2020	FEMA	2020	Digital (GIS)
Russian River Flood Modeling (inundation boundaries and depth grids)	Sonoma County	2017	Digital (GIS)
Functional Riparian Channels and Floodplains	Sonoma County Agricultural Preservation & Open Space District	2020	Digital (GIS)
Susceptibility to deep-seated landslides	California Geological Survey	2011	Digital (GIS)
USGS Coastal Storm Modeling System (v. 2.0, v. 2.1, and v. 2.2) sea level rise data	Our Coast Our Future	2019	Digital (GIS)
Tsunami Inundation Map for Emergency Planning	California Emergency Management Agency, California Geological Survey, and University of Southern California—Tsunami Research Center	2009	Digital (GIS)
Sonoma County Wildfire Hazard Index	Permit Sonoma, Sonoma County, Fire Safe Sonoma, Tukman Geospatial, Digital Mapping Solutions, Wildland Res Mgt	2021	Digital (GIS)
Sonoma Veg Map LiDAR Hydro Flattened Bare Earth DEM (3-foot resolution)	Sonoma County	2013	Digital (GIS)
Critical Facilities			
Police stations	Sonoma County (original ArcGIS Online)	Provided 2020	Digital (GIS)
Fire stations	Sonoma County	Provided 2020	Digital (GIS)
Public lands (city, county, state buildings)	Sonoma County	Provided 2020	Digital (GIS)
County buildings	Sonoma County	Provided 2020	Digital (GIS)
County leased buildings	Sonoma County	Provided 2020	Digital (GIS)
Post offices	Sonoma County (original ArcGIS Online)	Provided 2020	Digital (GIS)

Data	Source	Date	Format
Public schools	Sonoma County	Provided 2020	Digital (GIS)
Private schools	Sonoma County	Provided 2020	Digital (GIS)
College and university parcels	Sonoma County	Provided 2020	Digital (GIS)
Emergency shelters	Sonoma County	Provided 2020	Digital (GIS)
Licensed and certified healthcare facilities	Sonoma County (original ArcGIS Online)	Provided 2020	Digital (GIS)
Convalescent hospital parcels	Sonoma County	Provided 2020	Digital (GIS)
Animal hospital parcels	Sonoma County	Provided 2020	Digital (GIS)
Emergency Medical Services stations	Sonoma County	Provided 2020	Digital (GIS)
Geothermal power plants	Sonoma County	Provided 2020	Digital (GIS)
Hydroelectric power plants	Sonoma County	Provided 2020	Digital (GIS)
Electric substations	Sonoma County (original ArcGIS Online)	Provided 2020	Digital (GIS)
Sonoma-Marin Area Rail Transit stations	Sonoma County	Provided 2020	Digital (GIS)
Airports	Sonoma County	Provided 2020	Digital (GIS)
Bus transit stops	Sonoma County	Provided 2020	Digital (GIS)
Bridges	Sonoma County	Provided 2020	Digital (GIS)
Hazmat facilities	Sonoma County	Provided 2020	Digital (GIS)
Certified Unified Program Agency facilities	Sonoma County	Provided 2020	Digital (GIS)
Natural gas stations	California Energy Commission	Downloaded 2018	Digital (GIS)
Power plants	California Energy Commission	Downloaded 2020	Digital (GIS)
Wastewater treatment plants	California Water Resources Control Board	Downloaded 2020	Digital (GIS)
Hospital heliports	California Department of Transportation	Downloaded 2020	Digital (GIS)
Local Emergency Operations Centers	Homeland Infrastructure Foundation-Level Data (HIFLD)	Downloaded 2020	Digital (GIS)
Veterans Health Administration medical facilities	HIFLD	Downloaded 2020	Digital (GIS)
FM transmission towers	HIFLD	Downloaded 2020	Digital (GIS)
AM transmission towers	HIFLD	Downloaded 2020	Digital (GIS)
TV digital station transmitters	HIFLD	Downloaded 2020	Digital (GIS)
TV analog station transmitters	HIFLD	Downloaded 2020	Digital (GIS)
FDIC insured banks	HIFLD	Downloaded 2020	Digital (GIS)
Port facilities	HIFLD	Downloaded 2020	Digital (GIS)

6.5 LIMITATIONS

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk. Over the long term, the planning partners will collect additional data to assist in estimating potential losses associated with other hazards.

7. DAM FAILURE

7.1 GENERAL BACKGROUND

7.1.1 Definition and Classification of Dams

A dam is an artificial barrier that can store water, wastewater, or liquid-borne materials for many reasons—flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control. Many dams fulfill a combination of these functions. They are an important resource in the United States (ASDSO, 2013). In California, dams are regulated by the State of California Division of Safety of Dams. Additional regulatory oversight of dams is cited in Chapter 5 and described in Appendix B.

The California Water Code (Division 3) defines a dam as any artificial barrier, together with appurtenant works, that does or may impound or divert water, and that meets either of the following conditions:

- Is 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier (or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse) to the maximum possible water storage elevation
- Has an impounding capacity of 50 acre-feet or more

Dams can be classified according to their purpose, the construction material or methods used, their slope or cross-section, the way they resist the force of the water pressure, or the means used for controlling seepage. Materials used to construct dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, plastic, rubber, and combinations of these.

7.1.2 Causes of Dam Failure

Partial or full failure of dams has the potential to cause massive destruction to the ecosystems and communities located downstream. Partial or full failure can occur as a result of one or a combination of the following reasons (FEMA, 2015):

- Overtopping caused by floods that exceed the dam capacity (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams

- Piping and internal erosion of soil in embankment dams
- Inadequate or negligent operation, maintenance, and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction/landslides).

Many dam failures in the United States have been secondary results of other disasters. The most common causes are earthquakes, landslides, extreme storms, equipment malfunction, structural damage, foundation failures, and sabotage. Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

7.1.3 Planning Requirements

State of California

All dams whose inundation areas may impact the planning area have emergency action plans (EAPs) on file. The EAPs must include the following (Cal OES, 2018):

- Emergency notification flow charts
- Information on a four-step response process
- Description of agencies' roles and actions in response to an emergency incident
- Description of actions to be taken in advance of an emergency
- Inundation maps
- Additional information such as revision records and distribution lists.

After the EAPs are approved by the state, the law requires dam owners to send the approved EAPs to relevant stakeholders. Local public agencies can then adopt emergency procedures that incorporate the information in the EAP in a manner that conforms to local needs and includes methods and procedures for alerting and warning the public and other response and preparedness related items (State of California, 2018).

Federal Energy Regulatory Commission

Dams that fall under the jurisdiction of the Federal Energy Regulatory Commission (FERC) also have specified planning requirements. FERC has the largest dam safety program in the United States. It cooperates with many federal and state agencies to ensure and promote dam safety and, more recently, homeland security. FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans are designed to serve as an early warning system if there is a potential for, or a sudden release of water from, a dam failure or accident to the dam. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows and procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that in emergency situations everyone knows what to do, thus saving lives and minimizing property damage.

7.2 HAZARD PROFILE

7.2.1 Past Events

No known failures have occurred on dams that impact Sonoma County. However, according to the 2013 *State of California Multi-Hazard Mitigation Plan*, there have been nine failures of federally regulated dams elsewhere in the state since 1950. Overtopping caused two of the nine dam failures in the state, and the others were caused by seepage or leaks. The most catastrophic event was the failure of the St. Francis Dam in Los Angeles County, which failed in 1928 and killed an estimated 450 people.

The state's most recent dam emergency occurred in February 2017 when the Oroville Dam in Butte County was on the verge of overflow. The dam's concrete spillway was damaged by erosion and a massive hole developed. The auxiliary spillway was used to prevent overtopping of the dam, and it experienced erosion problems also. Evacuation orders were issued in advance of a potential large uncontrolled release of water from Lake Oroville, but such a release did not occur. After this incident, state officials ordered that flood-control spillways be re-inspected on 93 California dams with potential geologic, structural or performance issues that could jeopardize their ability to safely pass a flood event.

7.2.2 Location

List of High-Hazard Dams

According to the Army Corps of Engineers' National Inventory of Dams, there are 65 dams that are in the planning area or have inundation areas that extend into the planning area. Table 7-1 lists basic data about the 21 dams that are rated as high or extremely high risk. The locations of each dam are shown on Figure 7-1.

Warm Springs Dam

The largest dam in Sonoma County is the Warm Springs Dam that impounds Dry Creek and provides water supply and flood management. The dam was built in 1982 and forms Lake Sonoma Reservoir, which has a total storage capacity of 381,000 acre-feet: a water supply pool of 245,000 acre-feet and a flood pool of 136,000 acre-feet. The dam is owned by the U.S. Army Corps of Engineers. Water supply releases from this dam are controlled by the Sonoma County Water Agency. Water released for flood control is managed by the Corps (County of Sonoma 2017).

The Corps assessed the seismic integrity of the Warms Springs Dam in 2006. The assessment did not report any potential failure modes but did analyze the consequences of a failure. The occurrence of a seepage, overtopping, or a seismic event that could lead to a total breach of the dam could not entirely be ruled out due to the lack of updated studies. A breach could occur within a relatively short period of time, perhaps a few hours. The Corps categorized this dam as Dam Safety Action Class IV (considered marginally safe). This rating is based on probability of failure and on the population, residential and commercial structures, roads, farmland, bridge, and utilities downstream that could be damaged. The Corps plans to conduct additional safety assessment of the dam and appurtenant structures using the most recent information on seismic and flood conditions.

The Warm Springs Dam Failure Response Plan outlines the procedures and policy for potential failure of the Warm Springs Dam and possible impacts in the north central portion of the county. The plan identifies inundation areas, warning and evacuation procedures, and emergency contacts.

Table 7-1. High-Hazard Dams in the Planning Area or with Inundation Areas Extending into Planning Area

Name	Water Course	Owner	Year Built	Hazard Rating	Dam Type	Crest Length (feet)	Height (feet)	Storage Capacity (acre feet)	Condition Assessment
Fern Lake	Mill Cr. Trib.	Sonoma Developmental Center	1921	High	Earth	300	40	241	Satisfactory
Suttenfield	Sonoma Creek	Sonoma Developmental Center	1938	Extremely High	Earth	965	76	600	Satisfactory
Warm Springs[a]	Dry Creek	Corps of Engineers San Francisco District	1982	High	Earth	3000	319	130	n/a
Annadel No. 1	Spring Creek	California Department of Parks and Recreation	1956	Extremely High	Earth	400	67	395	Poor
Towibalyla	Franz Cr. Trib.	Kendall Jackson Wine Estates, LTD	1962	High	Earth	525	51	376	Satisfactory
Mallacomes	Foote Creek	Rancho Mallacomes	1951	High	Earth	940	57	225	Satisfactory
Piner Creek	Paulin Creek	Sonoma County Water Agency	1962	High	Earth	205	28	172	Satisfactory
Middle Fork Brush Creek	Middle Fk. Brush Cr.	Sonoma County Water Agency	1961	High	Earth	1100	37	138	Satisfactory
Matanzas Creek	Matanzas Creek	Sonoma County Water Agency	1963	Extremely High	Earth	685	95	1,500	Satisfactory
Santa Rosa Creek Reservoir	Santa Rosa Cr. Trib.	Sonoma County Water Agency	1963	Extremely High	Earth	1950	37	3,550	Satisfactory
Lake Ralphine	Santa Rosa Cr. Trib.	City of Santa Rosa	1882	Extremely High	Earth	700	35	387	Satisfactory
Fountaingrove	Mark West Cr. Trib.	City of Santa Rosa	1953	Extremely High	Earth	500	38	427	Satisfactory
Lagunita	Windsor Cr. Trib.	Private Entity	1954	Extremely High	Earth	308	49	133	Satisfactory
Azalea	N. Fk. Lancel Cr.	Silver Eagle Ranch, LLC	1955	High	Earth	140	44	85	Satisfactory
Lytton	Russian R. Trib.	Lytton Rancheria of California	1956	High	Earth	275	34	410	Satisfactory
Lowe	Franz Cr. Trib.	Ferrari-Carano Vineyards and Winery, LLC	1959	High	Earth	550	30	108	Satisfactory
Bosch No. 2	Windsor Cr. Trib.	Private Entity	1962	High	Earth	230	55	37	Satisfactory
Foothill Regulating Park	Windsor Cr. Trib.	County of Sonoma Regional Park	1963	High	Earth	274	51	109	Satisfactory
The Hill Ranch	Santa Rosa Cr.	Private Entity	1955	High	Earth	202	49	160	Satisfactory
Merlo	Fall Creek	Private Entity	1982	High	Earth	210	74	930	Satisfactory
La Crema Winery		Jackson Family Wines		High	Earth	1600	32	103	Fair

a. The Warm Springs Dam is a federal dam, not under the jurisdiction of the State of California. Data taken from U.S. Army Corps of Engineers' National Inventory of Dams

Source: California Department of Water Resources, Division of Safety of Dams, 2020

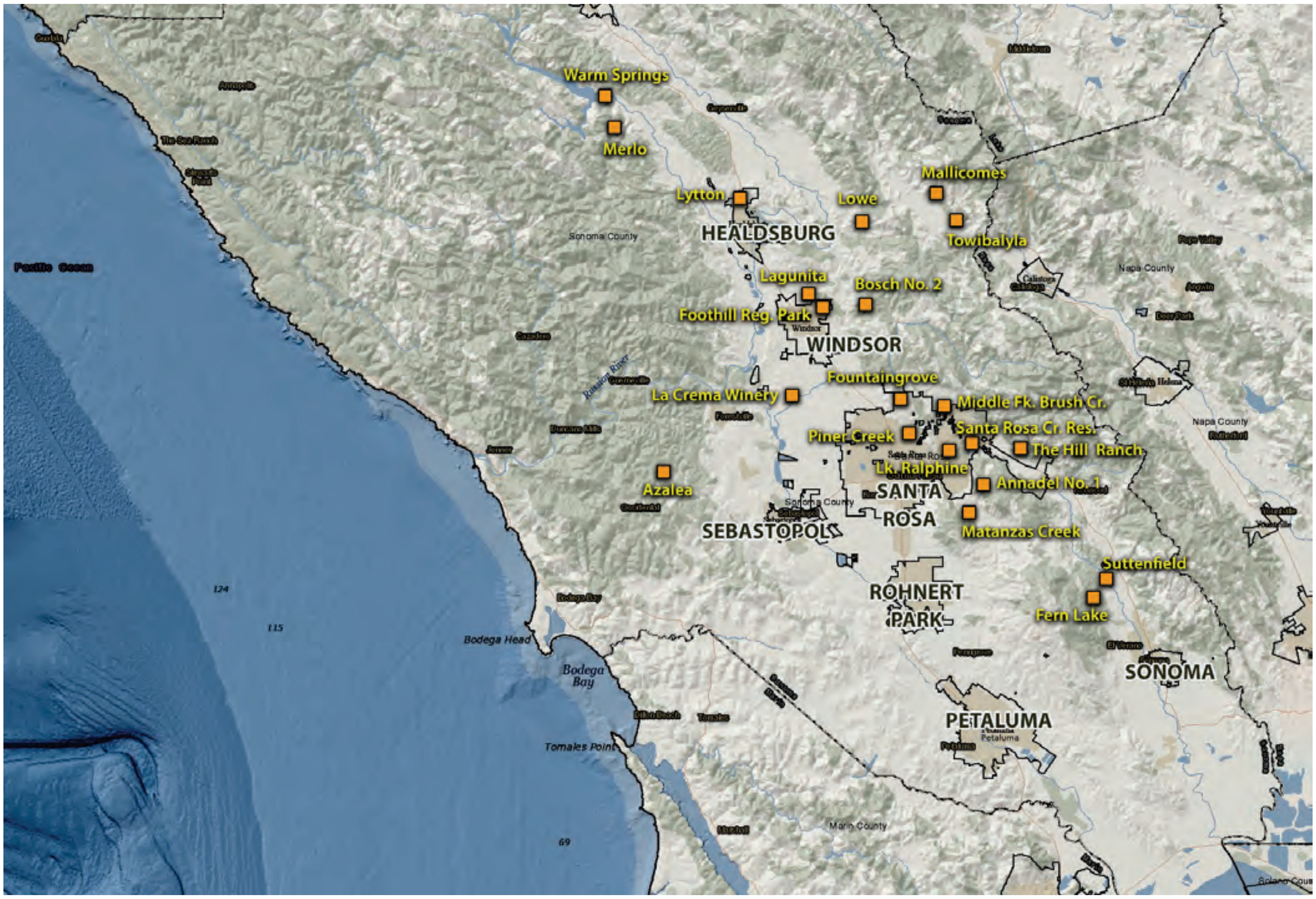


Figure 7-1. Locations of Dams in Sonoma County

Coyote Valley Dam

The Coyote Valley Dam in Mendocino County regulates the northern Russian River and was built in 1959. It forms the Lake Mendocino Reservoir, which holds 122,400 acre-feet. Failure of this dam could affect areas in Sonoma County. This dam is owned by the Corps of Engineers. Water releases are controlled in a manner similar to the approach for the Warm Springs Dam (County of Sonoma 2017).

The Corps assessed the seismic integrity of the Coyote Valley Dam in 2005 and categorized it as Dam Safety Action Class III. Dams in Class III, for confirmed and unconfirmed dam safety issues, are significantly inadequate or have moderate to high risk based on the combination of life or economic consequences and probability of failure. The assessment found that the following are the most likely modes of failure, in order of decreasing risk:

- Seepage along the conduit leading to the formation of piping, which can quickly progress to rapid breaching of the embankment.
- Tunnel/Conduit joint failure caused by significant displacements of the shells during both the operating base earthquake and maximum design earthquake, and intake tower stability and embankment/foundation liquefaction failures during a maximum design earthquake.
- The dam will be overtopped during the probable maximum flood event and will result in erosion of the crest and downstream slope leading to a complete breach.

The Corps plans to conduct additional safety assessment of the dam and appurtenant structures using the most recent information on seismic and flood conditions.

Other Dams in the County

There are 63 smaller dams throughout Sonoma County that are regulated by the Division of Safety of Dams. All are small and generally used for agricultural, drinking water, or stormwater management purposes. Failure of one of these dams could pose a significant threat to limited areas of the county. A dam inundation contingency plan for each dam is filed with the County.

Inundation Mapping

A key element for EAPs required for dams in California is a map defining the potential downstream inundation should the dam fail. For this risk assessment, digital data suitable for a quantitative assessment of dam failure risk was available for all high hazard dams listed in Table 7-1. To perform the risk assessment's evaluation of exposure and vulnerability, the dam failure inundation areas were combined into a single hazard area shown in Figure 7-2.

7.2.3 Frequency

Dam failure events are infrequent and usually coincide with or follow events such as earthquakes, landslides and excessive rainfall and snowmelt. Although the recent Oroville event raised public concern about dam failure, the probability of such failures remains low in today's regulatory environment. No recorded failures have occurred on dams that impact the planning area, so no estimate of frequency or probability of future occurrence can be developed based on the historical record.

All dams face a "residual risk" of failure, which represents the risk that conditions may exceed those for which the dam was designed. For example, dams may be designed to withstand a probable maximum precipitation, defined as "theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular geographical location at a certain time of the year" (Hansen 1982). The chance of occurrence of a precipitation event of a greater magnitude than that represents residual risk for such dams. This in turn represents a theoretical probability of future occurrence for a dam failure event, though the probability of an event exceeding the assumed maximum is not generally calculated as part of dam design.

7.2.4 Severity

Dam failure can be catastrophic to all life and property downstream. California's Division of Safety of Dams has developed a hazard potential classification system for state-jurisdiction dams, as shown on Table 7-2. This system is modified from federal guidelines, which recommend three-tier classification. The California system adds a fourth hazard classification of "extremely high." Dams classified as extremely high hazard may impact highly populated areas or critical infrastructure or have short evacuation warning times (California Division of Safety of Dams, 2017). All dams listed in Table 7-1 are classified as high hazard in this system.

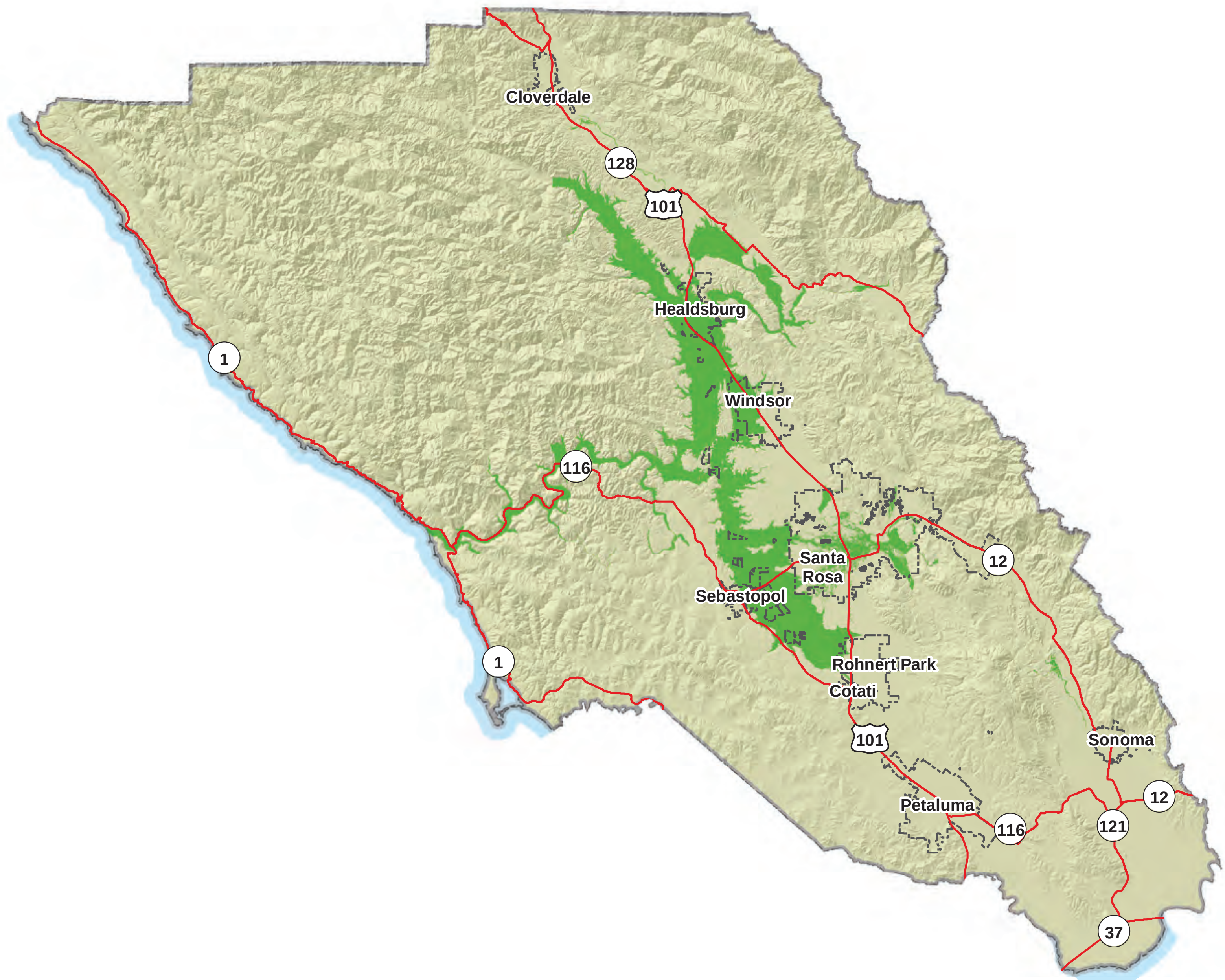


Figure 7-2. Dam Failure Inundation Area Used for Risk Assessment

Inundation Area

Cities

County Boundary

Highways

N

0 5 10 Miles

Data Sources: Sonoma Co., CA DWR

Table 7-2. State of California Downstream Hazard Potential Classification

Hazard Category	Direct Loss of Life	Economic, Environmental, and Lifeline Losses
Low	None expected	Low and principally limited to dam owner's property
Significant	None expected	Yes
High	Probable (one or more expected)	Yes, but not necessary for this classification
Extremely High	Considerable	Yes, major impacts to critical infrastructure or property

Source: California Division of Safety of Dams, 2017

7.2.5 Warning Time

Advance Warning of Failure

Warning time for dam failure varies depending on the cause of the failure. Events of extreme precipitation or massive snowmelt can be predicted in advance, so evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no or limited warning time. The USGS Earthquake Hazards Program has several dam-safety related earthquake programs, including dam-specific earthquake monitoring programs in California to help monitor safety concerns following seismic events.

Time for Failure to Occur

The process of the dam failure affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted, or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours.

Time After Failure Before Downstream Areas Are Affected

The number of people to be alerted and evacuated in the event of impending dam failure can vary widely. There may be few people along the river in winter, when only permanent residents are apt to be present; but there may be many people in summer, when seasonal cabins are occupied and there are visitors along all the rivers.

Another factor that must be considered is the initial flow in the river when the failure occurs. The initial flow is normally very low on all the rivers from May through October. During the winter, the initial flow is much higher and at times may even be equal to or greater than flood stage. This wide variation in initial flow has a significant impact on the areas that must be evacuated.

If the Warm Springs Dam failed, portions of the communities of Healdsburg, Windsor, Santa Rosa, Sebastopol, and Guerneville, as well as some rural population areas in the floodplain immediately downstream of the dam, would be within the 1- to 24-hour flood wave travel time bracket. Half of the rural population immediately downstream of the dam are within a 15-minute flood wave travel time and all are within a 1-hour flood wave travel time (County of Sonoma 2017).

7.2.6 Secondary Hazards

Dam failure can cause landslides, bank erosion, and destruction of downstream habitat. Dam failure may worsen the severity of a drought by releasing water that might have been used as a potable water source.

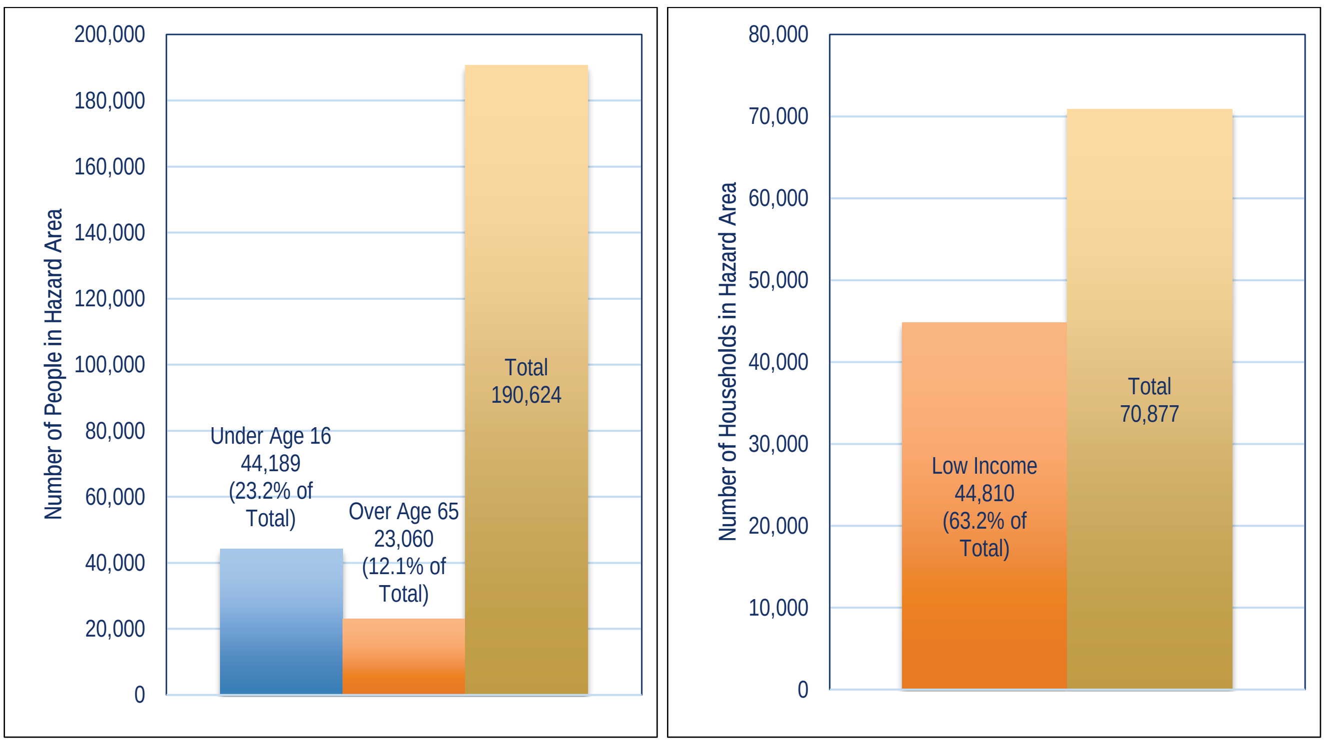
7.3 EXPOSURE

A quantitative assessment of exposure to the dam failure hazard was conducted using the inundation mapping (see Figure 7-2) and the asset inventory developed for this plan. Detailed results by jurisdiction are included in Appendix D; countywide summaries are provided below.

7.3.1 Population

The estimated total population living in the evaluated dam failure inundation zone is 72,953 (15.0 percent of the total planning area population).

Socially vulnerable populations exposed to the dam failure hazard were estimated based on data for the Census-defined blocks that lie at least partially within the mapped dam failure inundation zone. Because many of those Census blocks extend outside the inundation zone, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 7-3 summarizes the estimated exposure of socially vulnerable populations.



See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 7-3. Socially Vulnerable Populations in Dam Failure Inundation Zone Census Blocks

7.3.2 Property

Table 7-3 summarizes the estimated property exposure in the evaluated dam failure inundation area. Figure 7-4 shows the Hazus-defined occupancy class of all buildings in the combined dam failure inundation area. These occupancy classes provide an indication of land use within the mapped hazard area. Some land uses are more vulnerable to dam failure inundation, such as single-family homes, while others are less vulnerable, such as agricultural land or parks.

Table 7-3. Exposed Property in Evaluated Dam Failure Inundation Area

Acres of inundation area	119,638
Number of Buildings Exposed	28,064
Value of Exposed Structures	$20,123,003,848
Value of Exposed Contents	$17,118,450,390
Total Exposed Property Value	$37,241,454,238
Total Exposed Value as % of Planning Area Total	17.0%

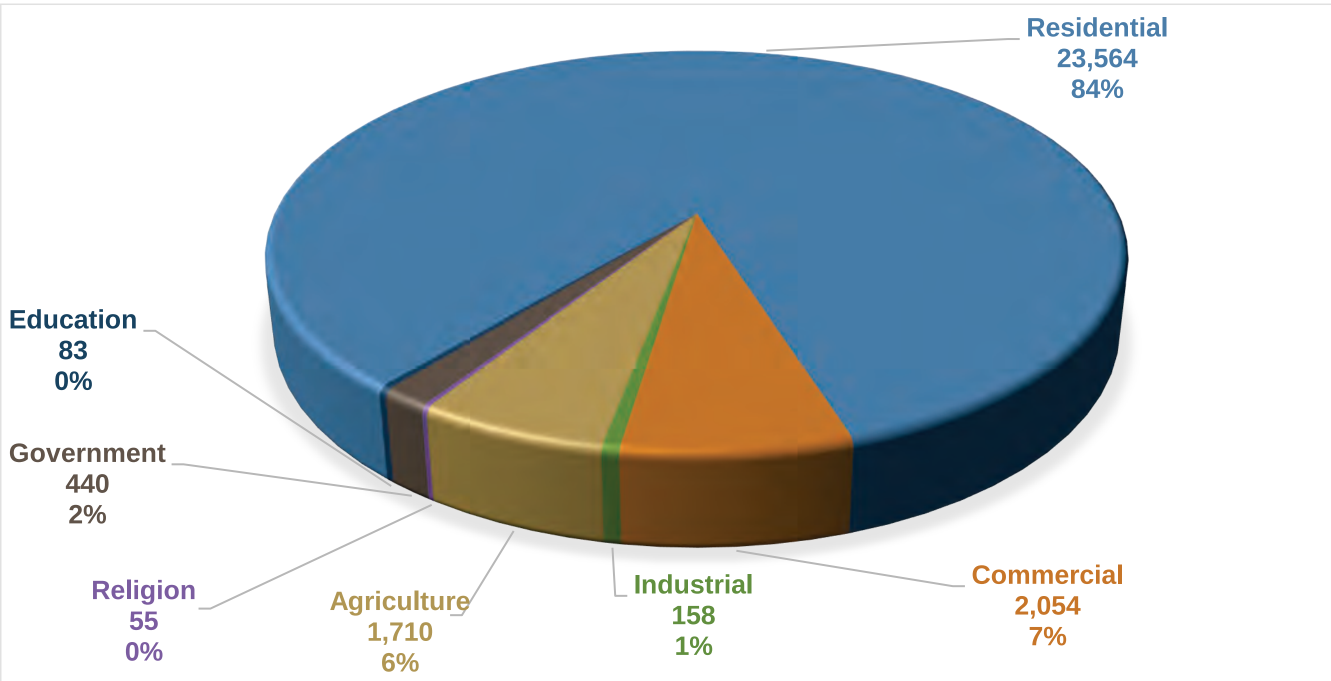


Figure 7-4. Building Occupancy Class Distribution in the Dam Failure Inundation Zone

7.3.3 Critical Facilities

Figure 7-5 shows critical facilities located in the dam inundation zone by facility type and river system. The total count of critical facilities in the dam failure inundation zone (1,059) represents 22 percent of the planning area total of 4,759. Significant facilities included in the mapped inundation zone include the following:

- **2 water treatment facilities**
- **12 wastewater treatment facilities**
- **660 hazardous material sites**
- **3 hospitals**
- **12 fire stations**
- **4 police stations**
- **49 schools**
- **111 road bridges**

7.3.4 Environment

All natural features and wildlife in the dam inundation zone are at risk from the dam failure hazard.

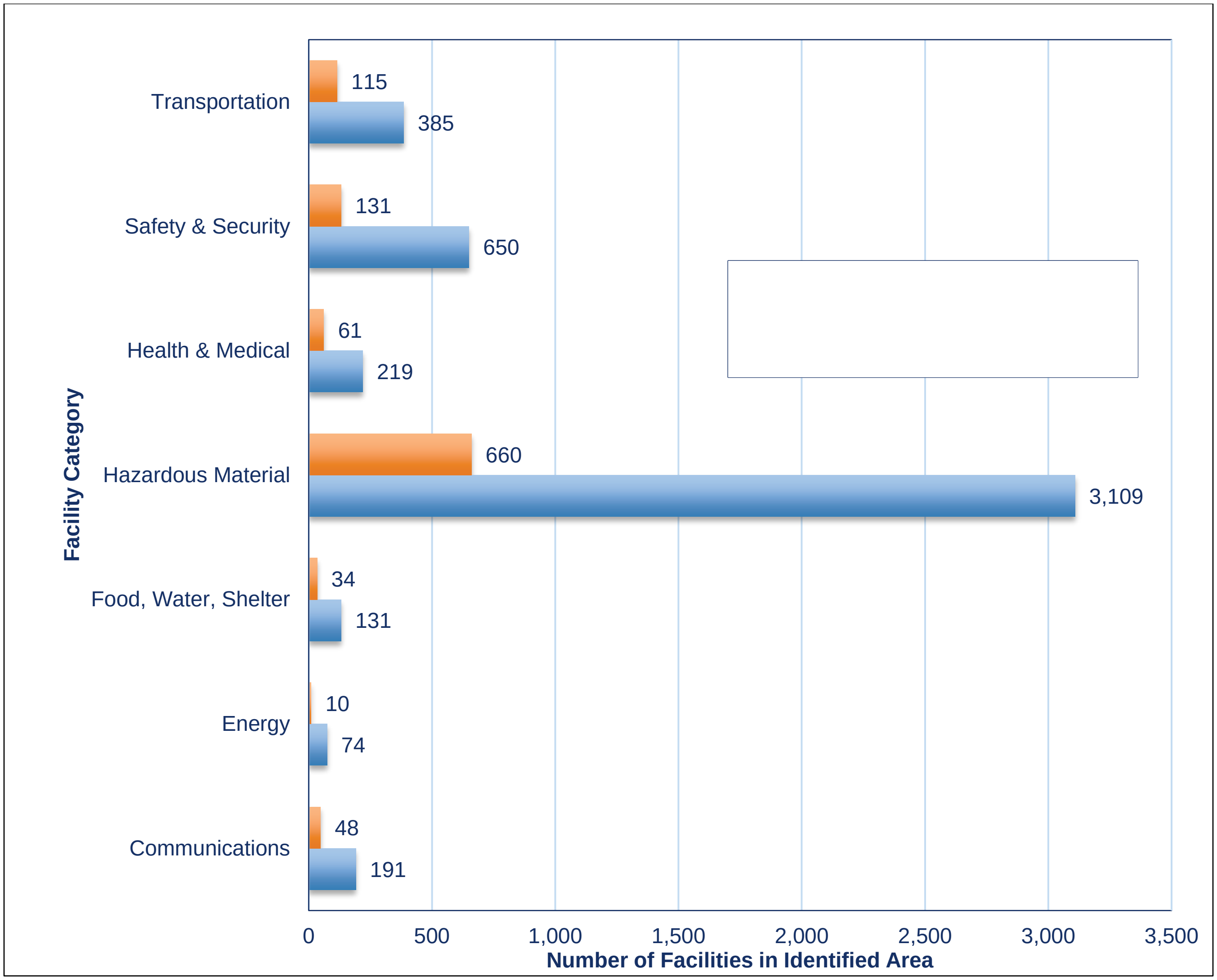


Figure 7-5. Critical Facilities in Dam Failure Inundation Zones and Countywide

7.4 VULNERABILITY

The vulnerability of people, property, and critical facilities was evaluated for the combined dam inundation area. Detailed results by jurisdiction are included in Appendix D; countywide summaries are provided below.

7.4.1 Population

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area before floodwaters arrive. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television, radio emergency warning system, siren, or cell phone alert. Impacts on persons and households for the five dams chosen for further analysis were estimated for each event through the Level 2 Hazus analysis. Table 7-4 summarizes the results.

Table 7-4. Estimated Dam Failure Impacts on Population

Number of Displaced Residents	44,359
Number of Residents Requiring Short Term Shelter	3,157

7.4.2 Property

Vulnerable properties are those closest to the dam inundation zone. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Properties in the dam inundation zone that are built to National Flood Insurance Program (NFIP) minimum construction standards may have some level of protection against dam inundation, depending on the velocity and elevation of the inundation waters. These properties also are more likely to have flood insurance. Table 7-5 summarizes the loss estimates for dam failure.

Table 7-5. Estimated Impact of a Dam Failure in the Planning Area

Number of Buildings Impacted	25,402
Estimated Loss, Structures	$7,546,212,770
Estimated Loss, Contents	$7,923,438,235
Estimated Loss, Total	$15,469,651,005
Total Loss as % of Total Replacement Value	7.1%

7.4.3 Critical Facilities

Hazus estimated damage to critical facilities in the dam failure inundation zones as summarized in Figure 7-6. Typical vulnerabilities of these facilities include the following:

- Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues and significant disruption to travel. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge.
- Utilities such as overhead power lines, cable and phone lines in the inundation zone could also be vulnerable. If phone lines were lost, significant communication issues may occur in the planning area due to limited cell phone reception in many areas.
- In addition, emergency response would be hindered due to the loss of transportation routes as well as some protective-function facilities in the safety and security category located in the inundation zone. Recovery time to restore many critical functions after an event may be lengthy.

7.4.4 Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce foreign elements into local waterways, resulting in destruction of downstream habitat and detrimental effects on many species of animals, especially endangered species such as the tidewater goby.

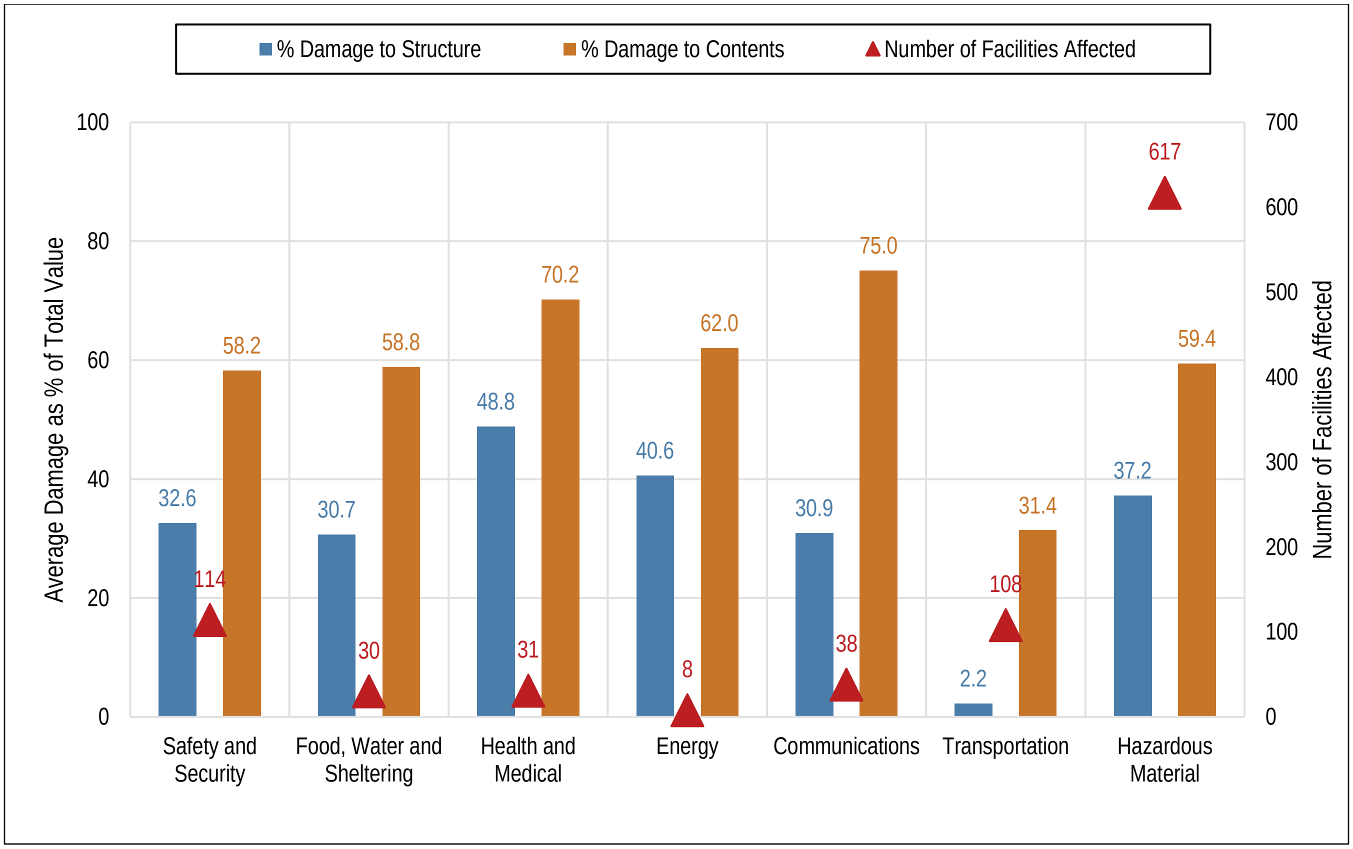


Figure 7-6. Estimated Damage to Critical Facilities from Dam Failure

7.5 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans adopted under state law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. Dam failure is currently not addressed as a stand-alone hazard in the safety elements, but flooding is. Municipalities participating in this plan have established comprehensive policies regarding sound land use in identified flood hazard areas. Any structures that are built in the dam failure inundation area outside of the regulated floodplain will not be subject to floodplain management codes and standards. These structures would be more vulnerable than those constructed with floodplain codes and standards. Flood-related policies in the general plans will help to reduce the risk associated with dam failure for all future development in the planning area.

7.6 SCENARIO

In a worst-case scenario, an earthquake could lead to liquefaction of the ground soils where the dams that impact the planning area are located, causing the dams to fail. This could occur without warning in the middle of the night when downstream residents are asleep and unprepared to evacuate. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of one of the dams.

7.7 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zone. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failures, which are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather. Important issues associated with the dam failure hazard include the following:

- Dam infrastructure may require repair and improvement to withstand climate change impacts, such as changing in the timing and intensity of rain events.
- Structures located in the dam inundation zone may be located outside of special flood hazard areas, meaning that they are not constructed to withstand floodwaters and are less likely to be covered by flood insurance. Even structures that have been designed with flood hazards in mind may not be able to withstand the height and velocity of flow from a dam failure event.
- California law requires that a property's location in a dam inundation area be disclosed to a seller if the seller or the seller's agent has knowledge of the property's location within the hazard area or if the local jurisdiction has compiled a list of parcels that are in the inundation area and has posted at the offices of the county recorder, county assessor, and county planning agency a notice that identifies the location of the list. It is unknown if this list has been compiled for the planning area.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.

8. DROUGHT

8.1 GENERAL BACKGROUND

Drought is a significant decrease in water supply relative to what is needed to sufficiently meet typical demand in each location. It is a normal phase in the Mediterranean climate cycle, originating from a deficiency of precipitation over an extended period, usually a season or more. This leads to a water shortage for some activity, group, or environmental sector. Drought is generally defined based on four ways of measuring it (National Drought Mitigation Center, 2021):

- **Meteorological drought**—Based on measurements such as precipitation deficit compared to normal or expected precipitation. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of global weather systems.
- **Agricultural drought—**Based on impacts due to reduced precipitation and water supply (e.g., crop loss, herd culling, etc.)
- **Hydrological drought**—Based on measurements of stream flows, groundwater, and reservoir levels relative to normal conditions
- **Socioeconomic drought**—Based on direct and indirect socio-economic impacts on society and the economy. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply. If a community has stored enough water to meet its needs in the event of a shortage of rainfall, then it may not experience socioeconomic drought even though its geographic area experiences meteorological drought.

8.1.1 Monitoring and Categorizing Drought

NOAA Drought Indices

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure the impacts and severity of meteorological, agricultural, and hydrological drought and to map their extent and locations:

- The ***Crop Moisture Index*** measures short-term drought weekly to assess impacts on agriculture.
- The ***Palmer Z Index*** measures short-term drought on a monthly scale.
- The ***Palmer Drought Severity Index*** is based on long-term weather patterns. The intensity of drought in a given month is dependent on current weather plus the cumulative patterns of previous months. Weather patterns can change quickly, and the Palmer Drought Severity Index can respond fairly rapidly.

- The ***Palmer Hydrological Drought Index*** quantifies hydrological effects (reservoir levels, groundwater levels, etc.), which take longer to develop and last longer. This index responds more slowly to changing conditions than the Palmer Drought Index.
- The ***Standardized Precipitation Index*** considers only precipitation. A value of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The Standardized Precipitation Index is computed for time scales ranging from one month to 24 months.

Each of these indices is meaningful for different sectors of society and the economy. For example an urbanized areas that uses water from reservoirs would be sensitive to hydrological drought characterized by the Palmer Hydrological Drought Index, while unirrigated grazing land would be sensitive to meteorological drought characterized by the Crop Moisture Index. Maps of these indices show drought conditions nationwide at a given point in time. They are not necessarily indicators of any given area's long-term susceptibility to drought. Recent examples of these maps are shown on Figure 8-1.

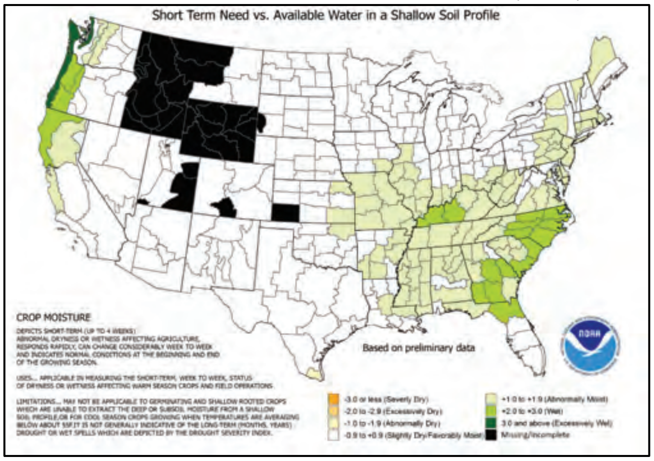
U.S. Drought Monitor

The U.S. Drought Monitor (USDM) is a map that is updated weekly to show the location and intensity of drought across the country. The USDM uses a five-category system (USDM, 2021):

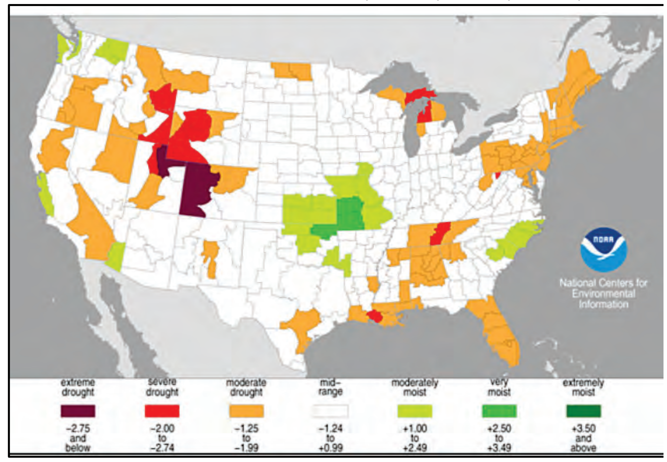
- D0—Abnormally Dry
  - Short-term dryness slowing planting, growth of crops
  - Some lingering water deficits
  - Pastures or crops not fully recovered
- D1—Moderate Drought
  - Some damage to crops, pastures
  - Some water shortages developing
  - Voluntary water-use restrictions requested
- D2—Severe Drought
  - Crop or pasture loss likely
  - Water shortages common
  - Water restrictions imposed
- D3—Extreme Drought
  - Major crop/pasture losses
  - Widespread water shortages or restrictions
- D4—Exceptional Drought
  - Exceptional and widespread crop/pasture losses
  - Shortages of water creating water emergencies

The USDM categories show experts' assessments of conditions related to drought. These experts check variables including temperature, soil moisture, stream flow, water levels in reservoirs and lakes, snow cover, and meltwater runoff. They also check whether areas are showing drought impacts such as water shortages and business interruptions. Associated statistics show what proportion of various geographic areas are in each category of dryness or drought, and how many people are affected. U.S. Drought Monitor data go back to 2000.

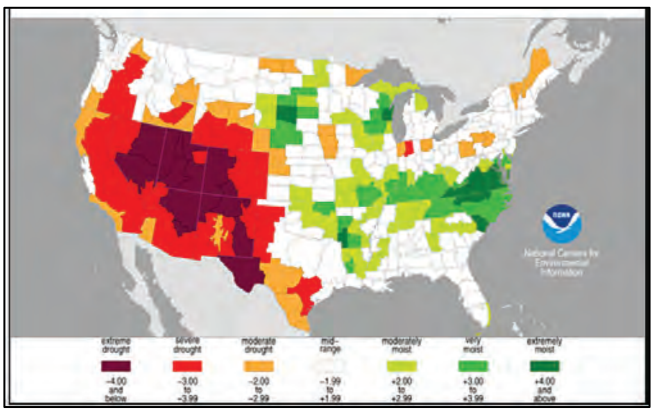
Sources: National Weather Service, 2021; National Centers for Environmental Information, 2021a, 2021b, 2021c, 2021d



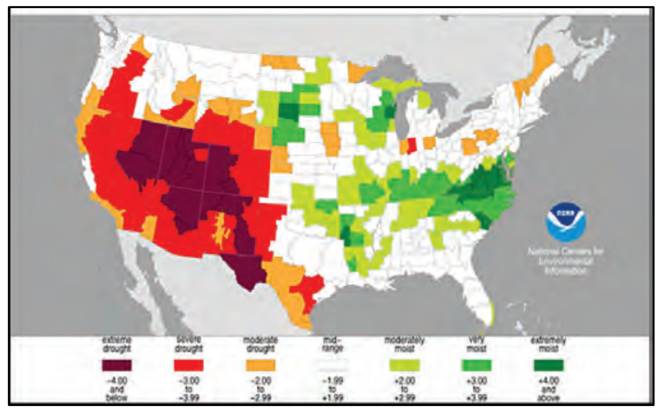
Crop Moisture Index (Week Ending February 06, 2020)



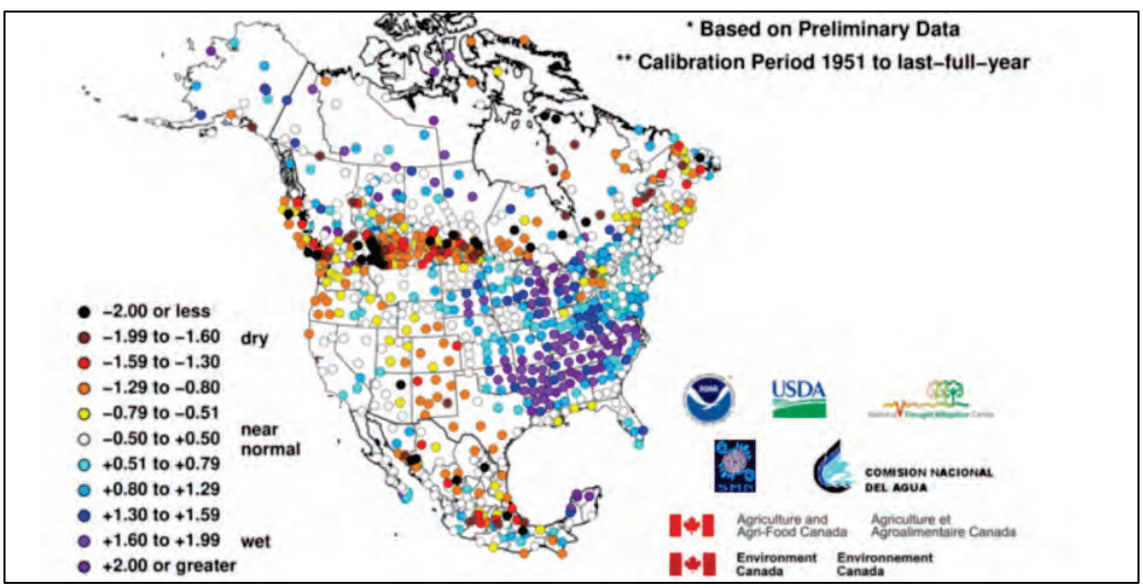
Palmer Z Index Short-Term Drought Conditions (January 2021)



Palmer Drought Severity Index (January 2021)



Palmer Hydrological Drought Index (January 2021)



Standardized Precipitation Index (24-Months Ending December 2020)

Figure 8-1. Standard National Drought and Precipitation Indices

8.1.2 Drought Impacts

Drought can have a widespread impact on the environment and the economy, although it typically does not result in loss of life or damage to structures, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- **Economic Impacts**—These impacts of drought cost people (or businesses) money. Farmers' crops are destroyed; low water supply necessitates spending on irrigation system modifications, drilling of new wells, and/or trucking in water; water-related businesses (such as sales of boats and fishing equipment) may experience reduced revenue.
- **Environmental Impacts**—Plants and animals depend on water. When a drought occurs, their food supply can shrink, and their habitat can be damaged.
- **Social Impacts**—Social impacts include public safety, health, conflicts between people when there is not enough water to go around, and changes in lifestyle.

The demand that society places on water systems and supplies—such as expanding populations, irrigation, and environmental needs—contributes to drought impacts. Drought can lead to difficult decisions regarding the allocation of water, as well as stringent water use restrictions, water quality problems, and inadequate water supplies for fire suppression. There are also issues such as growing conflicts between agricultural uses of surface water and in-stream uses, surface water and groundwater interrelationships, and the effects of growing water demand on uses of water.

Vulnerability of an activity to drought depends on its water demand and the water supplies available to meet the demand. The impacts of drought vary between sectors of the community in both timing and severity:

- **Water supply—**The water supply sector encompasses urban and rural drinking water systems that are affected when a drought depletes surface and groundwater supplies due to reduced runoff and recharge from precipitation.
- **Agriculture and commerce—**Impacts on agriculture and associated commerce include the reduction of crop yield and livestock sizes due to insufficient water supply for crop irrigation and maintenance of ground cover for grazing.
- **Environment, public health, and safety—**Impacts on the environmental, public health, and safety sectors include wildfires that are both detrimental to the forest ecosystem and hazardous to the public. The impacts also includes the desiccation of streams, resulting in the reduction of in-stream habitats for native species.

8.1.3 California Drought Response

During critically dry years, the California State Water Resources Control Board can mandate conservation by water users and agencies to address statewide water shortages. Table 8-1 lists State Drought Management Program stages mandated to water right holders.

Table 8-1. State Drought Management Program

Drought Stage	State Mandated Customer Demand Reduction	Rate Impacts
Stage 0 or 1	<10%	Normal rates
Stage 2	10 to 15%	Normal rates; Drought surcharge
Stage 3	15 to 20%	Normal rates; Drought surcharge
Stage 4	>20%	Normal rates, Drought surcharge

8.2 HAZARD PROFILE

8.2.1 Local Water Use and Supply

Sonoma County has two principal sources of water for residential, commercial, industrial, and agricultural use: the Russian River and groundwater. Additional water sources include diversions from small streams and springs and numerous reservoirs. Major users of Russian River water in Sonoma County are the cities of Cloverdale and Healdsburg, numerous individual diverters along the main stem of the Russian River and Dry Creek, and the Sonoma County Water Agency (Sonoma Water). About 73 percent of Sonoma County residents live in cities served by public water systems. Most residents of the unincorporated rural areas are outside urban service areas and are dependent on individual onsite wells or small-scale shared water supply systems.

Sonoma Water

Infrastructure

Sonoma Water serves the urbanized areas of Sonoma County and northern Marin County with water from the Russian River. The agency's extensive water supply infrastructure generally mitigates the effects of short-term dry periods for most water users (see Figure 8-2):

- Two major reservoirs regulate flow on the Russian River:
  - Sonoma Water and the Mendocino County Russian River Flood Control and Water Conservation Improvement District have water right permits authorizing storage up to the design capacity of 122,500 acre-feet per year in the Lake Mendocino reservoir (Coyote Valley Dam) in Mendocino County. Sonoma Water controls releases from the water supply pool in Lake Mendocino. However, the Corps manages flood control releases when the water level exceeds the top of the water supply pool elevation.
  - The Warm Springs Dam impounds water on Dry creek in Sonoma County forming Lake Sonoma, which has a total water supply capacity of 245,000 acre-feet (Sonoma Water, 2021a). Sonoma Water controls water supply releases from Lake Sonoma and the Corps manages flood control releases.
- Sonoma Water diverts water from the Russian River near Forestville and conveys the water via its transmission system (including diversion facilities, treatment facilities, aqueducts, pipelines, water storage tanks, and booster pump stations) to its customers.

Source: (Sonoma Water n.d.)

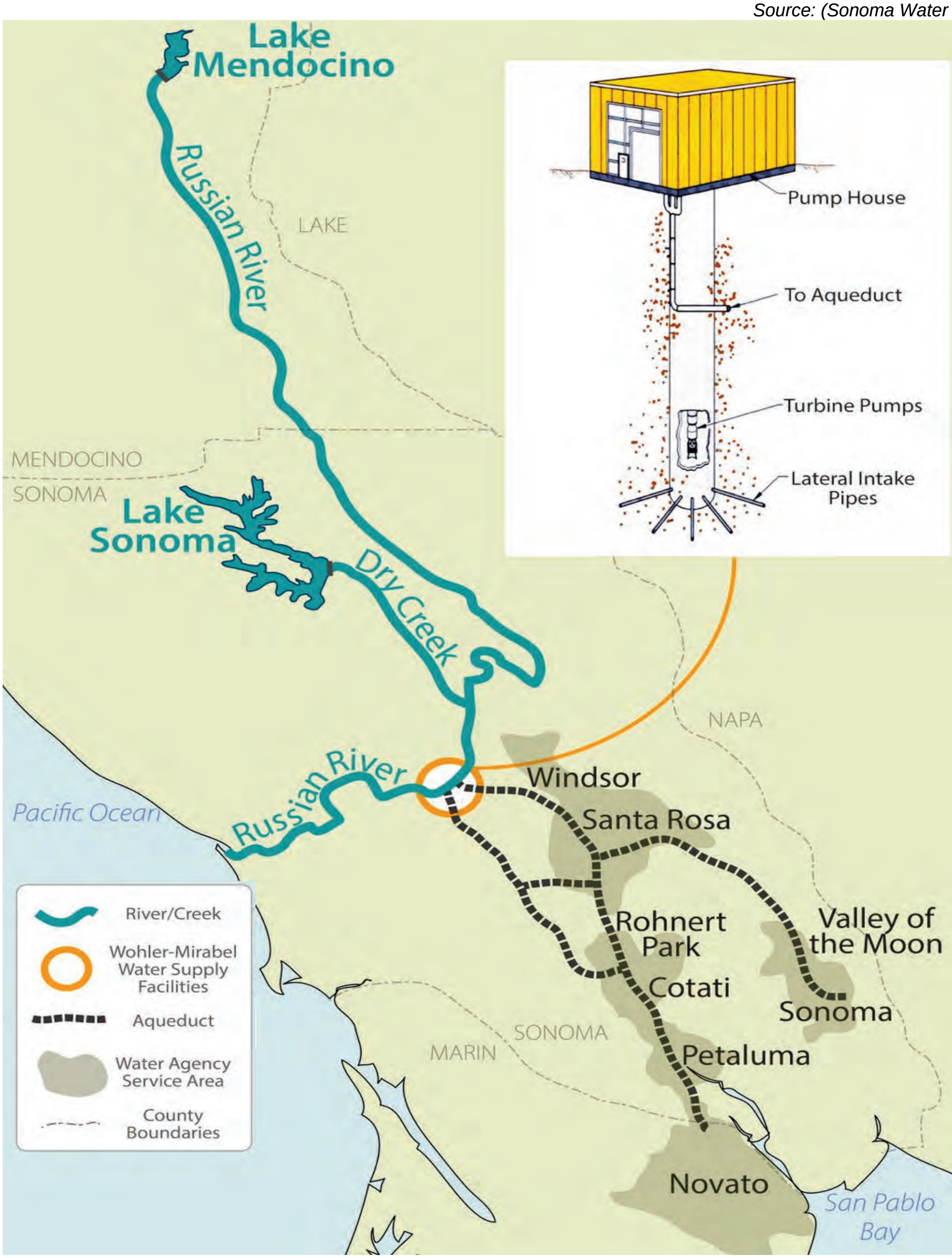


Figure 8-2. Russian River Watershed and the Sonoma Water Supply System

Planning Efforts

In accordance with California's Urban Water Management Planning Act, Sonoma Water is updating its *Urban Water Management Plan* and *Water Shortage Contingency Plan*. The updated plan will describe the following (Sonoma Water 2021):

- Existing water supplies and transmission system facilities
- Projected water demand in Sonoma Water's service area over the next 25 years
- Projected water supplies available to Sonoma Water over the next 25 years, the reliability of that supply, and general schedules for water supply projects
- Climate change impacts on the water supply
- Energy intensity
- Current and planned water conservation activities
- A comparison of water supply and water demand over the next 25 years under different hydrological assumptions (normal year, single dry year, multiple dry years).

Some municipalities in Sonoma County receive water deliveries from Sonoma Water and augment these with local supply, such as municipal groundwater supply wells. Most municipalities are currently updating their urban water management plans and water storage contingency plans to estimate projected water demand and water supply to ensure adequate drinking water is available for all users.

Sonoma Water's 2018 *Water Supply Strategies Action Plan*, a regional planning document to increase water supply system reliability, reported the following progress on water efficiency goals and new plans for the future (Sonoma Water 2018).

- Groundwater Sustainability Plans are being developed.
- Two Stormwater Resource Plans increase the region's ability to leverage grant funding and prioritize multi-beneficial projects.
- Continued development of forecast-informed reservoir operation strategies
- Following a multi-year drought in which water demands were significantly reduced, the region committed to extending the Sonoma Marin Saving Water Partnership memorandum or understanding.
- Advanced quantitative precipitation information from radar units that can provide critical information on location, timing, and intensity of precipitation throughout the Bay Area.
- Increased coordination with Lake Mendocino water users including Potter Valley Project relicensing activities.
- Climate adaptation planning to identify strategies to address climate risks and vulnerabilities to ensure an increased understanding of water supply reliability impacts.

Other Public Water Systems

In addition to Sonoma Water, municipalities and water districts provide water to customers throughout Sonoma County. About two dozen such systems serve 1,000 customers or more. The City of Santa Rosa serves nearly 180,000 customers. The cities of Petaluma, Rohnert Park, Healdsburg, and Sonoma, and the Town of Windsor, serve between 10,000 and 60,000 customers. Some of the public systems in the county are entirely reliant on groundwater; others have a mix of sources. Some purchase Russian River water through Sonoma Water or have separate surface water rights.

Small Water Systems

About 70 small water systems (defined as having between 5 to 14 service connections) supply water in Sonoma County, serving campgrounds, small commercial establishments, mobile home parks, isolated rural residences and subdivisions, and small unincorporated communities. Permitting, inspecting, and monitoring are conducted through County Department of Health Services, Division of Environmental Health. The vulnerability of these systems varies, depending on their location, water supply, and available storage and demand (County of Sonoma 2017).

Private Wells

Private wells are vulnerable wherever limited recharge and excessive withdrawals lead to a decline in groundwater levels. Groundwater availability and aquifer conditions vary widely in the county, but shallow wells and wells in upland areas may be particularly vulnerable. Private wells considered most vulnerable to drought are located in the marginal groundwater areas (Class 3 and 4 on Figure 8-3), though groundwater levels can be adversely affected in major (Class 1) groundwater basins as well (County of Sonoma 2017).

Surface Water

Users who are reliant on surface water are most vulnerable to drought. This includes water right holders along the upper Russian River, and small reservoirs throughout the County that are reliant on each season’s rainfall to fill the reservoir. The west Petaluma area has been severely impacted when ponds and reservoirs do not fill.

8.2.2 Past Events

Periods of Drought in California

The following sections describe prolonged droughts in California that have impacted the planning area.

2012 to 2017 Drought

California’s last drought set several records for the state. The period from 2012 to 2014 ranked as the driest three consecutive years for statewide precipitation. Calendar year 2014 set new records for statewide average temperatures and for record-low water allocations from the State Water Project and the federal Central Valley Project. Calendar year 2013 set minimum annual precipitation records for many communities. Detailed executive orders and regulations addressed water conservation and management. The statewide drought emergency was lifted in April 2017. In Sonoma County, the Board of Supervisors proclaimed a local emergency due to drought conditions on February 25, 2014. That proclamation covered all of Sonoma County, including all nine cities and special districts and was continued until March 1, 2016. This proclamation was guided by mandatory state emergency conservation regulations issued to all water providers in California (County of Sonoma 2017).

Source: Sonoma County 2021b

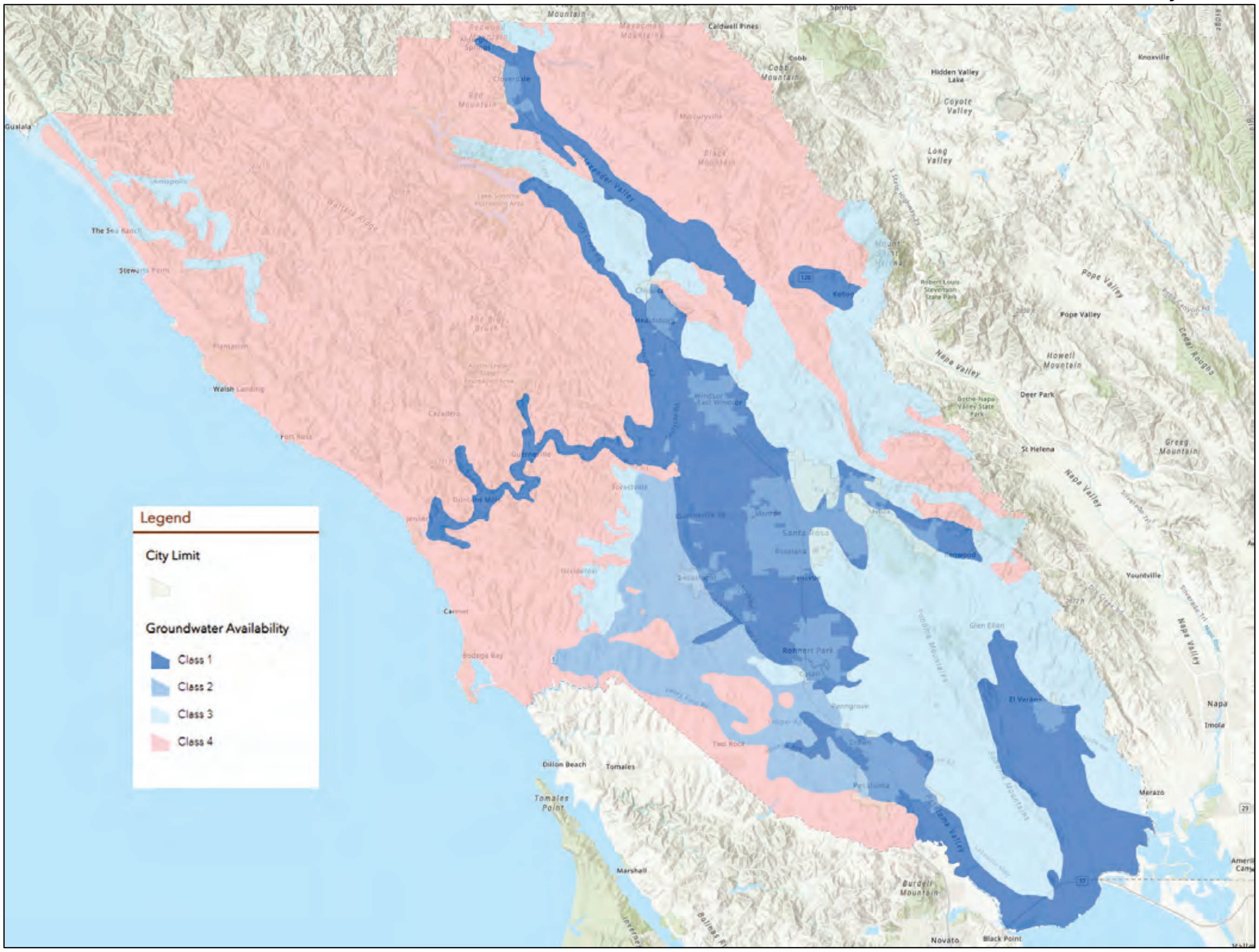


Figure 8-3. Groundwater Availability in Sonoma County

2007 to 2009 Drought

The state proclaimed a statewide drought emergency on June 4, 2008 after spring 2008 was the driest spring on record, with low snowmelt runoff. On February 27, 2009, the state proclaimed a state of emergency for the entire state as severe drought continued. The largest court-ordered water restriction in state history (at the time) was imposed. In Sonoma County, abnormally dry to extreme drought conditions occurred from April 2007 to January 2012. At the height of drought severity in 2009, Lake Sonoma was 74 percent full. Lake Mendocino was 38 percent full in 2009. After two dry years, and only 7.28 inches of rain—compared to 15.5 inches in 2008—the area was listed by the U.S. Drought Monitor as in a D2 (severe drought) condition (County of Sonoma 2017).

1987 to 1992 Drought

California received precipitation well below average levels for four consecutive years. While the Central Coast was most affected, the Sierra Nevada range in Northern California and the Central Valley counties were also affected. During this drought, only 56 percent of average runoff for the Sacramento Valley was received. In 1991, the State Water Project sharply decreased deliveries to water suppliers. By February 1991, all 58 counties in California were experiencing drought. Urban areas as well as agricultural areas were impacted.

1976 to 1977 Drought

California had a severe drought due to lack of precipitation in the winters of 1976 and 1977. 1977 was the driest period on record in California at that time,. The cumulative impact led to widespread water shortages and severe water conservation measures statewide. Over $2.6 billion in crop damage was recorded in 31 counties. FEMA declared a drought emergency (Declaration 3023-EM) on January 20, 1977 for 58 California counties. In Sonoma County, the Russian River saw only 6 percent of its normal runoff in 1977. The reduction of flow from this water source significantly impacted communities throughout Sonoma, Marin, and Mendocino counties. The Sonoma Water Board of Directors proclaimed an emergency for the Russian River Water Supply in February 1976 and the County Board of Supervisors proclaimed a local emergency in July 1976. The response required implementation of water conservation measures and construction of emergency wells to augment supplies (County of Sonoma 2017).

Agriculture-Related Drought Disasters

The U.S. Department of Agriculture (USDA) Farm Service Agency provides assistance for agriculture-related losses resulting from drought, flood, fire, freeze, tornadoes, pest infestation, and other natural disasters. The U.S. Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to them. Between 2012 and 2020, the period for which data is available, Sonoma County was included in drought-related USDA declarations in 2012, 2013, 2014, 2015, 2016, 2017, and 2020 (USDA Farm Services Agency, 2021).

8.2.3 Location

Drought is a regional phenomenon that has the potential to impact the entire planning area. A drought affects all aspects of the environment and the community simultaneously and has the potential to directly or indirectly impact every person in the planning area as well as adversely affect the local economy.

8.2.4 Frequency

Drought has a high probability of occurrence in the planning area. From January 2000 to May 2020, some part of Sonoma County experienced a USDM rating of D1 or higher in 370 out of 1,065 weeks—slightly more than one out of every three weeks (see Figure 8-4). Sonoma County has also been included in USDA drought disaster declarations seven times since 2012. Historical drought data for the planning area indicate there have been four significant multi-year droughts in the last 40 years (1980 to 2020), amounting to a severe drought every 10 to 11 years on average.

8.2.5 Severity

The severity of any given drought depends on many factors. Driving factors are the amount and timing of precipitation, duration of below average rainfall, 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.

Source: U.S. Drought Monitor, 2020

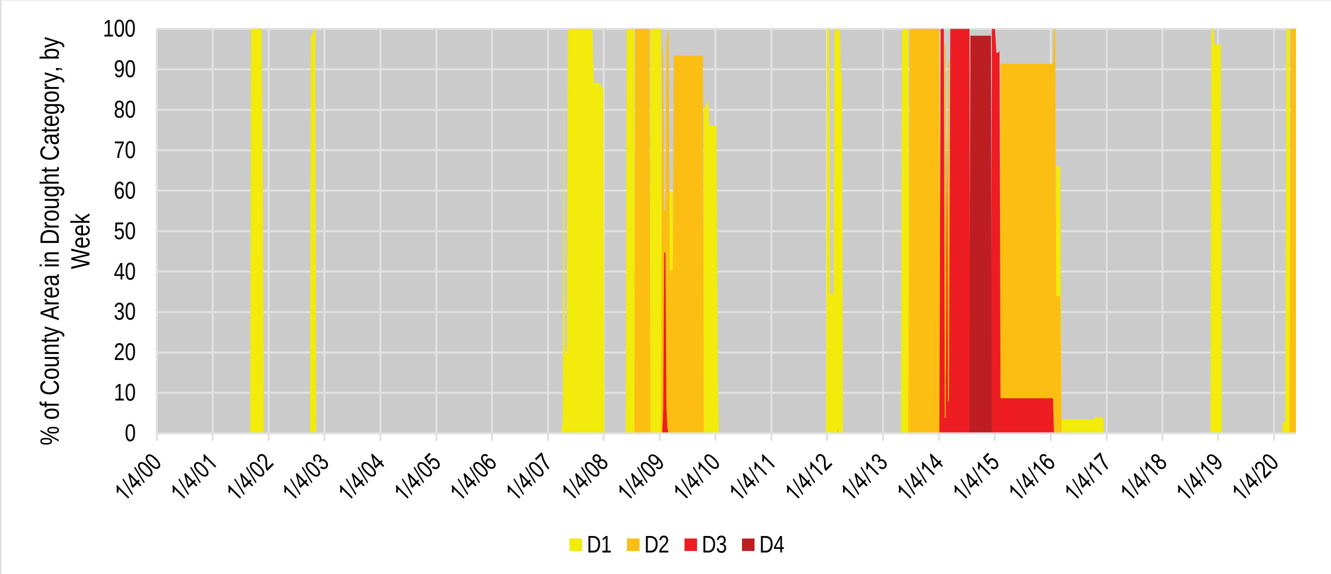


Figure 8-4. Percent of Sonoma County Affected by Each USDM Rating, 2000 – 2020

U.S. Drought Monitor Ratings

Sonoma County has a history of severe droughts. As shown in Figure 8-4, at least part of the county has experienced extreme (D3) or exceptional (D4) droughts more than once since 2000.

Drought Impact Reporter

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and staff of government agencies. The database is being populated beginning with the most recent impacts and working backward in time.

The Drought Impact Reporter indicates 149 impacts from drought that specifically affected Sonoma County from January 2010 through December 2019 (Drought Impact Reporter, 2020). Most (88.5 percent) are based on media reports. The following are the reported numbers of impacts by category (some incidents are assigned to more than one impact category):

- Agriculture—43
- Business and Industry—11
- Energy—6
- Fire—18
- Plants and Wildlife—49
- Relief, Response, and Restrictions—70
- Society and Public Health—54

- Tourism and Recreation—13
- Water Supply and Quality—82

Potential Agricultural Impact

The agricultural industry's dependency upon water for production and processing makes it vulnerable to drought conditions. For example, the 2014 Sonoma County Crop Report indicated that field crops saw significant damage due to drought. Many of the crops produced one third of their normal yield; volunteer hay yield was 37 percent of the five-year average and grain oats produced just 33 percent. Pasture and rangeland were severely impacted, with yields of 38 percent and 26 percent of normal. The 2019 Sonoma County Crop Report indicated record rainfall in the winter and growth in the value of nursery product due to landscape and lawn replacement efforts. Since this nursery increase was largely of drought-resistant plants, decreased water availability remains an issue of concern.

8.2.6 Warning Time

Predicting drought depends on the ability to forecast precipitation and temperature. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions.

Determination of when drought begins is based on impacts on water users and assessments of available water supply, including water stored in reservoirs or groundwater basins. Different water agencies have different criteria for defining drought. Some issue drought watch or drought warning announcements.

8.2.7 Secondary Hazards

The secondary hazard most associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. In addition, lack of sufficient water resources can stress trees and other vegetation, making them more vulnerable to infestation from pests, which in turn, can make them more vulnerable to ignition. Millions of board feet of timber have been lost, and in many cases erosion occurred, which caused serious damage to aquatic life, irrigation, and power production by heavy silting of streams, reservoirs, and rivers.

8.3 EXPOSURE

All people, property and environments in the planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions.

8.4 VULNERABILITY

8.4.1 Population

The entire population of the county is vulnerable to drought events. Drought can affect people's health and safety, including health problems related to low water flows, poor water quality, or dust. Droughts can also lead to loss of human life. Other possible impacts include recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and hygiene; compromised food and nutrition; and increased incidence of illness and disease (Centers for Disease Control and Prevention, 2012). A secondary, indirect impact from drought is an increase in wildfire risk. The vulnerability of the planning area population to the wildfire risk is discussed in Chapter 15.

8.4.2 Property

No structures will be directly affected by drought conditions, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Droughts can have significant impacts on other types of property such as landscaped areas and economically important natural resources. Drought causes the most significant economic impacts on industries that use water or depend on water for their business, most notably agriculture and related sectors (forestry, fisheries, and waterborne activities), power plants (including geothermal power production), and oil refineries. In addition to losses in yields in crop and livestock production, drought is associated with increased insect infestations, plant diseases, and wind erosion. Drought can lead to other losses because so many sectors are affected - losses that include reduced income for farmers and reduced business for retailers and others who provide goods and services to farmers. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue. Prices for food, energy, and other products may also increase as supplies decrease.

8.4.3 Critical Facilities

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility features such as landscaping may not be maintained due to limited water resources, but the risk to critical facility core functions is low.

8.4.4 Environment

Groundwater and Streams

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. 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. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams, especially during the summer when there is little or no precipitation. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest. Where stream flows are reduced, development that relies on surface water may seek to establish new groundwater wells, which could further increase groundwater depletion.

Other Potential Losses

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects. The following are potential impacts of drought:

- Wildlife habitat may be degraded through the loss of wetlands, lakes and vegetation. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity.

- Drought conditions greatly increase the likelihood of wildfires, a major threat to timber resources, structures, and other property.
- Water shortages and severe drought conditions would have a significant impact on Native American tribes' way of life in fishing and farming subsistence.
- Scenic resources in the county are vulnerable to the increased likelihood of wildfires associated with droughts.
- Drying up or dying off of forests could reduce ecological and eco-tourist values.
- Shortage of water supply can have significant economic impacts.
- Drought conditions often are associated with harmful algal blooms—specifically cyanobacteria that can cause severe illness and death in mammals.

8.5 FUTURE TRENDS IN DEVELOPMENT

All municipal planning partners in this effort have established general plans that include policies directing land use. They also have adopted local urban water management plans and water shortage contingency plans dealing with issues of long-term water supply planning and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed these plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation actions to increase the capability to deal with future trends in development. In addition, water providers in the planning area have plans and programs in place to balance competing needs for water resources within the planning area.

Sonoma Water and its water contractors participate in the Sonoma Marin Water Saving Partnership to develop, fund, and implement water conservation to ensure careful use of water as a precious resource. Measures to promote water conservation and provide incentives for investment in long-term water savings are developed, funded, and implemented.

8.6 SCENARIO

A multi-year drought that impacts the entire west or the State of California is the worst-case scenario for the planning area. In the past, such droughts and the wildfires and floods that followed them have caused extensive damage to natural systems. If another severe drought occurs before these systems have a chance to recover, it could exacerbate the stress already placed on existing planning area water resources.

8.7 ISSUES

The planning team has identified the following drought-related issues:

- The promotion of additional demand management and water conservation efforts even during non-drought periods should be encouraged.
- The planning area should plan for frequent droughts or multi-year droughts that can limit the ability to successfully recover from one drought and prepare for the next—particularly considering the longevity of the 2012 to 2017 drought.

- Water planning should consider impacts of additional drawn downs on groundwater supplies as pressure on surface water increases during drought.
- Drought in the county will increase and expand fire-prone areas and adversely affect the timber economy.
- With the possibility of climate change, drought may become a more pervasive issue due to warming trends and wider fluctuations in precipitation patterns. The probability of drought frequencies and durations may increase.
- Alternative water supplies or increased use of recycled water will need to be identified and developed, as well as alternative strategies to allocate and distribute existing water sources.
- Groundwater recharge techniques can be used to increase available water in storage and stabilize the groundwater supply.

9. EARTHQUAKE

9.1 GENERAL BACKGROUND

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

9.1.1 Earthquake Location

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth's surface directly above the hypocenter.

9.1.2 Earthquake Geology

Tectonic Plates

The Earth's crust, which is the rigid outermost shell of the planet, is broken into seven or eight major tectonic plates (depending on how they are defined) and many minor plates. Where the plates meet, they move in one of three ways along their mutual boundary: convergent (two plates moving together), divergent (two plates moving apart), or transform (two plates moving parallel to one another). Earthquakes, volcanic activity, mountain-building, and oceanic trench formation occur along plate boundaries. Subduction is a geological process that takes place at convergent boundaries of tectonic plate, in which one plate moves under another. Regions where this process occurs are known as subduction zones, and they have the potential to generate highly damaging earthquakes.

California is seismically active because of movement of the North American Plate, east of the San Andreas Fault, and the Pacific Plate to the west, which includes the state's coastal communities. The transform (parallel) movement of these tectonic plates against one another creates stresses that build as the rocks are gradually deformed. The rock deformation, or strain, is stored in the rocks as elastic strain energy. When the strength of the rock is exceeded, rupture occurs along a fault. The rocks on opposite sides of the fault slide past each other as they spring back into a more relaxed position. The strain energy is released partly as heat and partly as elastic waves called seismic waves. The passage of these seismic waves produces the ground shaking in earthquakes.

Faults

Geologists have found that earthquakes reoccur along faults, which are zones of weakness in the earth's crust. When a fault experiences an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake can still occur. In fact, relieving stress along one part of a fault may increase it in another part.

Faults are more likely to have future earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve the accumulating tectonic stresses. Geologists classify faults by their relative hazards. "Active" faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). "Potentially active" faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years) (California Department of Conservation, 2003).

Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Most of the seismic hazards are associated with well-known active faults. However, inactive faults or concealed faults (referred to as "blind-thrust" faults), where no displacements have been recorded, also have the potential to reactivate or experience displacement along a branch sometime in the future. An example of a fault zone that has been reactivated is the Foothills Fault Zone. The zone was considered inactive until evidence of an earthquake (approximately 1.6 million years ago) was found near Spenceville, California. Then, in 1975, an earthquake occurred on another branch of the zone near Oroville, California (now known as the Cleveland Hills Fault). The State Division of Mines and Geology indicates that increased earthquake activity throughout California may cause tectonic movement along currently inactive fault systems.

9.1.3 Earthquake-Related Hazards

According to the U.S. Geological Survey (USGS) Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect resident's normal activities. This includes the following:

- **Surface Faulting**—Displacement that reaches the earth's surface during slip along a fault. Commonly occurs with shallow earthquakes, those with an epicenter less than 20 kilometers.
- **Ground Motion (shaking)**—The movement of the earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves that are generated by sudden slip on a fault or sudden pressure at the explosive source and travel through the earth and along its surface.
- **Mass Movement**—A movement of surface material down a slope.
- **Liquefaction**—A process by which water-saturated sediment temporarily loses strength and acts as a fluid. Earthquake shaking can cause this effect.
- **Tectonic Deformation**—A change in the original shape of a material due to stress and strain.
- **Tsunami**—A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or violent underwater volcanic eruptions.

9.1.4 Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity.

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. Magnitude is commonly expressed by ratings on the moment magnitude scale (M_w), the most common scale used today (USGS, 2017). This scale is based on the total moment release of the earthquake (the product of the distance a fault moved and the force required to move it). The scale is as follows:

- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Intensity

The most used intensity scale is the modified Mercalli intensity scale. Ratings of the scale as well as the perceived shaking and damage potential for structures are shown in Table 9-1. The modified Mercalli intensity scale is generally represented visually using shake maps, which show the expected ground shaking at any given location produced by an earthquake with a specified magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the variation of ground shaking in a region immediately following significant earthquakes (for technical information about shake maps see USGS, 2018).

Table 9-1. Mercalli Scale and Peak Ground Acceleration Comparison

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17% - 1.4%
IV	Light	None	None	1.4% - 3.9%
V	Moderate	Very Light	Light	3.9% - 9.2%
VI	Strong	Light	Moderate	9.2% - 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% - 34%
VIII	Severe	Moderate/Heavy	Heavy	34% - 65%
IX	Violent	Heavy	Very Heavy	65% - 124%
X – XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA = peak ground acceleration. Measured in percent of g, where g is the acceleration of gravity
Sources: USGS, 2008; USGS, 2010

9.1.5 Ground Motion

Earthquake hazard assessment is based on expected ground motion. During an earthquake when the ground is shaking, it also experiences acceleration. The peak acceleration is the largest increase in velocity recorded by a particular station during an earthquake. Estimates are developed of the annual probability that certain ground motion accelerations will be exceeded; the annual probabilities can then be summed over a time period of interest.

The most commonly mapped ground motion parameters are horizontal and vertical peak ground accelerations (PGA) for a given soil type. PGA is a measure of how hard the earth shakes, or accelerates, in a given geographic area. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. PGA is measured in g (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short period structures” (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 9-1 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

9.1.6 USGS Earthquake Mapping Programs

ShakeMaps

The USGS Earthquake Hazards Program produces maps called ShakeMaps that map ground motion and shaking intensity following significant earthquakes. ShakeMaps focus on the ground shaking caused by the earthquake, rather than on characteristics of the earthquake source, such as magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth’s crust.

A ShakeMap shows the extent and variation of ground shaking immediately across the surrounding region following significant earthquakes. Such mapping is derived from peak ground motion amplitudes recorded on seismic sensors, with interpolation where data are lacking based on estimated amplitudes. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. In addition to the maps of recorded events, the USGS creates the following:

- Scenario ShakeMaps of hypothetical earthquakes of an assumed magnitude on known faults
- Probabilistic ShakeMaps, based on predicted shaking from all possible earthquakes over a 10,000-year period. In a probabilistic map, information from millions of scenario maps are combined to make a forecast for the future. The maps indicate the ground motion at any given point that has a given probability of being exceeded in a given timeframe, such as a 100-year (1-percent-annual chance) event.

National Seismic Hazard Map

National maps of earthquake shaking hazards provide information for creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al., 2001). The USGS updated the National Seismic Hazard Maps in 2018. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps. The 2018 map, shown in Figure 9-1, represents the best available data as determined by the USGS.

Source: (U.S. Geological Survey n.d.)

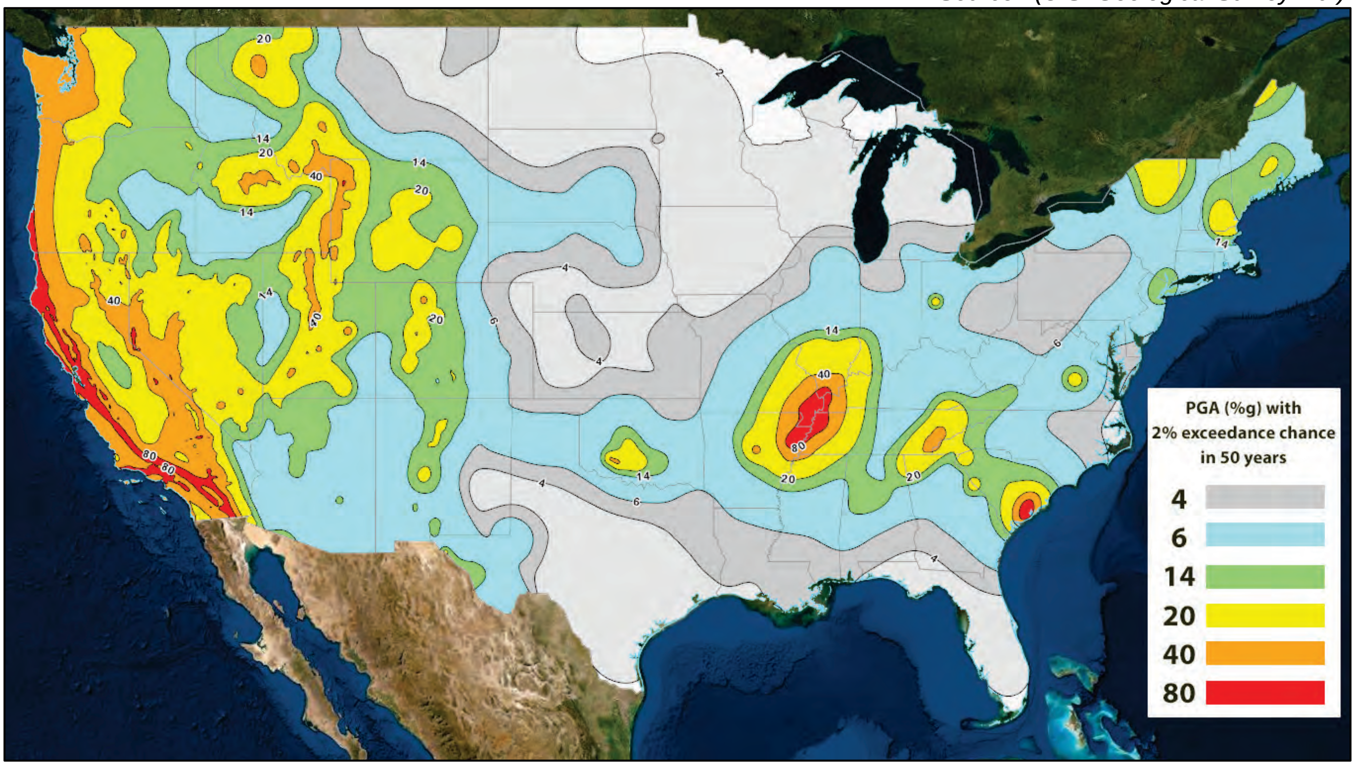


Figure 9-1. Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years

9.1.7 Liquefaction and Soil Types

Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. NEHRP soil types define the locations that will be significantly impacted by an earthquake. Table 9-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F (Southern California Earthquake Center, 2018). In general, these areas are also most susceptible to liquefaction. The areas that are most affected by ground shaking have NEHRP Soils D, E and F.

Table 9-2. NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

9.2 HAZARD PROFILE

9.2.1 Past Events

The Bay Area has experienced significant, well-documented earthquakes. Since 1855, more than 140 earthquakes have been felt in the Santa Rosa area (County of Sonoma 2017). According to the Northern California Earthquake Data Center, two earthquakes of magnitude 5.0 or greater have been felt in Sonoma County since 2000:

- December 14, 2016—A 5.01 magnitude event near The Geysers
- August 24, 2014—A 6.02 magnitude event near South Napa

The sections below describe major recorded historical earthquakes that have affected Sonoma County.

Pre-1900 Earthquakes

Seven earthquakes are believed to have caused damage to structures in Sonoma County in the 19th century. Reported damage from these earthquakes indicates a Modified Mercalli rating of VI to VIII. Notable events were the 1868 magnitude 7.2 earthquake on the Hayward Fault and the 1898 magnitude 6.7 earthquake on the Rodgers Creek Fault. Although damage from these two events was limited due to the area’s sparse population at the time, a recurrence of either of these events would result in significant damage today (County of Sonoma 2017).

1906 San Francisco Earthquake

The April 18, 1906, magnitude 8.3 earthquake on the northern segment of the San Andreas Fault caused major damage in Santa Rosa, Sebastopol, Healdsburg, Petaluma and other communities. Santa Rosa is said to have suffered more damage proportionally to its size than any other Bay Area city. The only reported casualties in Sonoma County were in Santa Rosa, where 65 died. The shaking lasted for about 50 seconds. The Santa Rosa Courthouse was totally destroyed by the shaking and ensuing fire, as were approximately eight blocks of commercial buildings. It was reported that almost all non-wood buildings were destroyed by the shaking alone (County of Sonoma 2017).

1969 Rodgers Creek / Healdsburg Fault Earthquake

The last major earthquakes with an epicenter in Sonoma County occurred on October 1, 1969. Two earthquakes of magnitudes 5.6 and 5.7 originated 2 miles north of Santa Rosa. Damage was concentrated in Santa Rosa and principally confined to the partial collapse of unreinforced masonry buildings and wood frame buildings. In all, 99 structures were significantly damaged, approximately half in the business district and half in residential areas.

Total building damage was estimated at $6 million, with dwelling contents losses at $1.25 million. Several County buildings suffered damage, including the library, post office, and veterans memorial building. There was no loss of life from these earthquakes. The mayor of Santa Rosa sought state and federal disaster assistance, but there was not enough damage to public facilities to warrant a declaration. Small Business Administration loans were made available to commercial and residential property owners (County of Sonoma 2017).

1989 Loma Prieta Earthquake

This magnitude 6.9 earthquake was caused by slip along the San Andreas Fault. Damage in Sonoma County was minor (only five dwellings were yellow tagged), but the quake killed 63 people and injured 3,757 throughout Northern California and caused an estimated $6 billion in property damage. It was the largest earthquake to occur on the San Andreas Fault since the 1906 San Francisco earthquake (County of Sonoma 2017).

2014 South Napa Earthquake

On August 24, 2014, a magnitude 6.0 earthquake shook Napa, Solano, and Sonoma County. The epicenter was 9 miles southeast of the City of Sonoma. The earthquake occurred on the West Napa Fault, a fault that was not mapped under the Alquist-Priolo earthquake fault hazard zone. It was the largest event in the Bay Area since the 1989 Loma Prieta earthquake. At least 12 aftershocks followed. The quake injured 257 people and killed one. Several structures in eastern Sonoma County were severely damaged. The governor issued an emergency proclamation for this event and a federal disaster was declared on September 11, 2014. The total economic loss was estimated at $400 million (County of Sonoma 2017).

2016 The Geysers Earthquake

A 5.0 magnitude earthquake occurred 4 miles west of The Geysers and 14 miles southwest of Clearlake on December 14, 2016, following a series of medium size earthquakes in Mammoth Lakes and the Central Coast. This event was primarily felt in the Clearlake and Santa Rosa areas but was also felt throughout the Bay Area.

9.2.2 Location

The Mendocino Triple Junction, in the Pacific Ocean near Cape Mendocino, is the point where the Gorda plate, the North American plate, and the Pacific plate meet. This is the location of a change in the broad plate motions that dominate the west coast of North America, linking the convergence boundary of the Cascadia subduction zone, the transform boundary of the San Andreas Fault system, and the Gorda plate’s subduction under the North American plate and simultaneous converging against the Pacific plate.

Fault Locations

Several major faults traverse Sonoma County. The Alquist-Priolo Earthquake Fault Maps identify the following earthquake faults running through or near the county (see Figure 9-2):

- **San Andreas Fault—**The San Andreas Fault intersects land in Sonoma County at Doran Beach and Bodega Bay as well as south of Fort Ross, traveling north to the county line just east of the coastline. Studies of the North Coast section of the San Andreas Fault suggest an average recurrence interval of 200 to 300 years, although studies indicate a long interval between the 1906 earthquake and the previous earthquake, which occurred around 1300. Prior to 1300, the intervals were about 200 years (USGS n.d.).

Source: (U.S. Geological Survey 2016)

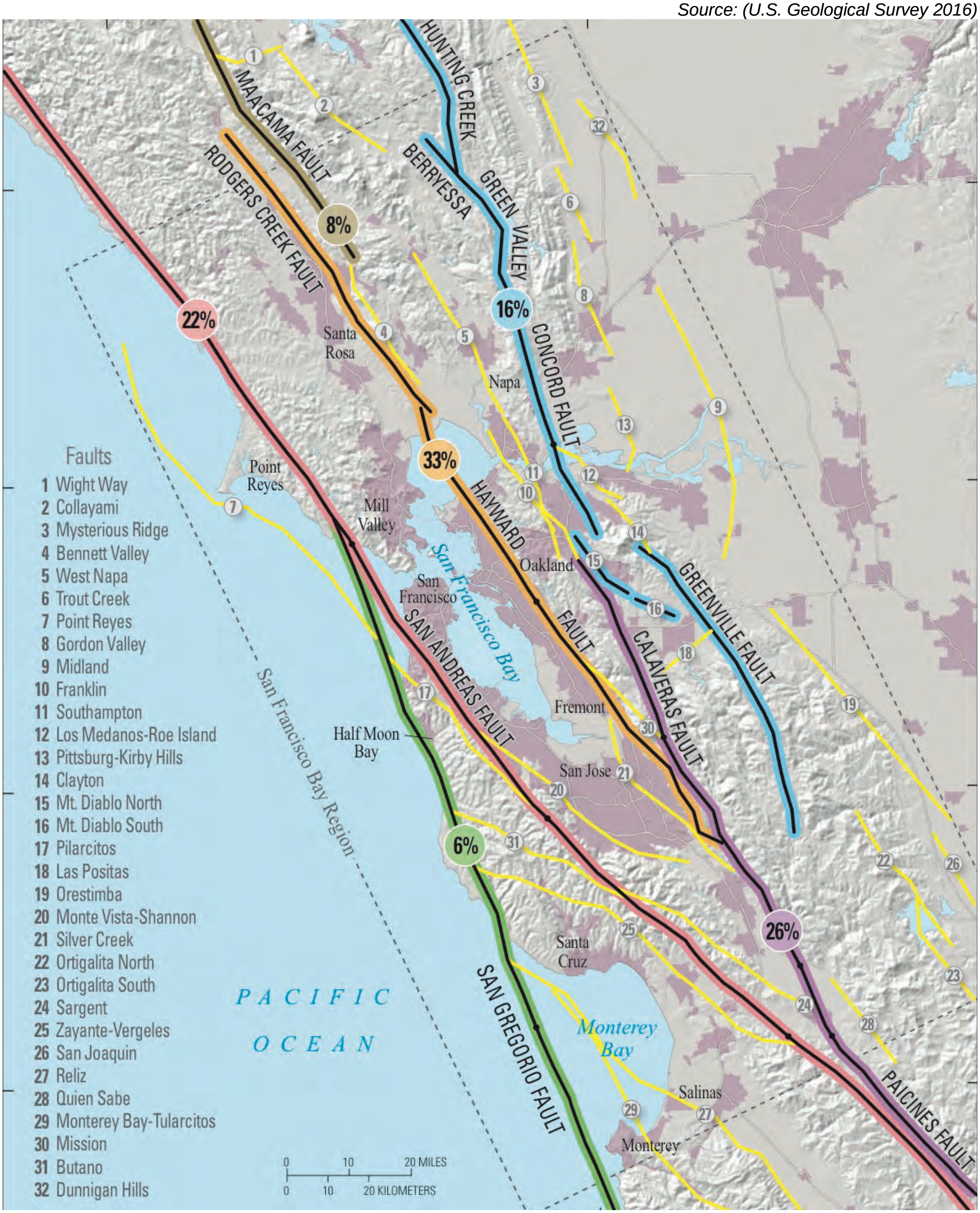


Figure 9-2. Mapped Faults in Sonoma County

- **Rodgers Creek Fault—**The Rodgers Creek Fault, which lies east of the San Andreas Fault, is the main strand of the North American-Pacific Plate boundary north of San Francisco Bay. The two sides of the fault slip past each other at a rate of 6 to 10 millimeters per year. It is estimated that there is a 33 percent chance of an earthquake of magnitude 6.7 or greater on the combined Rodgers Creek-Hayward fault system over the 30-year period from 2014 through 2043. In 2018, USGS released a more detailed and higher resolution map of the Rodgers Creek Fault. The new map shows the Rodgers Creek Fault extending about 11 miles farther north than previously thought and flanking the east side of the town of Healdsburg. It also showed an overall increase in the known width and complexity of the fault zone. These new findings indicate a greater hazard than previously thought (U.S. Geological Survey 2018).
- **Hayward Fault—**The Hayward Fault runs along the foot of the East Bay Hills. Its last major earthquake occurred on October 21, 1868, destroying downtown Hayward, killing 5 people, and injuring 30. It had an estimated magnitude of 6.8 and was considered the "Great Earthquake" until 1906. Scientists have found that the most recent five major earthquakes on this fault happened on average every 140 years. It is very likely that the Hayward fault will rupture and produce a significant earthquake within the next 30 years (Berkeley Seismology Lab 2018).
- **Maacama Fault—**The Maacama Fault passes east of the City of Cloverdale. The Maacama fault zone is one of three major fault zones that make up the San Andreas fault system in northern California. The fault is creeping near the town of Willits. Preliminary studies indicate that over the last 700 years, only fault creep has occurred at the site; however, over the last 3,500 years, slip has been accommodate by both creep and earthquakes with surface rupture. The preliminary minimum long-term slip rate at Haehl Creek on the Maacama fault of greater than or equal to 8 millimeters per year is consistent with rates found on the Hayward and Rodgers Creek segments of this fault system and is consistent with the notion that the fault zone is capable of producing large earthquakes (Larsen 2005).

Faults outside the planning area also can impact its people, property, and economy. A rupture in the Cascadia subduction zone, for example, would have considerable impacts on the planning area (Pacific Northwest Seismic Network, 2018). This is the 600-mile-long offshore zone, from northern Vancouver Island to Cape Mendocino, where the Juan de Fuca plate is being subducted below the North American plate.

NEHRP Soil Type and Liquefaction Mapping

Figure 9-3 shows NEHRP soil classifications in Sonoma County. Figure 9-4 shows areas in that have moderate, high, or very high susceptibility to liquefaction.

9.2.3 Frequency

Historic records of earthquake occurrences may give some indication of future probabilities. Seismic activity was more frequent from 1830 to 1930 than it has been since. This leads some scientists to suspect that pressure is building up along the faults in the Bay Area that can result in a large quake. Such a quake could have dramatic and devastating effects throughout the Bay Area. The USGS reports the following earthquake probabilities for the Bay Area over next 30 years (U.S. Geological Survey n.d.):

- 72 percent probability of an earthquake measuring magnitude 6.7
- 51 percent probability of an earthquake measuring magnitude 7
- 20 percent probability of an earthquake measuring magnitude 7.5

Figure 9-3. NEHRP Soil Class

C (Dense soil/soft rock)
D (Stiff soil)
E (Soft clay)
Cities
County Boundary
Highways

Data Sources: Sonoma Co, CGS

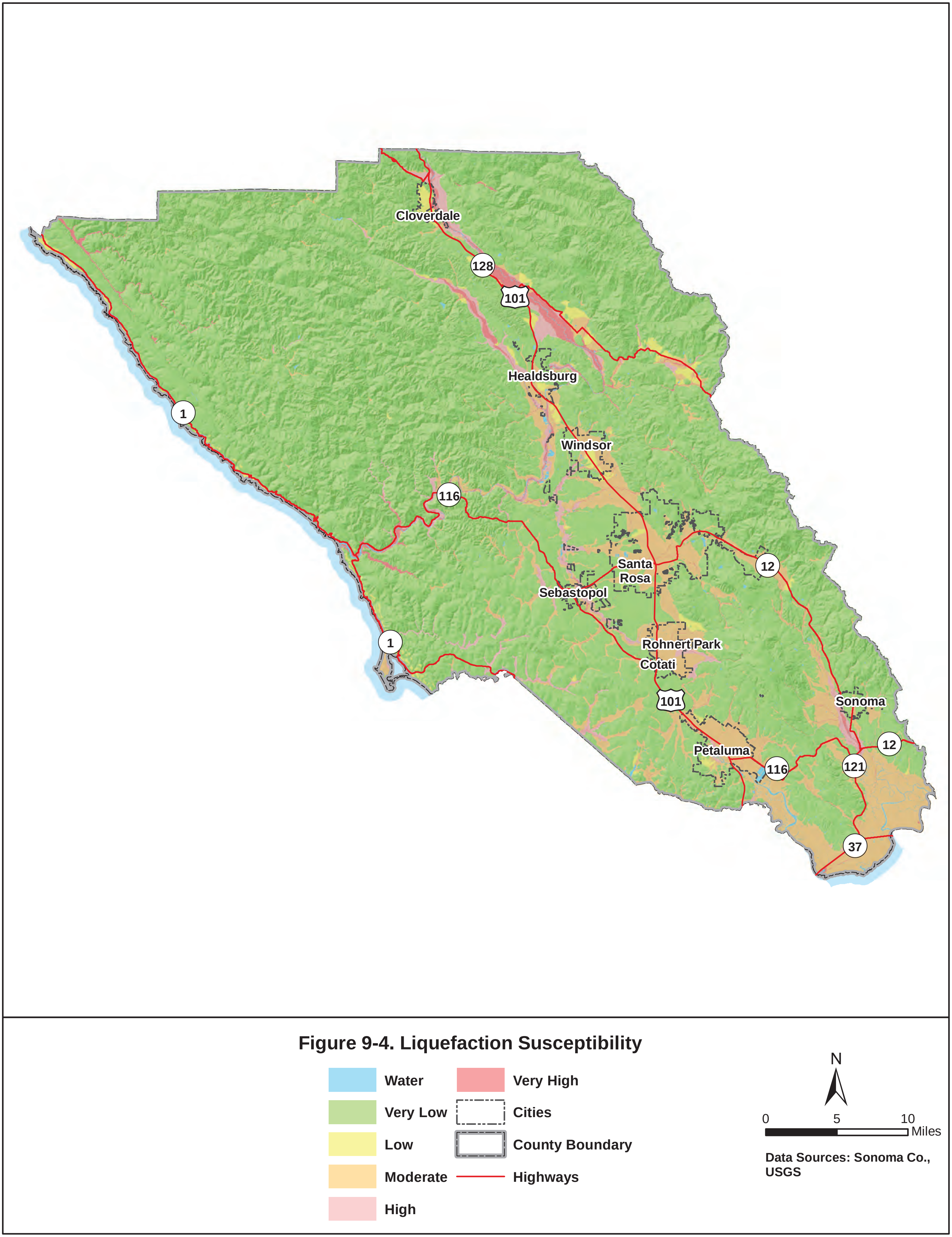


Figure 9-4. Liquefaction Susceptibility

9.2.4 Severity

The severity of an earthquake can be expressed in terms of intensity or magnitude (see Section 0). The State of California Department of Conservation probabilistic ground shaking maps, based on current information about fault zones, show the PGA that has a certain probability of being exceeded in a 50-year period. Sonoma County is in a high-risk area, with a 10-percent probability in a 50-year period of ground shaking from a seismic event exceeding 40 to 60 percent of gravity in most parts of the county. Figure 9-5 shows the expected peak horizontal ground accelerations for this probability.

Source: (U.S. Geological Survey n.d.)

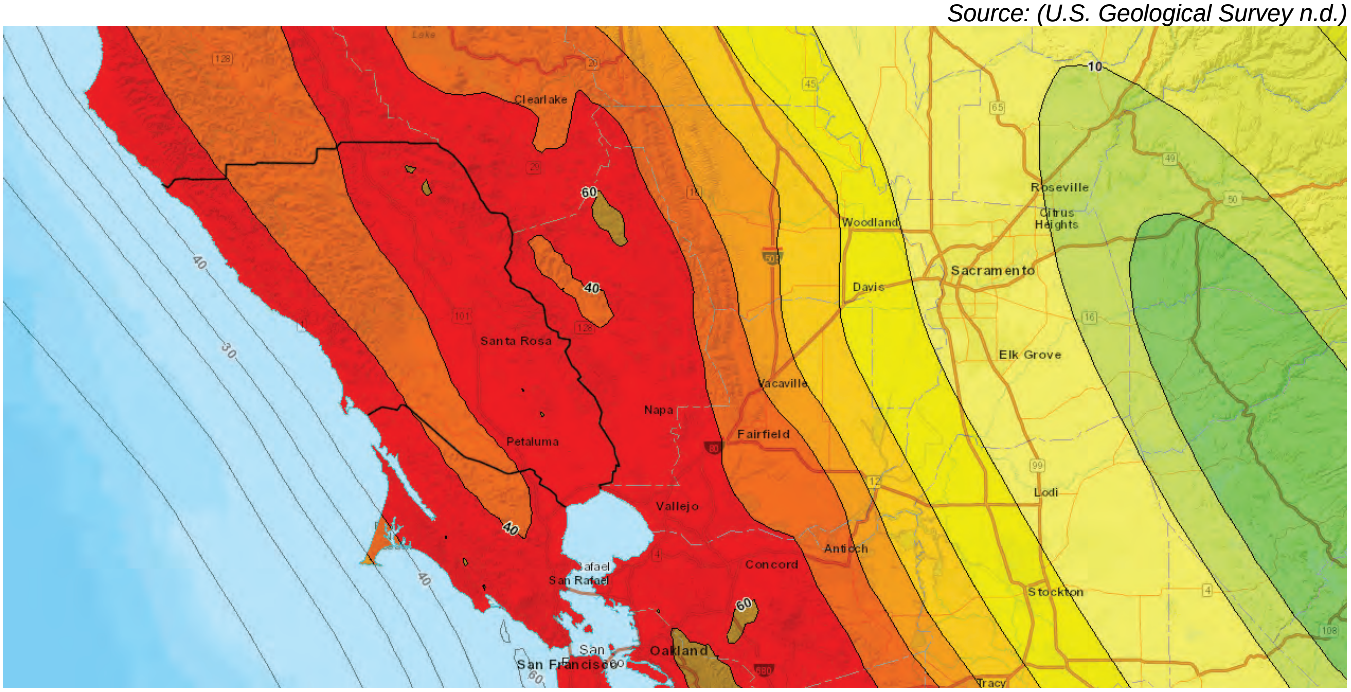


Figure 9-5. Peak Horizontal Acceleration (%g) with 10% Probability of Exceedance in 50 Years

9.2.5 Warning Time

There is no current reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that detect the lower energy compressional waves (P waves) that precede the secondary waves (S waves) experienced as an earthquake. Earthquake early warning systems may provide a few seconds’ or a few minutes’ notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, pause hazardous or high-risk work, or initiate protective automated systems in structures or critical infrastructure.

9.2.6 Secondary Hazards

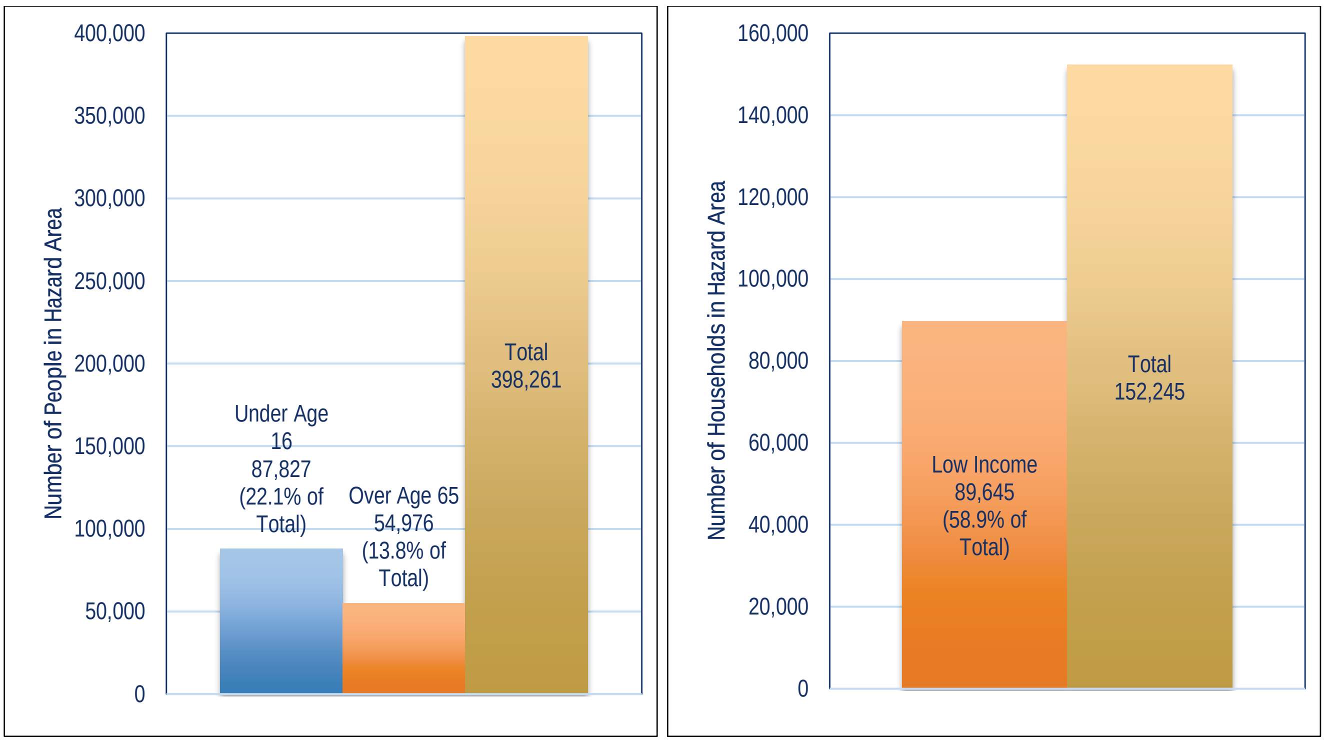
Earthquakes can cause landslides, often as a result of loss of cohesion in clay-rich soils. Earthen dams and levees are highly susceptible to seismic events, and the impacts of their eventual failures can be considered secondary risk exposure to earthquakes. Depending on the location, earthquakes can also trigger tsunamis. Additionally, fires can result from gas lines or power lines that are broken or downed during the earthquake. It may be difficult to control a fire, particularly if the water lines feeding fire hydrants are also broken.

9.3 EXPOSURE

9.3.1 Population

The entire population of the planning area (490,000) is potentially exposed to direct damage from earthquakes or indirect impacts such as business interruption, road closures, and loss of function of utilities.

Socially vulnerable populations living on NEHRP D or E soils were estimated based on data for the Census-defined blocks that lie at least partially within the mapped soil zones. Because many of those Census blocks extend outside the define soils zones, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 9-6 summarizes the estimated exposure of socially vulnerable populations.



See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 9-6. Socially Vulnerable Populations Living on NEHRP D or E Soils Census Blocks

9.3.2 Property

According to County Assessor records, there are 173,000 buildings in the planning area, most of them residential. All buildings are considered to be exposed to the earthquake hazard.

9.3.3 Critical Facilities

Since the entire planning area has exposure to the earthquake hazard, all critical facilities components are considered to be exposed. The breakdown of the numbers and types of facilities is presented in Table 4-4. Critical facilities constructed on NEHRP Type D and E soils are particularly at risk from seismic events. Figure 9-7 shows the number of critical facilities built on these soils in the planning area, by type of facility.

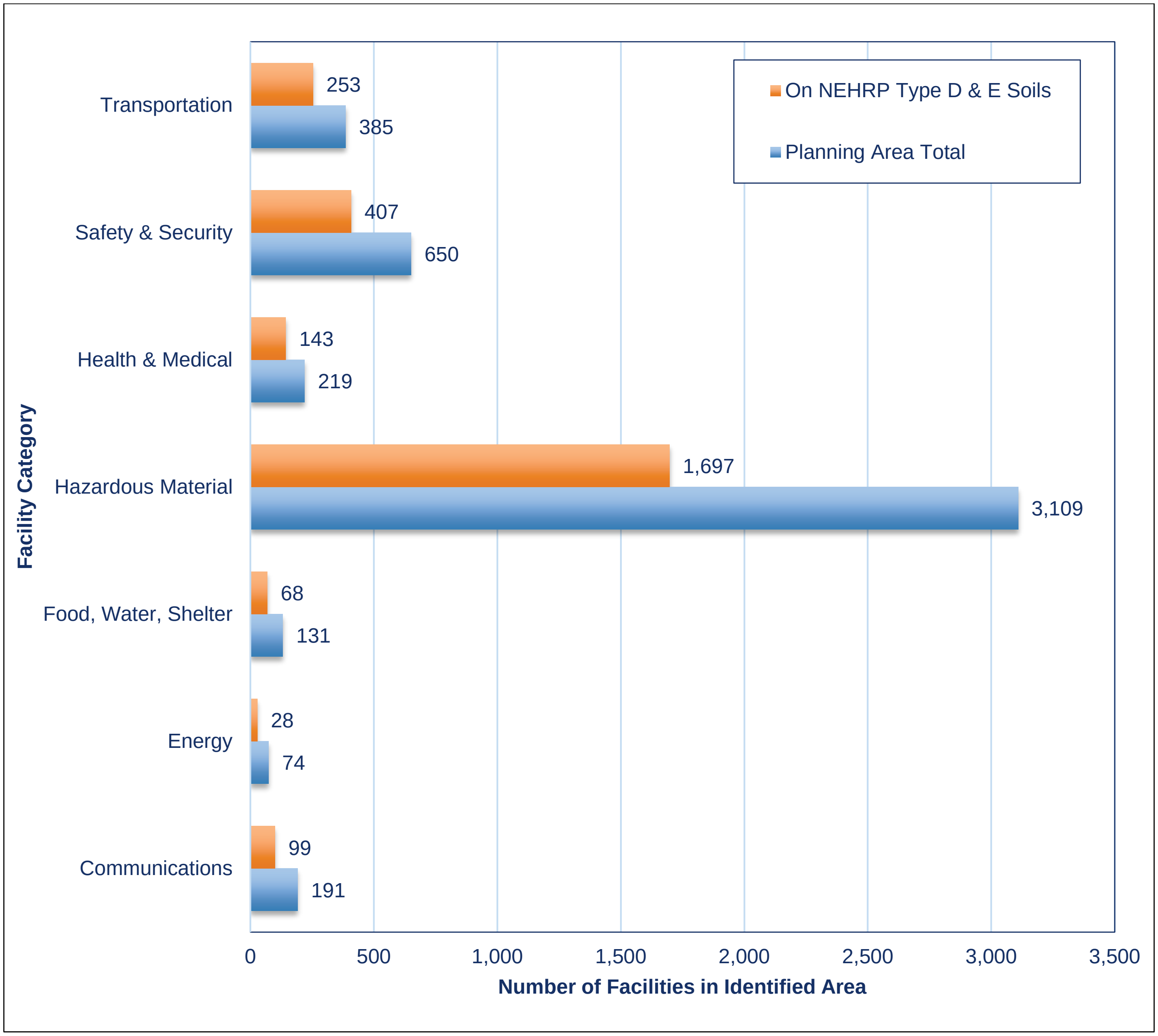


Figure 9-7. Critical Facilities Constructed on NEHRP Type D and E Soils, and Countywide

Significant facilities included in the mapped areas of NEHRP Type D and E soils include the following:

- 2 water treatment facilities
- 20 wastewater treatment facilities
- 1,697 hazardous material sites
- 4 hospitals
- 43 fire stations
- 8 police stations
- 206 school buildings
- 230 road bridges
- 10 port facilities
- 3 airports

9.3.4 Environment

The entire planning area is exposed to the earthquake hazard, including all natural resources, habitat, and wildlife.

9.4 VULNERABILITY

Earthquake vulnerability data for the risk assessment was generated using a Hazus Level 2 (user-defined) analysis for the for the events listed in Table 9-3. The countywide analysis results are summarized in the sections below. Detailed information, broken down by municipality, can be found in Appendix D.

Table 9-3. Earthquakes Modeled for Risk Assessment

Event	Magnitude	Epicenter Location	PGA
100-Year Probabilistic Earthquake	N/A	N/A	Figure 9-8
Hayward Fault Scenario	7.57	16 miles southeast of Petaluma	Figure 9-9
Maacama Fault Scenario	7.55	26 miles north-northwest of Cloverdale	Figure 9-10
Rodgers Creek – Healdsburg Fault Scenario	7.19	3 miles north-northeast of Santa Rosa	Figure 9-11
San Andreas Fault Scenario	8.04	16 miles west of Sebastopol	Figure 9-12

9.4.1 Population

Hazus estimated impacts on persons and households in the planning area for the selected earthquake scenarios as summarized in Table 9-4.

Table 9-4. Estimated Earthquake Impact on Persons

Scenario	Displaced Households	Persons Requiring Short Term Shelter
100-Year Probabilistic Earthquake	874	558
Hayward Fault Scenario	5,020	3,250
Maacama Fault Scenario	1,663	1,072
Rodgers Creek – Healdsburg Fault Scenario	3,792	2,466
San Andreas Fault Scenario	584	370

9.4.2 Property

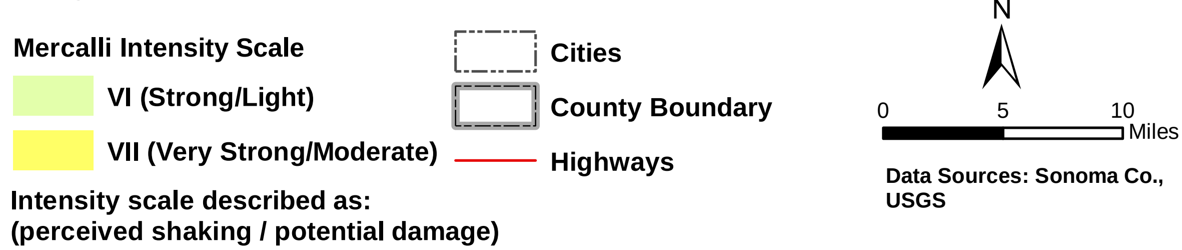
Building Age

Table 9-5 identifies significant milestones in building and seismic code requirements that directly affect the structural integrity of development. Using U.S. Census estimates of housing stock age, estimates were developed of the number of housing units constructed before each of these dates. About a quarter of the planning area’s housing units were constructed after the Uniform Building Code was amended in 1994 to include seismic safety provisions. Housing units built before 1933 when there were no building permits, inspections, or seismic standards, account for only about 3 percent.

Loss Potential

Table 9-6 summarizes Hazus estimates of earthquake damage in the planning area for the evaluated scenarios. The debris estimate includes only structural debris; it does not include additional debris that may accumulate, such as from trees. In addition, these estimates do not include losses that would occur from any local tsunamis or fires stemming from an earthquake.

Figure 9-8. 100-Year Probabilistic Earthquake



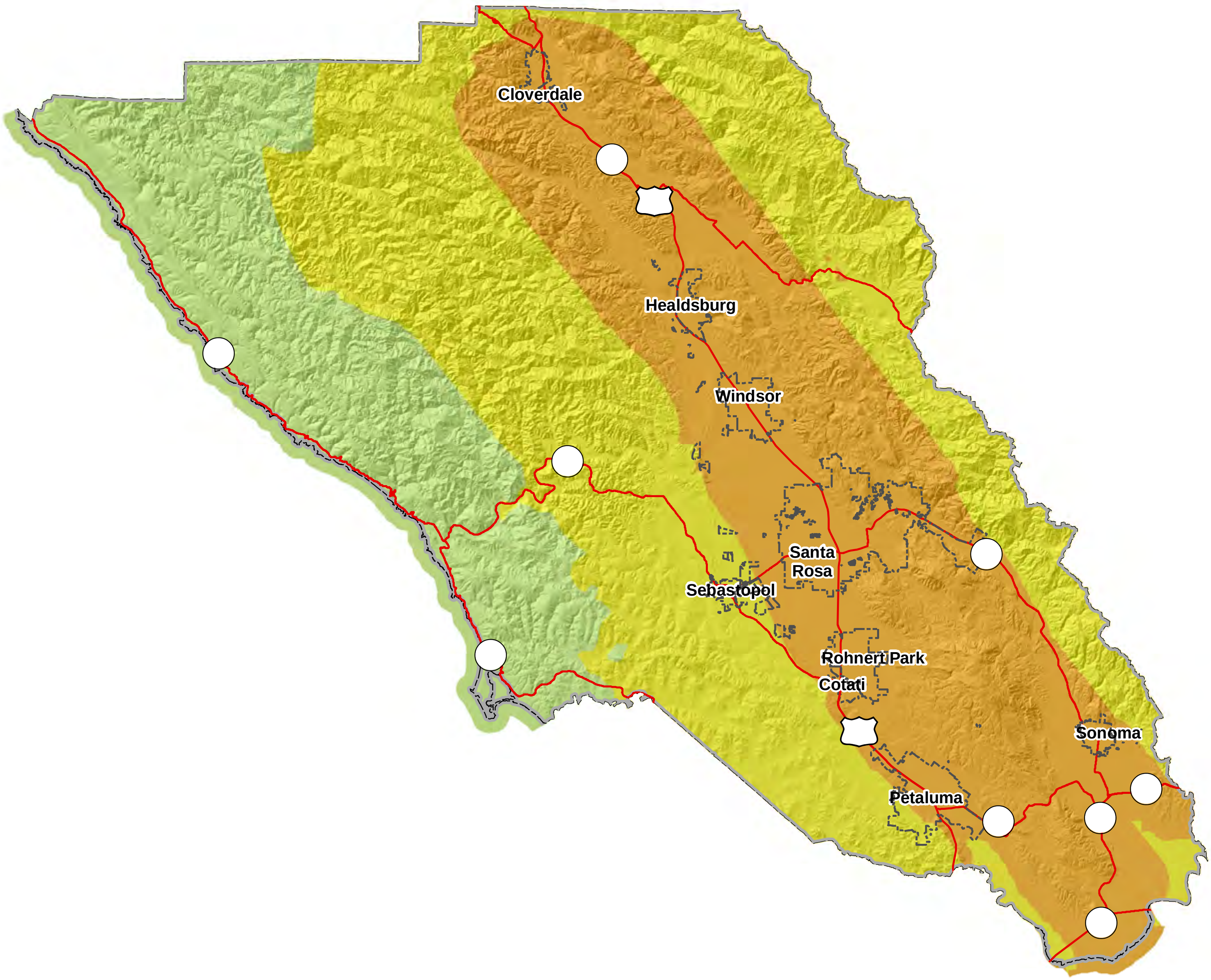


Figure 9-9. Hayward M7.57 Earthquake Scenario

Mercalli Intensity Scale

- VI (Strong/Light)
- VII (Very Strong/Moderate)
- VIII (Severe/Moderate-Heavy)

Intensity scale described as:
(perceived shaking / potential damage)

- Cities
- County Boundary
- Highways

N

0 5 10 Miles

Data Sources: Sonoma Co., USGS

Figure 9-10. Maacama M7.55 Earthquake Scenario

Mercalli Intensity Scale

- V (Moderate/Very Light)
- VI (Strong/Light)
- VII (Very Strong/Moderate)
- VIII (Severe/Moderate-Heavy)

Intensity scale described as: (perceived shaking / potential damage)

- Cities
- County Boundary
- Highways

N

0 5 10 Miles

Data Sources: Sonoma Co., USGS

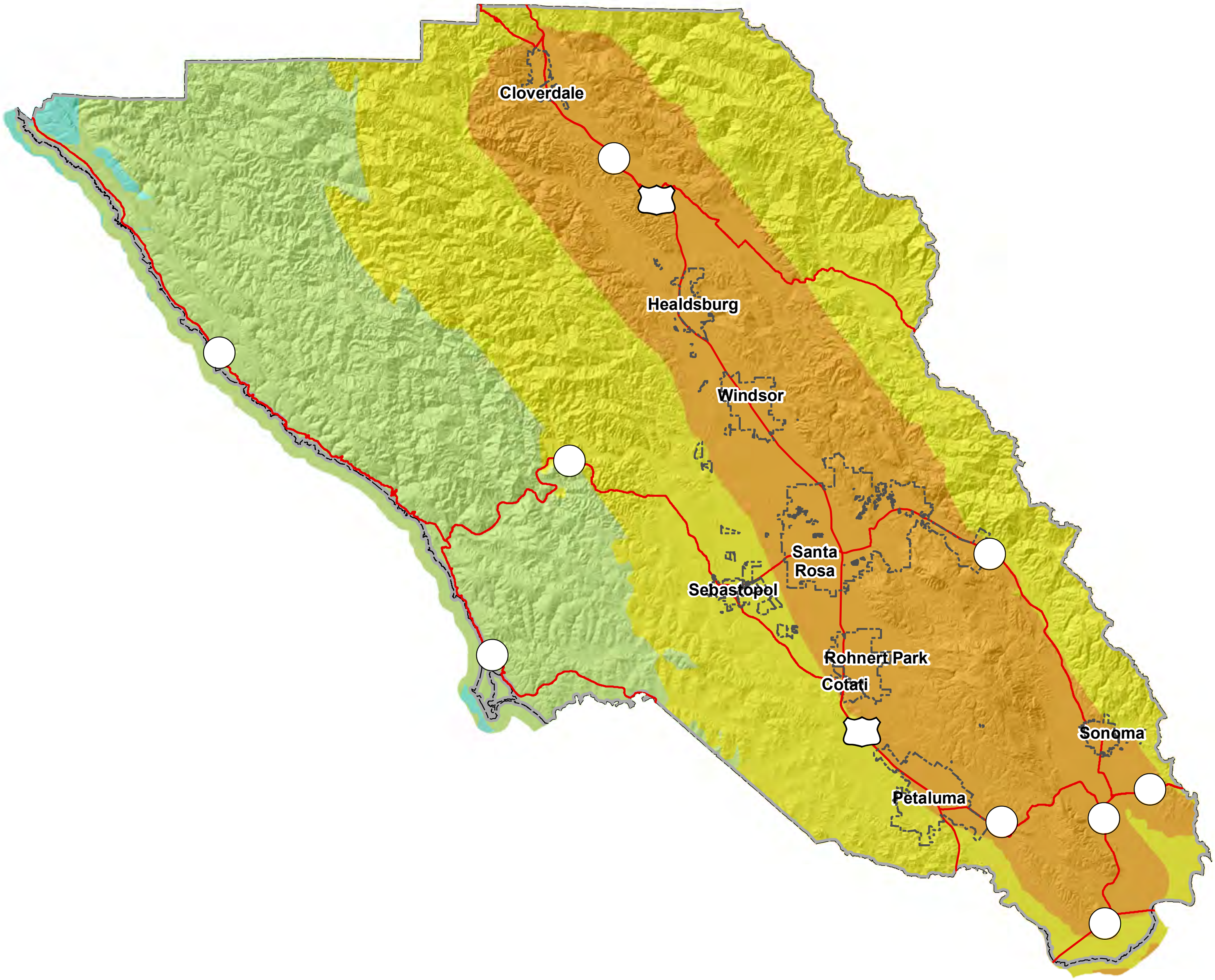


Figure 9-11. Rodgers Creek – Healdsburg M7.19

Mercalli Intensity Scale

- V (Moderate/Very Light)
- VI (Strong/Light)
- VII (Very Strong/Moderate)
- VIII (Severe/Moderate-Heavy)

Intensity scale described as: (perceived shaking / potential damage)

- Cities
- County Boundary
- Highways

N

0 5 10 Miles

Data Sources: Sonoma Co., USGS

Figure 9-12. San Andreas M8.04 Earthquake Scenario

Mercalli Intensity Scale

- VI (Strong/Light)
- VII (Very Strong/Moderate)
- VIII (Severe/Moderate-Heavy)

Intensity scale described as:
(perceived shaking / potential damage)

- Cities
- County Boundary
- Highways

N

0 5 10 Miles

Data Sources: Sonoma Co., USGS

Table 9-5. Age of Housing Units in Planning Area

Time Period	Number of Current Planning Area Housing Units Built in Period	% of Total Housing Units	Significance of Time Frame
Pre-1933	5,640	3.3%	Before 1933, there were no explicit earthquake requirements in building codes. State law did not require local governments to have building officials or issue building permits.
1933-1940	2,980	1.7%	In 1940, the first strong motion recording was made.
1941-1960	21,917	12.6%	In 1960, the Structural Engineers Association of California published guidelines on recommended earthquake provisions.
1961-1975	35,516	20.5%	In 1975, significant improvements were made to lateral force requirements.
1976-1994	66,594	38.4%	In 1994, the Uniform Building Code was amended to include provisions for seismic safety.
1995 – present	40,837	23.5%	Seismic code is currently enforced.
Total	173,484	100.0%	

Note: Number and percent estimates are approximation as housing unit age information does not correspond directly with the time periods indicated. In addition, there are significant margins of error associated with the Census estimates.

Table 9-6. Estimated Impact of Earthquake Scenario Events in the Planning Area

Earthquake Scenario Event	Structure Debris		Structure + Contents Damage	
	Tons	Truckloads	Value	% of Total Value
100-Year Probabilistic Earthquake	836,820	33,473	$14,392,110,613	6.6%
Hayward Fault Scenario	4,117,150	164,686	$31,275,029,312	14.3%
Maacama Fault Scenario	1,862,920	74,517	$18,535,479,687	8.5%
Rodgers Creek – Healdsburg Fault Scenario	2,592,600	103,704	$24,448,538,642	11.2%
San Andreas Fault Scenario	995,710	39,828	$14,504,660,400	6.6%

9.4.3 Critical Facilities

Level of Damage

Hazus classifies the vulnerability of critical facilities to earthquake as no damage, slight damage, moderate damage, extensive damage, or complete damage. Hazus was used to assign a category to each critical facility in the planning area for the assessed earthquake scenarios. Summary results are shown in Figure 9-13 through Figure 9-17.

Time to Restore Critical Facilities to Functionality

Hazus estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, Hazus may estimate that a facility has 5 percent chance of being fully functional at Day 3, and a 95 percent chance of being fully functional at Day 90. The analysis of critical facilities in the planning area was performed for the assessed earthquake scenarios. The results are summarized in Figure 9-18 through Figure 9-22. These figures show the average functionality for all critical facilities in each category.

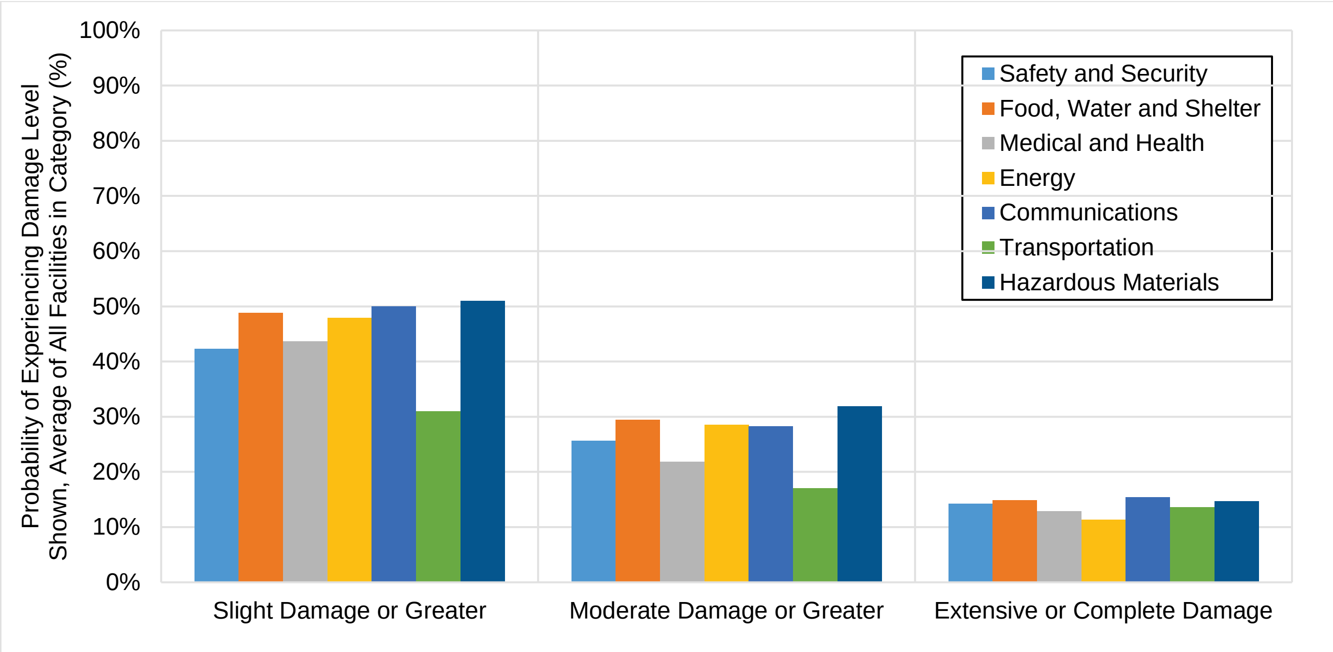


Figure 9-13. Critical Facility Damage Potential, 100-Year Probabilistic Earthquake

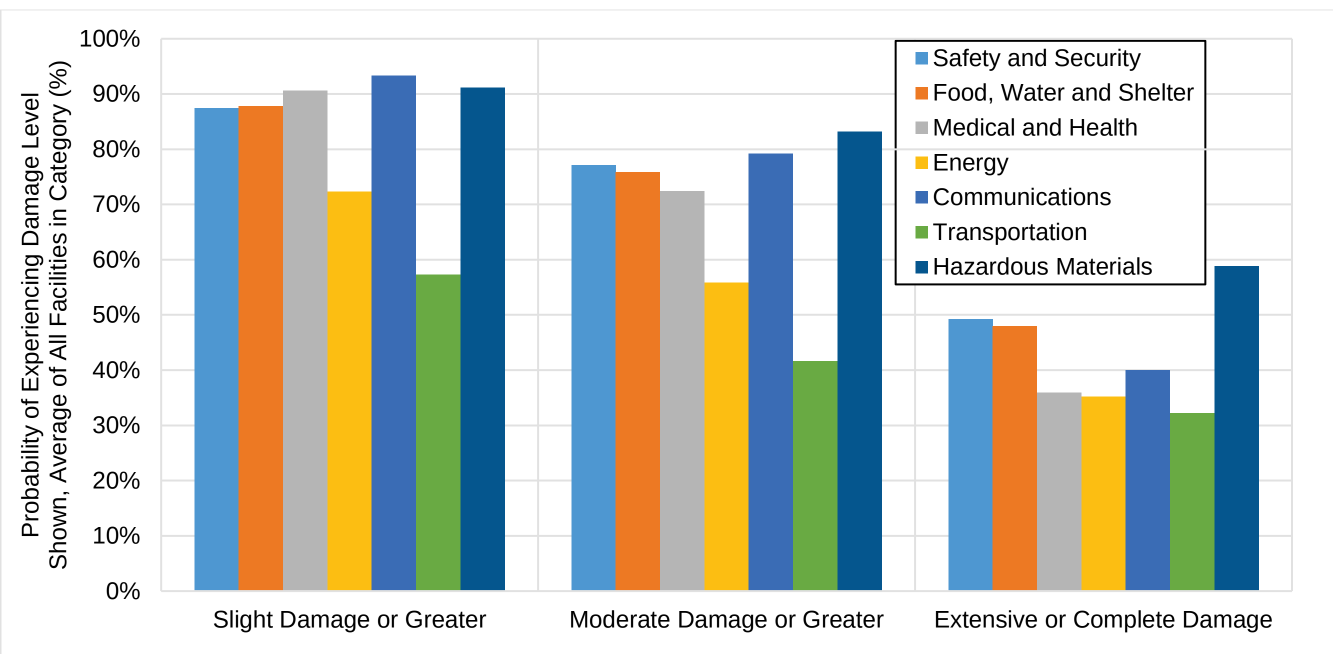


Figure 9-14. Critical Facility Damage Potential, Hayward Fault Scenario

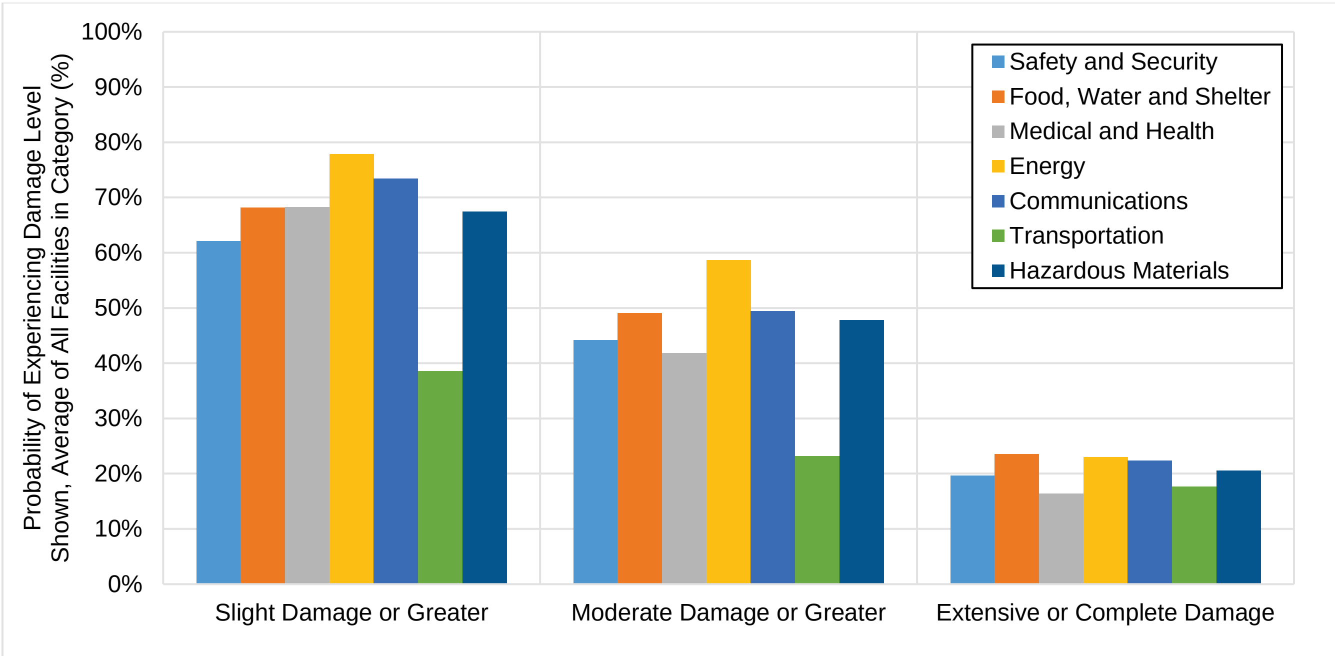


Figure 9-15. Critical Facility Damage Potential, Maacama Fault Scenario

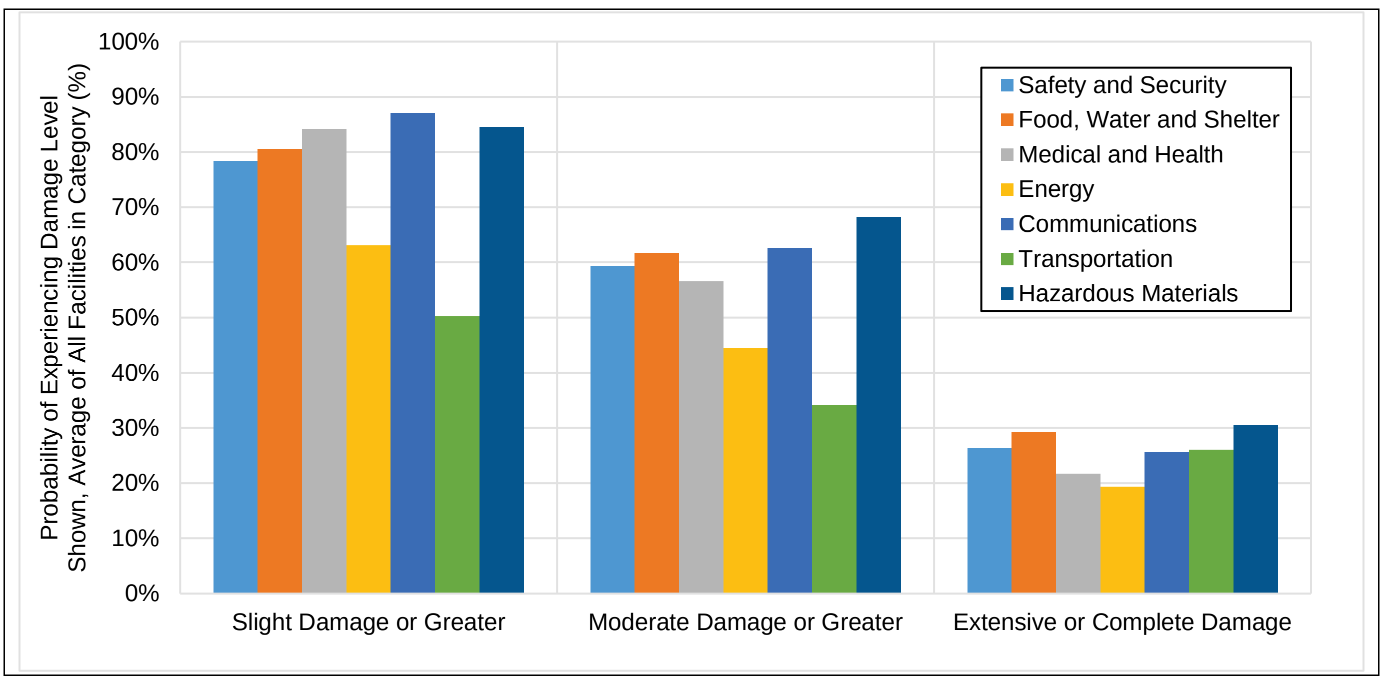


Figure 9-16. Critical Facility Damage Potential, Rodgers Creek – Healdsburg Fault Scenario

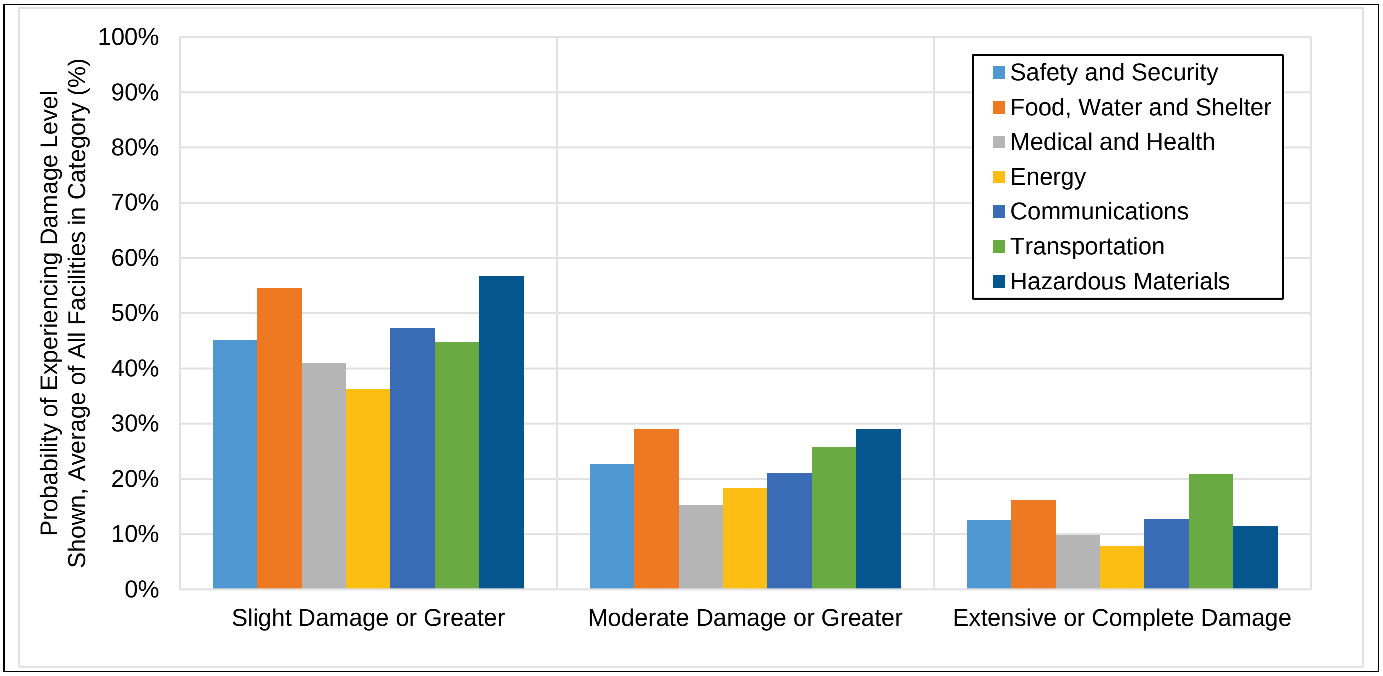


Figure 9-17. Critical Facility Damage Potential, San Andreas Scenario

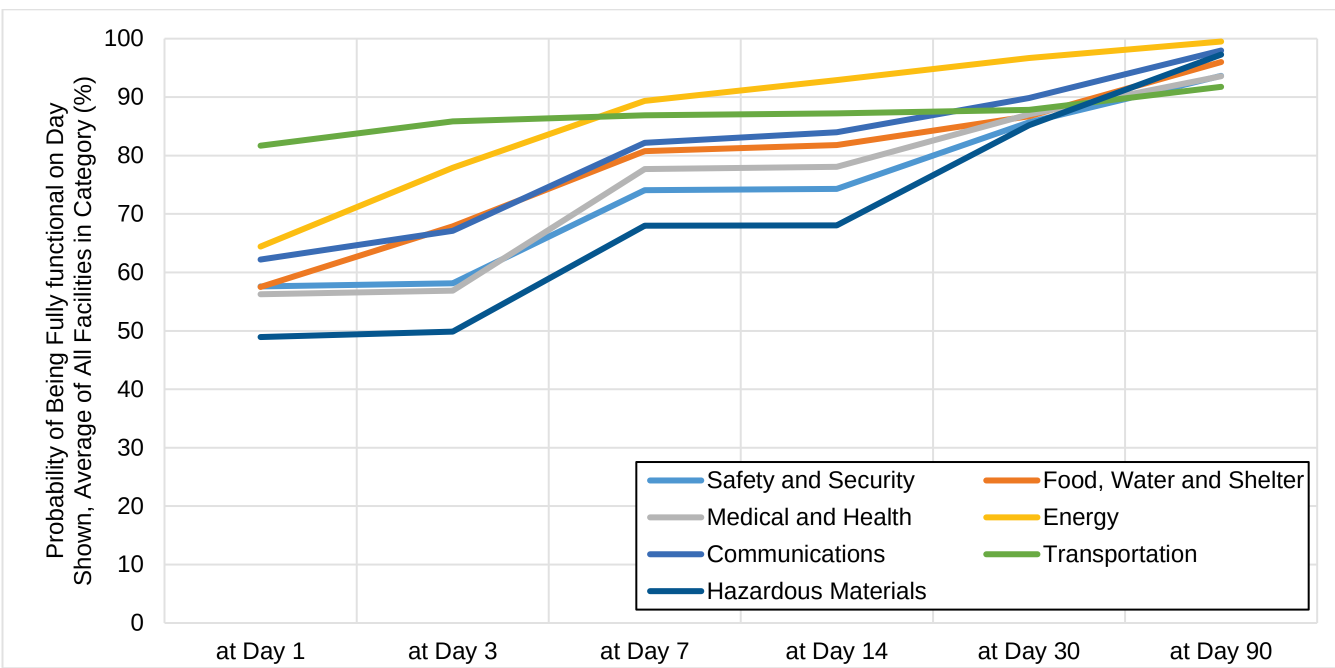


Figure 9-18. Critical Facility Functionality, 100-Year Probabilistic Earthquake

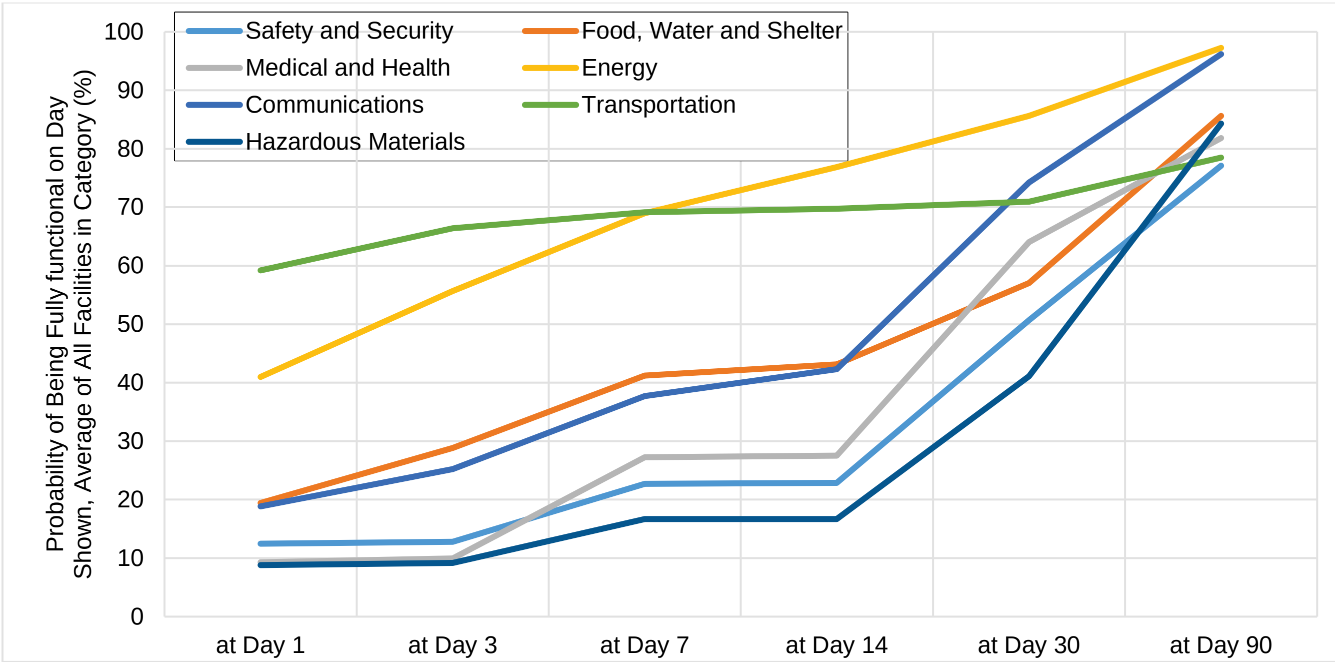


Figure 9-19. Critical Facility Functionality, Hayward Fault Scenario

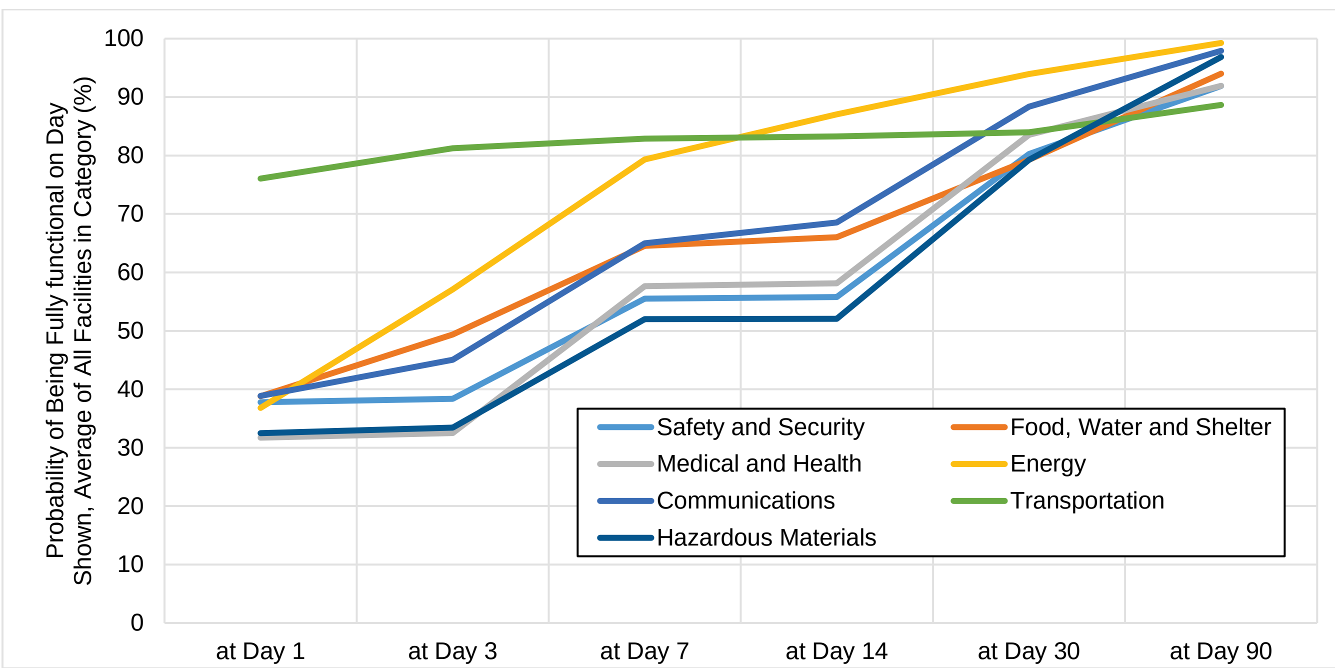


Figure 9-20. Critical Facility Functionality, Maacama Fault Scenario

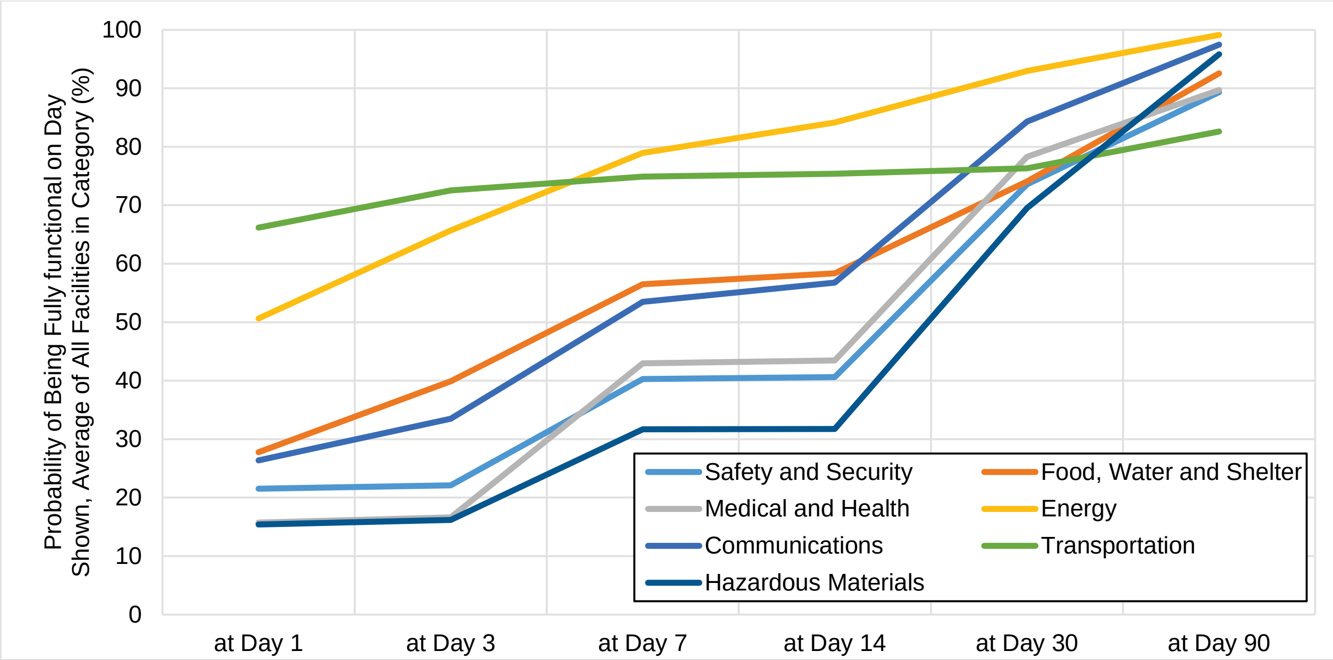


Figure 9-21. Critical Facility Functionality, Rodgers Creek – Healdsburg Fault Scenario

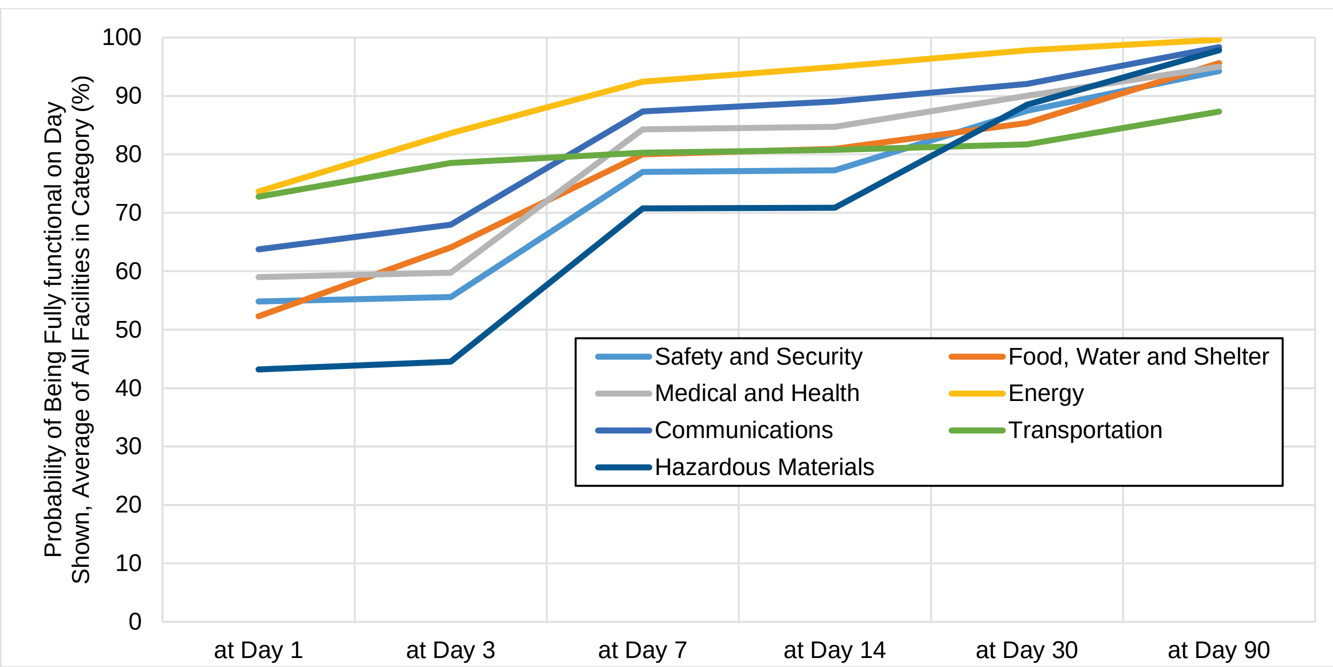


Figure 9-22. Critical Facility Functionality, San Andreas Fault Scenario

9.4.4 Environment

Environmental problems as a result of an earthquake can be numerous. Secondary hazards will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly damage surrounding habitat. It is also possible for streams to be rerouted after an earthquake. Rerouting can change the water quality, possibly damaging habitat and feeding areas. Streams fed by groundwater wells can dry up because of changes in underlying geology.

9.5 FUTURE TRENDS IN DEVELOPMENT

As populations grow, it is critical that the services supporting these communities—such as water, sewer, power, roads, hospitals, and public safety agencies—are able to maintain or quickly resume functionality after a disaster. Land use in the planning area will be directed by general plans adopted under California’s General Planning Law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards, including seismic hazards. The information in this plan provides a tool to ensure that there is no increase in exposure in areas of high seismic risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. Geologic hazard areas are heavily regulated under California’s General Planning Law. The International Building Code establishes provisions to address seismic risk.

9.6 SCENARIO

Based on history and geology, the planning area will be frequently impacted by earthquakes. The worst-case scenario is a higher-magnitude event (7.5 or higher) with an epicenter within 50 miles of the county. Earthquakes of this magnitude or higher could lead to massive structural failure of property on soils prone to liquefaction. Building and road foundations would lose load-bearing strength. Injuries could occur from debris, such as parapets and chimneys that could topple or be shaken loose and fall on those walking or driving below. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. An earthquake event of this magnitude located off the coast could cause a significant local tsunami that would further damage structures and jeopardize lives. An earthquake may also cause minor landslides along unstable slopes, which put at risk major roads and highways that act as sole evacuation routes. This would be even more likely if the earthquake occurred during the winter or early spring.

9.7 ISSUES

Important issues associated with an earthquake include the following:

- A large percentage of the planning area is located on NEHRP D soils, which are prone to liquefaction. Structures on these soils may experience significant structural damage.
- It is estimated more than a third of the planning area’s building stock was built prior to 1975, when seismic provisions became uniformly applied through building code applications. Many structures may need seismic retrofits in order to withstand a moderate earthquake. Residential retrofit programs, such as Earthquake Brace+Bolt, may be able to assist in the costs of these efforts.
- Due to limitations in current modeling abilities, the risk to critical facilities in the planning area from the earthquake hazard is likely understated. A more thorough review of the age of critical facilities, codes they were built to, and location on liquefiable soils should be conducted.

- Damage to transportation systems in the planning area after an earthquake has the potential to significantly disrupt response and recovery efforts and lead to isolation of populations.
- Earthquakes can cause fires in wooden homes and collapse of essential buildings such as fire stations.
- Landslides and tsunamis are major secondary hazards that could have a widespread effect on the county.
- Citizens are expected to be self-sufficient up to two weeks after a major earthquake without government response agencies, utilities, private-sector services, and infrastructure components. Education programs are currently in place to facilitate development of individual, family, neighborhood, and business earthquake preparedness. It takes individuals, families, and communities working in concert with one another to be prepared for disaster.
- After a major seismic event, the planning area is likely to experience disruptions in the flow of goods and services resulting from the destruction of major transportation infrastructure across the broader region.
- A seismic event can damage communication systems, complicating efforts to coordinate response to the event.

10. FLOODING

10.1 GENERAL BACKGROUND

10.1.1 Types of Floodplains in the Planning Area

A floodplain is the area adjacent to a river, creek, lake, or the ocean that becomes inundated during a flood. In general, there are two types of floodplains in the planning area: riverine and coastal.

Riverine Floodplains

Riverine floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce, and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

The frequency and severity of flooding for river systems are based on discharge probability. The discharge probability is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for different discharge levels and storm surge levels. These measurements reflect statistical averages only; it is possible for multiple floods with a low probability of occurrence (such as a 1-percent-annual-chance flood) to occur in a short time period. For riverine flooding, the same flood event can have flows at different points on a river that correspond to different probabilities of occurrence.

Coastal Floodplains

Coastal floodplains are adjacent to the ocean and other tidally influenced areas. Like riverine floodplains, coastal floodplains may be broad or narrow, depending on local topography and natural flood defenses such as dune systems or tidal wetlands. Coastal floods are usually caused by coastal storms that, when combined with normal tides, push water toward the shore. This is commonly referred to as storm surge. The result can be waves that extend further inland, causing damage to development that would not normally be subject to wave action.

10.1.2 FEMA Regulatory Flood Zones

The extent of flooding associated with a 1-percent annual probability of occurrence (also called the base flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

FEMA defines flood hazard areas as areas expected to be inundated by a flood of a given magnitude. These areas are determined via statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on DFIRMs (Digital Flood Insurance Rate Maps), which provide the following information:

- Locations of specific properties in relation to special flood hazard areas
- Base flood elevations (1-percent-annual-chance) at specific sites
- Magnitudes of flood in specific areas
- Undeveloped coastal barriers where flood insurance is not available
- Regulatory floodways and floodplain boundaries (1-percent and 0.2-percent-annual-chance floodplains).

Land covered by floodwaters of the base flood is the special flood hazard area on a DFIRM—an area where NFIP floodplain management regulations must be enforced, and where mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities, because many communities have maps showing the extent of the base flood and likely depths that will occur.

The base flood elevation (the water elevation of a flood that has a 1-percent chance of occurring in any given year) is one of the most important factors in estimating potential damage from flooding. A structure within a 1-percent-annual-chance floodplain has a 26-percent chance of undergoing flood damage during the term of a 30-year mortgage. The 1-percent-annual-chance flood is used by the NFIP as the basis for insurance requirements nationwide. DFIRMs also depict 0.2-percent-annual-chance flood designations.

DFIRMs and other flood hazard information can be used to identify the expected spatial extent of flooding from a 1-percent and 0.2-percent annual chance event. They depict the following SFHAs and other areas:

- **Zone A (Also known as Unnumbered A-zones**)—SFHAs where no base flood elevations or depths are shown because detailed hydraulic analyses have not been performed.
- **Zones A1-30 and AE—**SFHAs that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base flood elevations are shown within these zones.
- **Zone AH—**SFHAs that are subject to shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

- **Zone AO—**SFHAs subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
- **Zone AR—**Areas with a temporarily increased flood risk due to the building or restoration of flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements apply, but rates do not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
- **Zone A99—**Areas with a 1 percent annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
- **Zone VE, V1-30—**SFHAs along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base flood elevations derived from detailed hydraulic analysis are shown within these zones.
- **Zone B and X (shaded)—**Zones where the land elevation as been determined to be above the base flood elevation, but below the 500-year flood elevation. These zones are not SFHAs.
- **Zones C and X (unshaded)—**Zones where the land elevation has been determined to be above both the base flood elevation and the 500-year flood elevation. These zones are not SFHAs.

The FEMA designated floodway is the channel of a water course and portion of the adjacent floodplain that is needed to convey the base flood without increasing flood levels by more than a specified amount (typically, 1 foot). A floodway may be designated within the SFHA where the deepest, highest velocity flow is expected and any infrastructure will be at risk. Floodways should be kept free of obstructions and development to allow floodwaters to move downstream unobstructed. Any development in a floodway is subject to severe damage and high risks for occupants and emergency responders.

Flood damage may occur outside of SFHAs. FEMA typically does not designate SFHAs for areas subject to flooding from local drainage problems, particularly in urban areas; drainage basins of less than 1 square mile in area; or hillside areas subject to runoff, erosion, and mudflow. FEMA does not map flooding along the length of all streams or in areas that are undeveloped.

According to FEMA, the coastal high hazard area (or “V zone,” where V stands for velocity wave action) is the most hazardous part of the coastal floodplain, due to its exposure to wave effects. The V zone has an increased degree of flood risk compared to coastal flood areas not within the coastal high hazard area (A zones), and is subject to more stringent regulatory requirements. Figure 10-1 is a typical transect illustrating the coastal V and A zones and the effects of energy dissipation and regeneration of a wave as it moves inland. Wave elevations are decreased by obstructions such as buildings, vegetation, and rising ground surface.

10.1.3 Floodplain Ecosystems and Beneficial Functions

Floodplains can support ecosystems that are rich in plant and animal species. Wetting of the floodplain soil releases a surge of nutrients left over from the last flood or caused by the rapid decomposition of organic matter accumulated since then. Microscopic organisms thrive, and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients falls away quickly, but the surge of new growth endures. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, trees that grow in floodplains tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

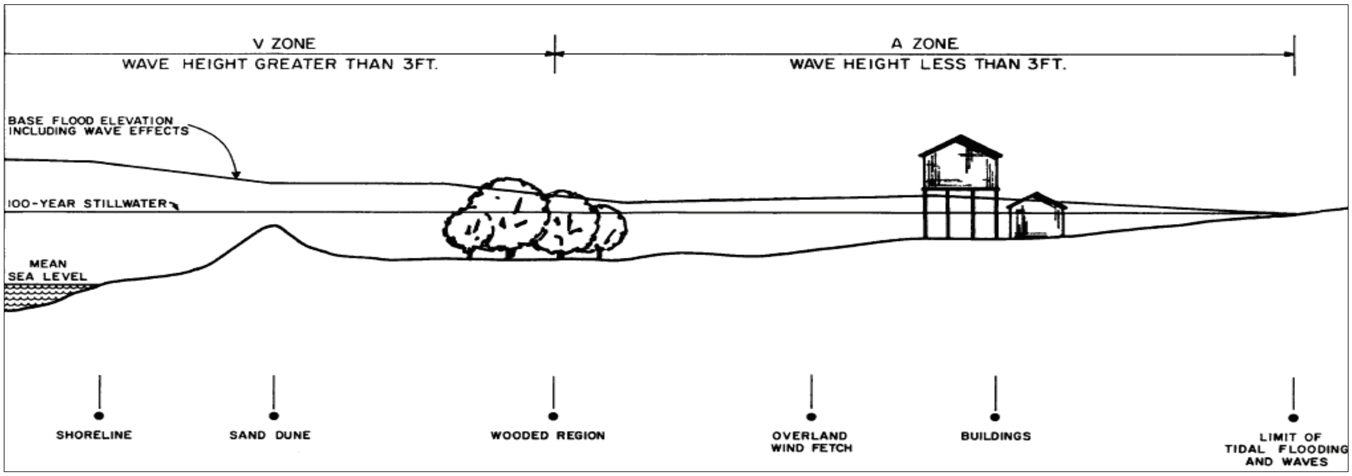


Figure 10-1. Typical Transect Schematic

Floodplains have many natural beneficial functions, and disruption of them can have long-term consequences for entire regions. Some well-known, water-related functions of floodplains (noted by FEMA) include:

- Natural flood and erosion control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation
- Surface water quality maintenance
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperatures of water
- Provide groundwater recharge
- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface flows

Areas in the floodplain that typically provide these natural functions are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species.

10.1.4 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; riverine floodplain land is fertile and suitable for farming; transportation by water is easily accessible; land is flatter and easier to develop; and there is value placed in ocean views. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels or causing erosion of natural flood protection systems such as dunes. Flood potential can be increased in several ways: reducing a stream's capacity to contain flows; increasing flow rates or velocities downstream; and allowing waves to extend further inland. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

10.2 HAZARD PROFILE

10.2.1 Federal Flood Program Participation

National Flood Insurance Program

The most vulnerable structures in the planning area are those that are not constructed to standards to withstand the impacts of a flood. Such structures may have been built before flood damage prevention regulations were in effect or may not be subject to flood-related building codes because they are outside mapped flood hazard areas. Table 10-1 summarizes planning area participation in the National Flood Insurance Program (NFIP). The average flood insurance claim paid out in the planning area since participation in NFIP began is $38,200.

Table 10-1. Flood Insurance Statistics

Jurisdiction	Initial FIRM Effective Date	# of Flood Insurance Policies as of 03/31/2021	Insurance In Force	Total Written Premium + Federal Policy Fee	Claims through 03/31/2021	
					Number	Value
Cloverdale	09/27/1985	35	$9,048,600	$8,766	9	$327,240
Cotati	04/15/1980	72	$22,529,500	$7,412	0	$2,275
Healdsburg	03/04/1980	115	$39,433,000	$11,673	42	$759,335
Petaluma	02/15/1980	362	$128,484,100	$35,705	280	$8,643,392
Rohnert Park	06/01/1981	46	$15,456,500	$9,095	5	$3,639
Santa Rosa	08/03/1981	145	$47,368,200	$12,478	21	$465,602
Sebastopol	06/18/1980	37	$15,563,600	$420	21	$1,602,797
City of Sonoma	01/17/1979	79	$21,724,100	$8,679	28	$683,642
Sonoma County	01/20/1982	2,183	$557,908,100	$804,699	2,986	$116,859,702
Town of Windsor	12/02/2008	62	$19,496,400	$10,270	0	$45,252
Total		3,136	$877,012,100	$909,197	3,392	$129,392,876

Levee Accreditation

For the NFIP, FEMA only recognizes levee systems that meet minimum design, operation, and maintenance standards. CFR 44 (Section 65.10) describes the information needed for FEMA to determine if a levee system provides protection from the 1 percent annual chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate FIRM flood zone.

FEMA coordinates its programs with the U.S. Army Corps of Engineers, who may inspect, maintain, and repair levee systems. The Corps has authority under Public Law 84-99 to supplement local efforts to repair flood control projects that are damaged by floods. Like FEMA, the Corps provides a program to allow public sponsors or operators to address levee system maintenance deficiencies. Failure to do so within the required timeframe results in the levee system being placed in an inactive status in the Corps' Rehabilitation and Inspection Program. Levee systems in an inactive status are ineligible for rehabilitation assistance under Public Law 84-99.

There are about 60 levees in Sonoma County. Table 10-2 lists the 29 levees shown on the FEMA FIRM, all of which protect population, structures, and/or valuable property from riverine flooding.

Table 10-2. Levees Shown on FIRM for Sonoma County

Levee Name	Population	Structures	Property Value	Length (miles)	FIRM Status
All Coast Lumber Company and Cloverdale Water Treatment Plan	51	3	$5.29 million	1.24	Non-Accredited
J. Black #3	6	4	$2.27 million	0.99	Non-Accredited
Petaluma River Left Bank	508	213	$140 million	0.83	Non-Accredited
Petaluma River Right Bank	567	176	$104 million	0.89	A99
Sonoma County Levee 106	2	1	$327,000	0.26	Non-Accredited
Sonoma County Levee 111	1	1	$595,000	0.09	Non-Accredited
Sonoma County Levee 12	121	44	$23 million	2.58	Non-Accredited
Sonoma County Levee 13	124	13	$106 million	0.59	Non-Accredited
Sonoma County Levee 16	14	7	$9.28 million	1.08	Non-Accredited
Sonoma County Levee 17	25	14	$8.33 million	0.7	Non-Accredited
Sonoma County Levee 18	18	2	$16.2 million	0.07	Non-Accredited
Sonoma County Levee 21	0	2	$4.11 million	1.31	Non-Accredited
Sonoma County Levee 25	307	24	$88.8 million	0.24	Non-Accredited
Sonoma County Levee 29	102	16	$29.9 million	0.9	Non-Accredited
Sonoma County Levee 30	5	2	$844,000	1.93	Non-Accredited
Sonoma County Levee 32	63	17	$4.78 million	0.23	Non-Accredited
Sonoma County Levee 33	62	21	$13.3 million	0.85	Non-Accredited
Sonoma County Levee 34	477	1	$4.47 million	1.39	Non-Accredited
Sonoma County Levee 37	4	1	$358,000	0.21	Non-Accredited
Sonoma County Levee 38	154	3	$11.8 million	1.47	Non-Accredited
Sonoma County Levee 39	4	1	$391,000	0.45	Non-Accredited
Sonoma County Levee 4	4	3	$2.04 million	0.39	Non-Accredited
Sonoma County Levee 46	12	3	$1.85 million	1.76	Non-Accredited
Sonoma County Levee 48	2	2	$2.6 million	0.62	Non-Accredited
Sonoma County Levee 50	2	1	$1.03 million	4.82	Non-Accredited
Sonoma County Levee 62	0	3	$3.41 million	7.91	Non-Accredited
Sonoma County Levee 65	7	4	$5.24 million	5.62	Non-Accredited
Sonoma County Levee 67	0	4	$2.16 million	9.56	Non-Accredited
Sonoma County Levee 80	13	4	$2.38 million	1.11	Non-Accredited

The Community Rating System

Sonoma County and the City of Petaluma currently participate in the CRS program. Table 10-3 summarizes the CRS status of each. Many of the mitigation actions identified in this plan are creditable activities under the CRS program. Therefore, successful implementation of this plan offers the potential to enhance the CRS classification.

Table 10-3. CRS Status of Participating Jurisdictions

Jurisdiction	NFIP Community #	CRS Entry Date	Current CRS Classification	Premium Discount	
				SFHA	Non SFHA
City of Petaluma	060379	10/01/1991	6	20%	10%
Sonoma County	060375	10/01/1991	10	0%	0%

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses more than $1,000
- Two paid losses more than $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. Studies have found that many of these properties are outside any mapped 1 percent annual chance (100-year) floodplain. The key identifiers for repetitive loss properties are the existence of NFIP insurance policies and claims paid by the policies.

FEMA further designates as severe repetitive loss (SRL) any NFIP-insured single-family or multi-family residential building for which either of the following is true:

- The building has incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000
- At least two separate claims payments (building payments only) have been made under NFIP coverage, with the cumulative amount of claims exceeding the market value of the building.

To qualify as an SRL property, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other are counted as one claim. In determining SRL status, FEMA considers the loss history since 1978, or from the building's construction if it was built after 1978, regardless of any changes in the ownership of the building.

FEMA-sponsored programs, such as the CRS, require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss.

FEMA's list of repetitive loss properties identifies 969 such properties in the Sonoma County planning area, as of March 28, 2021, as summarized in Table 10-4. These properties likely were flooded by flood events typical for the floodplain reflected in the current mapping. Note that special purpose district planning partners to this plan have no identified repetitive loss properties because districts are not eligible participants in the NFIP.

FEMA recently changed its policies on providing repetitive loss properties information due to implications of the Privacy Act. The "routine use" provision for acquiring the data, which requires certifications on how the data will be used, was not well-defined at the time of this plan update. Repetitive loss data for all planning partners could not be acquired in time for analysis and assessment for this plan. Therefore, the resolution of the repetitive loss data available to support this plan update is limited to property counts only. No location or dates of loss data was available. As the State of California's largest repetitive loss community, Sonoma County and its planning partners understand the importance of a thorough understanding of the repetitive flood loss problem. The County and its planning partners will seek to meet FEMA requirements for access to this data through plan implementation. Future updates to this plan will seek to have enhanced resolution for more detailed analysis.

Table 10-4. Repetitive Loss Properties in Sonoma County

Jurisdiction	Repetitive Loss Properties	Total Number of Losses	Payment Made for Losses		
			Building Payments	Contents Payments	Total Payments
Healdsburg	8	25	$305,938.77	$52,298.70	$358,237.47
Morro Bay	3	6	$107,144.24	$.00	$107,144.24
Petaluma	39	108	$2,750,657.29	$668,253.68	$3,418,910.97
Santa Rosa	2	4	$27,134.97	$.00	$27,134.97
Sebastopol	9	23	$654,611.00	$665,023.72	$1,319,634.72
Sonoma (City)	4	10	$167,180.17	$40,134.26	$207,314.43
Sonoma County	904	3,217	$69,494,790.53	$15,992,640.94	$85,487,431.47
Total	969	3,393	$73,507,456.97	$17,418,351.30	$90,925,808.27

Source: March 28, 2021 FEMA Repetitive Loss Summary

10.2.2 Typical Flood-Causing Events

There are six types of flood events that can impact the planning area: riverine flooding, urban flooding, coastal flooding, tsunami flooding, flooding from sea level rise, and flooding from a dam failure. This hazard profile focuses on the coastal, riverine, and urban flood hazards. Floods resulting from a dam failure are discussed in Chapter 7. Tsunami flooding is discussed in Chapter 14. Floods from sea level rise are discussed in Chapter 12

10.2.3 Flooding Sources

River Systems

Riverine floods in Sonoma County occur during winter. Typically, they develop within 24 to 48 hours after a storm event and recede within three days after the end of the storm. Damaging floods in the county occur most frequently along the Russian River, Petaluma River, Sonoma Creek, Laguna De Santa Rosa, and their tributaries.

Russian River

The Russian River watershed is the largest in Sonoma County, draining a total of 1,485 square miles. It originates in Mendocino County, flows southward through eastern Sonoma County to Healdsburg, where it turns west; then flows into the Pacific Ocean at Jenner. Nearly 90 percent of the drainage basis lies upstream of the flood-prone areas of the Russian River which includes the unincorporated communities of Monte Rio, Guerneville, Rio Nido and Forestville. The watershed comprises much of the county's prime agricultural land and has been greatly influenced by urbanization in the vicinity of Windsor and Santa Rosa. West of Forestville, the river's floodplain narrows significantly as it flows through the Coast Range to the Pacific.

Along the lower Russian River, floods are characterized by high velocity and significant depth of flow due to the relatively narrow floodplain. The frequency of flooding in this portion of the river causes repetitive flood losses in the residential and commercial districts of Mirabel Park, Duncans Mills, Monte Rio, Rio Nido and Guerneville. The National Weather Service considers the Russian River at flood stage when it reaches a height of 32 feet at the Guerneville Bridge. Floods reaching a gauge height of less than 34 feet at the Guerneville Bridge are common during a typical winter but do not usually present significant problems for the community.

The USGS has maintained stream-gaging stations to record flow levels on the Russian River since 1911. The gages are located in the communities of Cloverdale (USGS gauge #11463000), Healdsburg (USGS gauge

#11464000), and Guerneville (USGS gauge # 11467000). The drainage area monitored by these gaging station is about 1,340 square miles, of which 235 square miles are in the drainage areas behind either the Warm Springs Dam or the Coyote Valley Dam. The Guerneville gauge monitors peak discharge 4.3 miles upstream from the Guerneville Bridge and 20.8 miles upstream from the mouth of the Russian River. For County emergency response purposes, a staff gauge on the Guerneville Bridge is used to monitor flood elevation levels and risk to the community of Guerneville. This gauge does not measure or record flow levels and is not an official USGS gaging station (County of Sonoma 2017).

Sonoma Creek

Sonoma Creek frequently floods during relatively small winter storm events that cause flows to overtop the banks. The flooding is of short duration, but may last several days. The bordering low lands are most impacted, as a result of storm water runoff from the upper watershed (County of Sonoma 2017).

Petaluma River

Petaluma River floods after multi-day storm events due to inadequate storm water infrastructure. Flooding along this river mainly occurs in the Payran area, between Denman Flat and the confluence of Lynch Creek; and the Penngrove area. Between 1997 and 2008, the City of Petaluma significantly reduced its flood exposure in the Payran area by completing $40 million in improvements to flood control infrastructure, including 3,600 feet of channel widening and floodwalls, pump stations, two vehicular bridge replacements, and two railroad bridge replacements (County of Sonoma 2017).

Laguna De Santa Rosa

The Laguna De Santa Rosa is a freshwater estuary that receives stormwater from southern Santa Rosa, Rohnert Park, Cotati, Sebastopol, and large unincorporated areas. Many portions of these cities were developed in or near the Laguna’s historical flood inundation area. The most significant flood impacts along the Laguna and its tributaries occur in western Rohnert Park, Cotati, and eastern Sebastopol. The City of Santa Rosa’s Laguna Treatment Plant has experienced significant flooding on numerous occasions.

Urban Flooding

Urban flooding occurs when available stormwater conveyance systems lack the capacity to convey rainfall runoff to nearby creeks, streams, and rivers. As drainage facilities are overwhelmed, roads and transportation corridors become conveyance facilities. Urban floods can be a great disturbance of daily life in urban areas. Roads can be blocked, and people may be unable to go to work or school. Economic damage can be high, but the number of casualties is usually limited, because of the nature of the flood.

The two key factors that contribute to urban flooding are rainfall intensity and duration. Topography, soil conditions, urbanization and groundcover also play an important role. On flat terrain, the flow speed is low and people can still drive through flooded areas. The water rises relatively slowly and usually does not reach life endangering depths. Risks are much greater where conditions cause floodwaters to flow at higher velocity.

Coastal Flooding

Coastal flooding occurs when intense, offshore low-pressure systems drive ocean water inland. The water pushed ashore is called storm surge. Flooding along the Pacific coast is often associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. Though at lower risk, the San Pablo Bay shoreline also can be affected by storm surges and tidal actions.

Most flood damage along the California coast is due to the confluence of large waves, storm surges, and high tides during strong El Niño events. These storm events can result in coastal bluff erosion. Much of the Sonoma County coastline is elevated above sea level with dramatic coastal bluffs. The bluffs are subject to erosion from winter storms, wave action, wind, and stormwater runoff and can become unstable. Bluff erosion or retreat may occur suddenly and catastrophically through slope failure due to heavy rain, high wave action, and high tides.

According to the National Academy of Sciences, storms and sea level rise are causing California coastal bluffs, beaches, and dunes to retreat at rates from a few inches to several feet per year. The Academy projects that California coastal bluffs could retreat more than 100 feet by 2100. The ability of coastal bluffs to withstand continuous erosive forces over time depends on the relative resistance of the shoreline rocks. Factors that determine rock resistance are the type of rock, extent of shearing and fracturing, and inclination of the rock layers. Coastal bluffs consisting of native materials from the Franciscan or Merced geologic formations are the most affected by erosion (County of Sonoma 2017).

Coastal bluff erosion has threatened development in some areas west of State Highway 1, such as Gleason Beach. Structures and septic systems in these areas were built on or near the edge of coastal bluffs and on steep slopes, which are eroding. Landslides, in conjunction with wave action, failure of shoreline protection measures, and changes in drainage have resulted in severe erosion, bluff failure, and loss of bluff top area. Some houses have been demolished and removed because they posed a public safety risk, and several other houses have been damaged to the extent that they are no longer habitable. Caltrans investigations in 1998 and 2003 determined that coastal erosion rates near Gleason Beach were about 1 foot per year. Coastal erosion threatens the stability of State Highway 1, and Caltrans developed a project to relocate State Highway 1 at Gleason Beach. The project is scheduled to begin in mid-2021.

10.2.4 Past Events

Significant floods occurred on the Russian River in 1955, 1964, 1986, 1995, 1997, 2006, and 2017. The earliest major flood recorded on the Russian River occurred in 1862. This flood predated gauge measurements of river flow, but is estimated to have had a discharge of about 100,000 cubic feet per second. The Petaluma River has also had a history of flooding. According to the Corps of Engineers, floods in 1982, 1986, and 1998 caused over $34 million in damage within the City of Petaluma, particularly in the Payran area. These flood hazards have been significantly reduced by construction of flood control channels and flood walls, completed in 2008 (County of Sonoma 2017). Table 10-5 summarizes the 15 federally declared flood disasters in Sonoma County related to flooding between 1960 and 2020.

The largest flood in recent history occurred between February 14 and 18, 1986, when a peak discharge of 102,000 cubic feet per second was recorded and the flood reached a gage height of 48.6 feet at Guerneville. Heavy rains from December 26, 2005, to January 3, 2006. The Russian River rose above flood stage at all USGS gaging stations in Sonoma County. Significant flooding also occurred on the Petaluma River and Sonoma Creek. At Guerneville, the river crested at 41.6 feet. The rainfall measured in the City of Santa Rosa during this storm was near record-setting at 17.6 inches. A federal disaster declaration was issued for this event, and more than 100 roadways were blocked due to flooding or landslides. Some 2,100 business and residential properties were inundated, and 50,000 residents were without power. Sonoma County business and residential damages were estimated at $104 million (County of Sonoma 2017).

Table 10-5. Declared Sonoma County Flood Disaster Events

Date	Declaration #	Type of event	Assistance Type[a]	Estimated Damage
February 24 – March 1, 2019	4434	Severe winter storms, flooding, landslides, mudslides	PA	$155 million
February 1 – 23, 2017	4308	Severe winter storms, flooding, mudslides	PA	$537.1 million
January 3 – 12, 2017	4301	Severe winter storms, flooding, and mudslides	PA	$162.3 million
March 29 – April 16, 2006	1646	Severe storms, flooding, landslides, and mudslides	PA	
December 17 – January 3, 2006	1628	Severe storms, flooding, mudslides, and landslides	IA & PA	$163.2 million
February 2 – April 30, 1998	1203	Severe winter storms and flooding	IA & PA	
December 28, 1996 – April 1, 1997	1155	Severe storms/flooding	IA & PA	
February 13 – April 19, 1995	1046	Severe winter storms, flooding, landslides, mud flows	IA & PA	
January 3 – February 10, 1995	1044	Severe winter storms, flooding, landslides, mud flows	IA & PA	
January 5 – March 20, 1993	979	Severe storm, winter storm, mud & landslides, flooding	IA & PA	
February 12 – March 10, 1986	758	Severe storms, flooding	IA & PA	
January 21 – March 30, 1983	677	Coastal storms, floods, slides, tornadoes	IA & PA	
December 19, 1981 – January 8, 1983	651	Severe storms, flood, mudslides, high tide	IA & PA	
January 16, 1969	253	Severe storms, flooding	IA & PA	
December 24, 1964	183	Heavy rains & flooding	IA & PA	

a. IA = Individual Assistance; PA = Public Assistance; HMGP = Hazard Mitigation Grant Program; N/A = Information not available or applicable

10.2.5 Location

FEMA-generated FIRMs (Flood Insurance Rate Maps) are the principle tool used to identify the extent and location of the flood hazard. FEMA last updated a FIRM for the County of Sonoma on March 7, 2017. Flood hazard zones from that mapping are shown on Figure 10-2. Preliminary data were released in May 2020 for additional FIRM updates, but those changes have not yet become effective.

Additional areas called "flood awareness areas" were delineated using the County's "functional riparian channels and floodplains" data (see Figure 10-3). The mapped areas overlap with the FEMA and Russian River data in some areas but also include streams not mapped by FEMA.

10.2.6 Frequency

Riverine Flooding

Annual peak gauge heights and discharges for the Russian River at the USGS Guerneville gage indicate that peak flows exceeded flood stage at Guerneville in 34 of 59 years. The number of floods experienced may be greater as some years had more than one high flow event. The future potential for flood frequency and intensity in the near term is expected to be similar to the observed historic probabilities. Based on this, the planning area can expect at least one episode of minor river flooding most winters. In the longer term, the effects of development and of climate change storm intensity, frequency and flooding are unknown (County of Sonoma 2017).

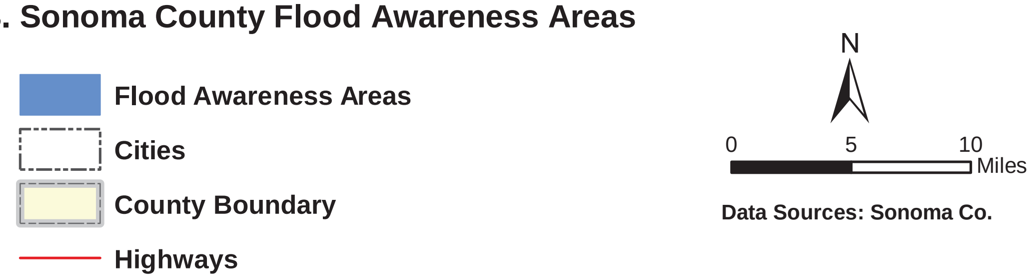
Figure 10-2. FEMA FIRM Flood Hazard Areas

1% Annual Chance Flood (100-Year)
0.2% Annual Chance Flood (500-Year)
Cities
County Boundary
Highways

N
0 5 10 Miles

Data Sources: Sonoma Co., FEMA

Figure 10-3. Sonoma County Flood Awareness Areas



Flood frequency for riverine flooding is often evaluated by examining peak discharges; Table 10-6 lists peak flows on the Petaluma and Russian Rivers used in FEMA's flood insurance study to define flows with a 10 percent, 2 percent, 1 percent, and 0.2 percent probability of occurring in any given years. These values are often referred to a flows likely to occur once every 10, 50, 100, or 500 years, respectively. FEMA's peak flows for all surface waters in the county are included in Appendix E.

Table 10-6. Peak Riverine Discharges on the Petaluma and Russian Rivers

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
Petaluma River				
Downstream of confluence with Adobe Creek	8,672	11,034	11,910	15,044
At Highway 101 bridge	6,675	9,149	10,494	13,694
Downstream of confluence of Washington Creek	5,758	8,459	9,757	13,056
Downstream of confluence of Lynch Creek	5,246	7,492	8,671	11,563
Downstream of confluence of Capri Creek	4,653	6,583	7,728	10,523
Downstream of confluence of Willow Brook	3,587	4,825	5,360	6,733
Upstream of confluence of Willow Brook	1,701	2,947	3,529	4,801
Russian River				
At Pacific Ocean	76,000	102,000	114,000	135,000
Upstream of Duncan Mills	75,000	100,000	112,000	133,000
Upstream of confluence of Austin Creek	74,000	98,000	107,000	131,000
Upstream of Summerhome Gage	73,000	97,000	106,000	130,000
Downstream of confluence of Mark West Creek	67,000	92,000	97,000	126,000
Upstream of confluence of Mark West Creek	60,000	88,000	103,000	140,000
Upstream of confluence of Dry Creek	56,000	79,000	90,000	129,000
Upstream of confluence of Brooks Creek	55,000	78,000	88,000	127,000
Upstream of confluence of Maacama Canal	51,000	73,000	82,000	115,000
Upstream of confluence of Sausal Creek	50,000	71,000	81,000	111,000
Upstream of confluence of Lytton Creek	50,000	70,000	80,000	110,000
Upstream of confluence of Miller Creek	48,000	68,000	79,000	106,000
Upstream of confluence of Gill Creek	47,000	67,000	76,000	105,000
Upstream of confluence of Big Sulphur Creek	46,000	58,000	73,000	100,000
Upstream of confluence of Oat Valley Creek	40,000	56,000	64,000	85,000
Russian River Split Flow				
At Healdsburg Avenue	*	215	640	9,140

* Data not available

Source: FEMA Flood Insurance Study Number 06097CV001E, Sonoma County, California and Incorporated Areas, March 7, 2017

Coastal Flooding

The frequency and severity of coastal flooding are based on storm surge height, which is the height of water accounting for waves. Table 10-7 summarizes the still-water elevations along the San Pablo Bay coastline, representing the steady state water depth not accounting for breaking waves. These are the projected elevations of floodwaters in the absence of waves resulting from wind or seismic effects. Table 10-8 shows the storm surge water levels used for mapping the coastal floodplains in the planning area.

Low	8.4	9.8	10.6	10.9
High	15.7	15.1	17.2	16.5

a. Elevation in 1988 North American Vertical Datum

Source: FEMA Flood Insurance Study Number 06097CV001E, Sonoma County, California and Incorporated Areas, March 7, 2017

Table 10-8. Regional Storm Surge Water Elevations

	Regional Storm Surge Water Elevations (feet, North American Vertical Datum)		
	Point Reyes	Bodega Harbor	Arena Cove
50-percent	7.6	7.6	7.8
20-percent	7.9	7.9	8.2
10-percent	8.2	8.2	8.4
4-percent	8.5	8.5	8.8
2-percent	8.8	8.8	9.0
1-percent	9.1	9.1	9.3
0.2 percent	9.8	9.8	10.1

Source: FEMA Flood Insurance Study Number 06097CV001E, Sonoma County, California and Incorporated Areas, March 7, 2017

10.2.7 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. Wave action has significant velocity, and waves as small as 1.5 feet can cause substantial damage to structures and other development. Table 10-9 summarizes impacts and estimated costs of recent federally declared flood disasters in Sonoma County.

10.2.8 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. Flash flooding is infrequent in the planning area.

As major storm systems approach, the National Weather Service, in coordination with the California Department of Water Resources, monitors weather conditions and real-time precipitation and river stage data; forecasts the amount and timing of expected precipitation; and issues official river forecasts and hydrologic statements. Updated a minimum of twice daily, these river forecasts are available as both text products and as graphical river guidance plots, which provide river stage information for each official forecast point for the next five days following the forecast issuance. As storm events continue with streams and rivers rising to threatening levels, these forecasts may be updated more frequently if needed.

Table 10-9. Damage and Estimated Losses from Recent Floods in Sonoma County

Date	Loss Estimates[a]	Damage
January 8-31, 1995	$21 million	• Over 50 roads closed • 15,000 residents without power • Total displaced persons exceeded 2,000, of which 456 flood victims were evacuated by air • 13 medical cases were treated and 2 flood-related fatalities occurred
March 7-15, 1995	$13.3 million	• Over 100 roads closed • 45,000 residents without power At least 3,000 residents displaced • Up to 30 containers of possible toxic materials identified in the flood zone
December 30, 1996 – January 4, 1997	$31 million	• Up to 200 roads were closed or damaged temporarily 463 homes damaged • 12,000 residents without power • Over 1,200 victims evacuated their residences and 2 storm-related deaths occurred • Sewage and treatment plants overflowed
February 2, 1998	$28 million	• 200 roads were listed as flooded or closed 6,400 residents without power • 250+ homes were inundated • 1,200 residents voluntarily evacuated 4 storm-related deaths
December 30, 2005 – January 3, 2006	$104 million	• Over 100 roads closed due to flooding and landslides Approximately 50,000 county residents without power 2106 properties inundated, 67 declared uninhabitable Unknown number of self-evacuations • Laguna Wastewater Treatment Plant flooded with partially treated sewage spill
December 2014	$1.1 million	• 48 businesses and single-family dwellings damaged along Foss Creek
January – February 2017	$155 million	• 1,900 homes (1,760 with major damage) and 578 businesses damaged by flood waters • Emergency operations center activated
February 2019	$155 million	• 2,000 buildings damaged and 1 fatality • 3,500 evacuated • Emergency operations center activated

a. Dollar amounts in the year of occurrence

Graphical river guidance plots can be accessed at these websites:

- http://www.cnrfc.noaa.gov
- http://cdec.water.ca.gov/guidance_plots/

10.2.9 Secondary Hazards

The most problematic secondary hazard for flooding is bank or coastal erosion. In many cases the threat and effects of erosion are worse than actual flooding. This is especially true on the upper courses of rivers where there are steep gradients. Floodwaters in these reaches may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or drainage sewers.

10.3 EXPOSURE

A quantitative assessment of exposure to the dam failure hazard was conducted using the asset inventory developed for this plan, flood mapping by FEMA for the most recent Sonoma County FIRM (see Figure 10-2), and Sonoma County's mapped flood awareness areas (see Figure 10-3). Detailed results by jurisdiction are included in Appendix D; countywide summaries are provided below.

10.3.1 Population

Table 10-10 summarizes the estimated population living in the evaluated flood hazard areas.

Table 10-10. Exposed Population in Evaluated Flood Hazard Zones

	1% Annual Chance Flood Zone	0.2% Annual Chance Flood Zone	Flood Awareness Areas
Population Exposed	7,768	17,861	7,524
% of Total Planning Area Population	1.6%	3.7%	1.55%

Socially vulnerable populations living in the mapped flood zones were estimated based on data for the Census-defined blocks that lie at least partially within the mapped flood zone. Because many of those Census blocks extend outside the flood zone, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 10-4 summarizes the estimated exposure of socially vulnerable populations.

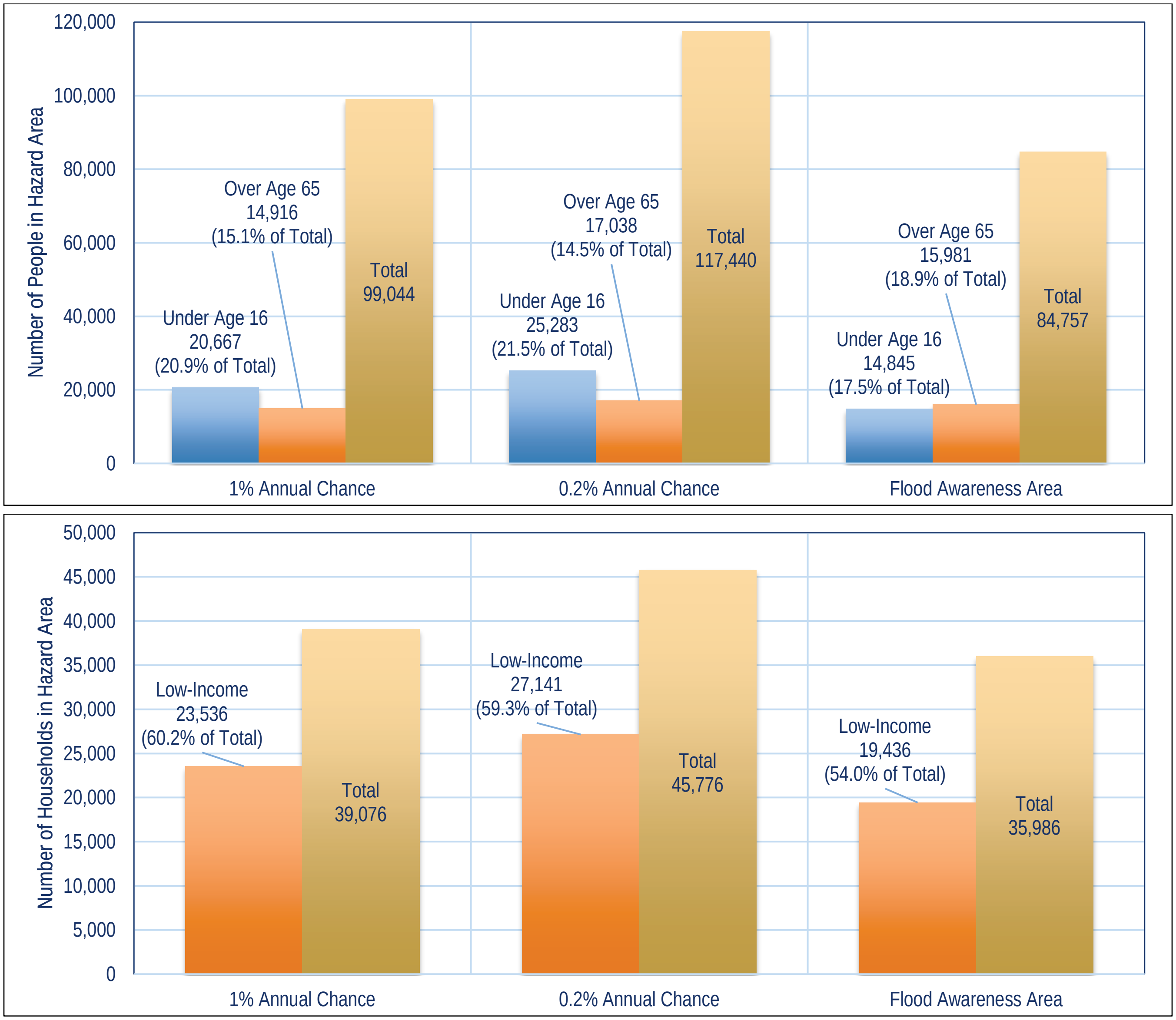
10.3.2 Property

Table 10-11 summarizes the estimated property exposure in the evaluated flood hazard areas. Figure 10-5 shows the occupancy class defined by Hazus for all buildings in the mapped floodplains. These occupancy classes provide an indication of land use within the mapped hazard area. Some land uses are more vulnerable to flood risks, such as single-family homes, while others are less vulnerable, such as agricultural land or parks.

10.3.3 Critical Facilities

The breakdown of critical facility exposure by facility type is shown in Figure 10-6. Critical facilities exposed to the flood hazard represent the following percentages of all critical facilities in the planning area:

- 7.9 percent (377 facilities) of all critical facilities are in the 1-percent-annual-chance flood hazard area.
- 11.6 percent (550 facilities) of all critical facilities are in the 0.2-percent-annual-chance flood hazard area.
- 8.8 percent (418 facilities) of all critical facilities are in the flood awareness area.



See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 10-4. Socially Vulnerable Populations in Flood Zone Census Blocks

Table 10-11. Exposed Property in Evaluated Flood Hazard Zones

	1% Annual Chance Flood Zone	0.2% Annual Chance Flood Zone	Flood Awareness Areas
Acres of inundation area	58,495	64,542	—
Number of Buildings Exposed	4,570	8,416	4,654
Value of Exposed Structures	$6,282,146,827	$9,094,421,934	$5,241,949,336
Value of Exposed Contents	$6,062,349,168	$8,493,127,383	$4,978,042,951
Total Exposed Property Value	$12,344,495,994	$17,587,549,317	$10,219,992,287
Total Exposed Value as % of Planning Area Total	*5.6%*	*8.0%*	*4.68%*

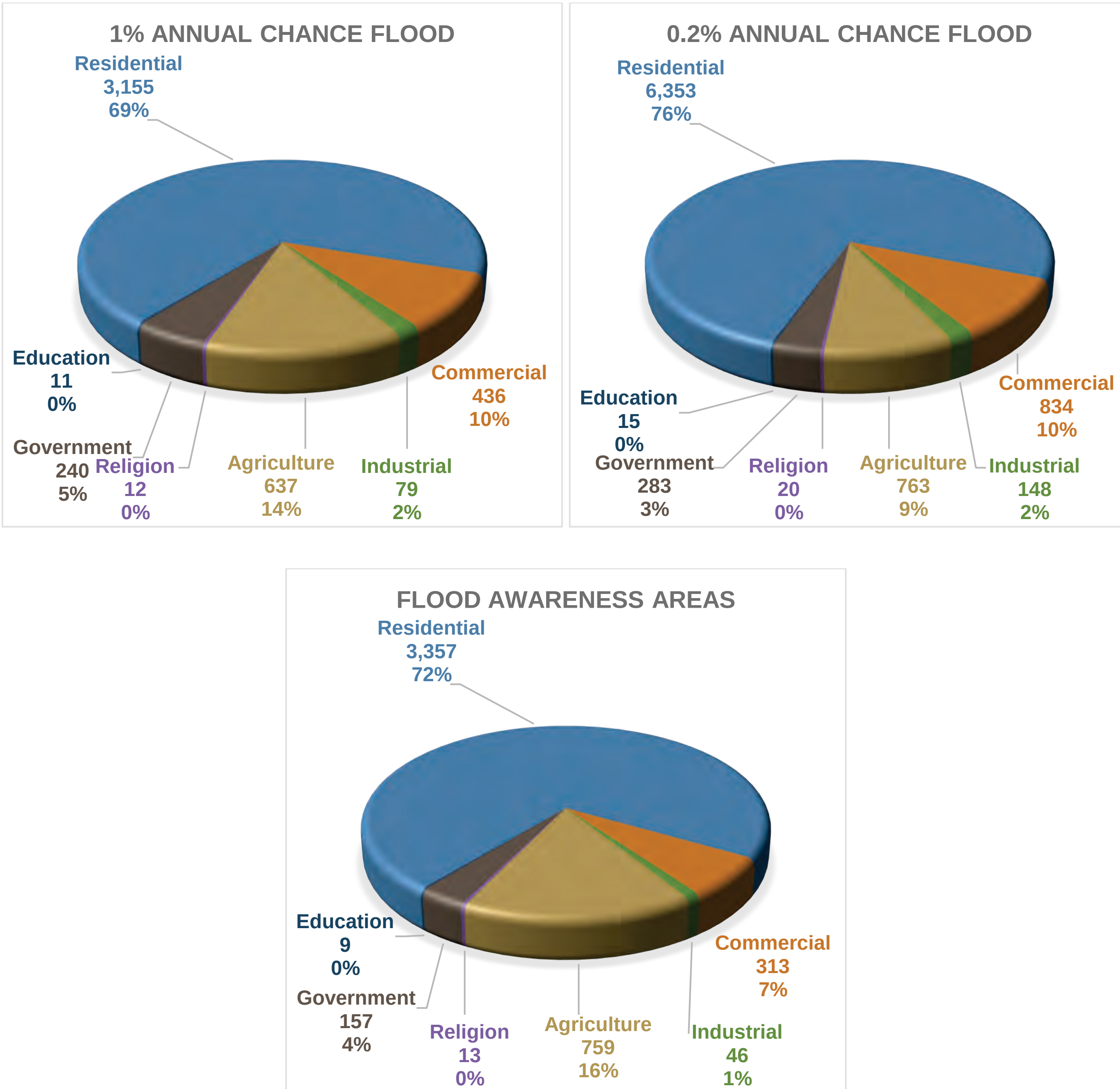


Figure 10-5. Building Occupancy Classes in the Mapped Flood Zones

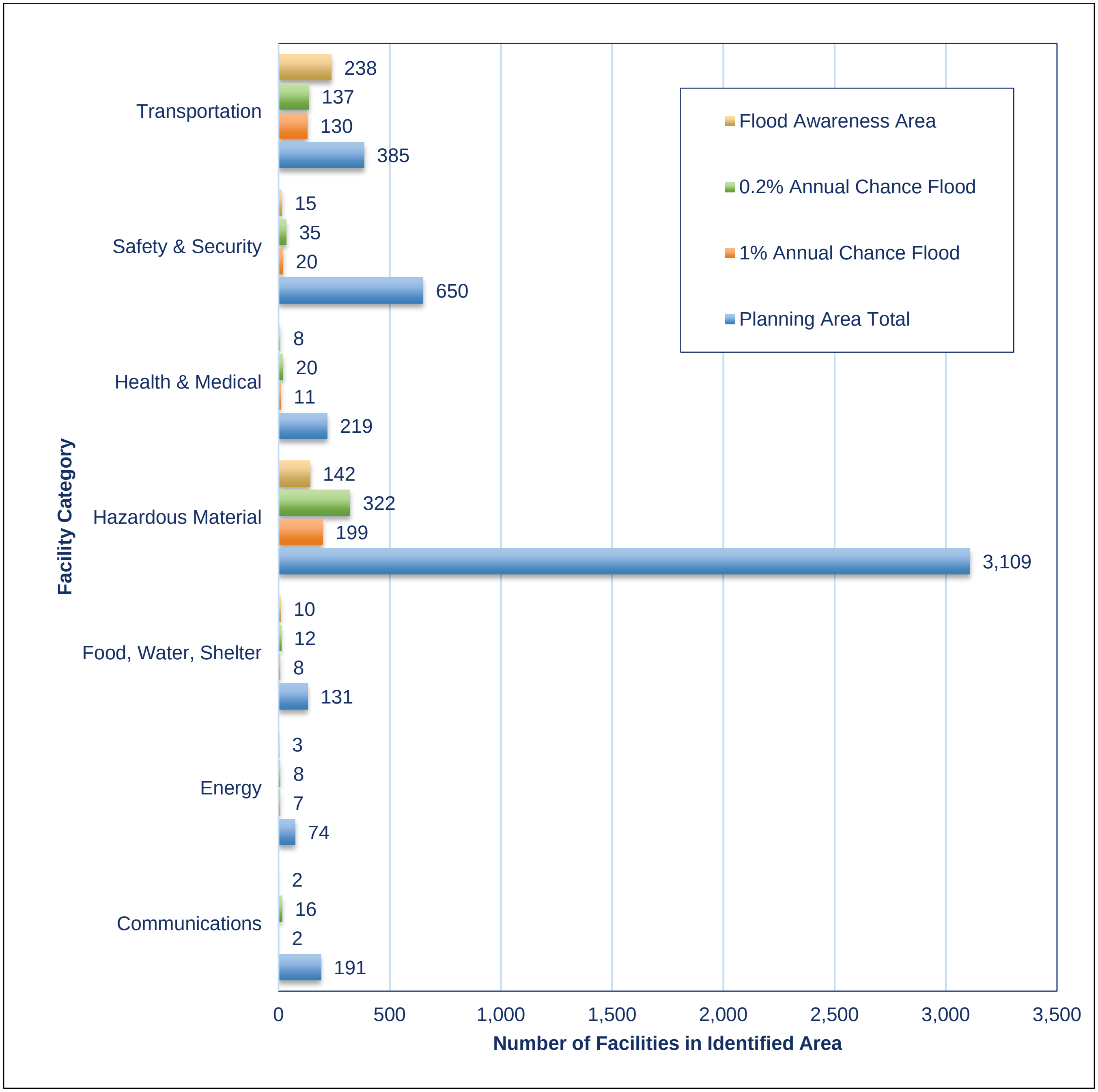


Figure 10-6. Critical Facilities in Mapped Flood Hazard Areas and Countywide

Significant facilities included in the 1 percent annual chance flood zone include the following:

- 4 wastewater treatment facilities
- 199 hazardous material sites
- 5 schools
- 1 airport
- 5 fire stations
- 115 road bridges
- 14 port facilities

All levees line flood-prone rivers and are therefore exposed to the flood hazard. This includes the 29 levees, totaling 50 miles in length, listed in Table 10-2, which have been identified as protecting people and valuable assets from floodwaters.

10.3.4 Environment

Because floodplain management measures place restrictions on development in areas affected by flooding, floodplains often have a higher portion of area that is undeveloped open space or natural area. These undeveloped areas represent environment exposed to the flood hazard.

10.4 VULNERABILITY

The results of the vulnerability assessment indicate estimated damage for the 1-percent and 0.2-percent-annual-chance flood hazards. Detailed results by jurisdiction are included in Appendix D; countywide summaries are provided below.

10.4.1 Population

Impacts on persons and households for evaluated flood events were estimated for each event through the Level 2 Hazus analysis. Table 10-12 summarizes the results.

Table 10-12. Estimated Flood Impacts on Residents

	Displaced Population	Number of Residents Requiring Short Term Shelter
1% Annual Chance Flood Zone	1,684	85
0.2% Annual Chance Flood Zone	4,802	273

10.4.2 Property

Table 10-13 summarizes Hazus estimates of flood damage in the planning area. The debris estimate includes only structural debris and building finishes; it does not include additional debris that may result from a flood event, such as from trees, sediment, building contents, bridges or utility lines.

Table 10-13. Estimated Impact of a Flood Event in the Planning Area

Damage Type	1% Annual Chance Event	0.2% Annual Chance Event
Structure Debris (Tons)	657,111	784,257
Buildings Impacted	3,594	5,264
Total Value (Structure + Contents) Damaged	$3,890,916,991	$4,480,381,334
Damage as % of Total Value	1.8%	2.0%

10.4.3 Critical Facilities

Estimated Damage

Hazus was used to estimate the percent of damage to the building and contents of critical facilities, using depth/damage function curves. The results are summarized in Figure 10-7 and Figure 10-8.

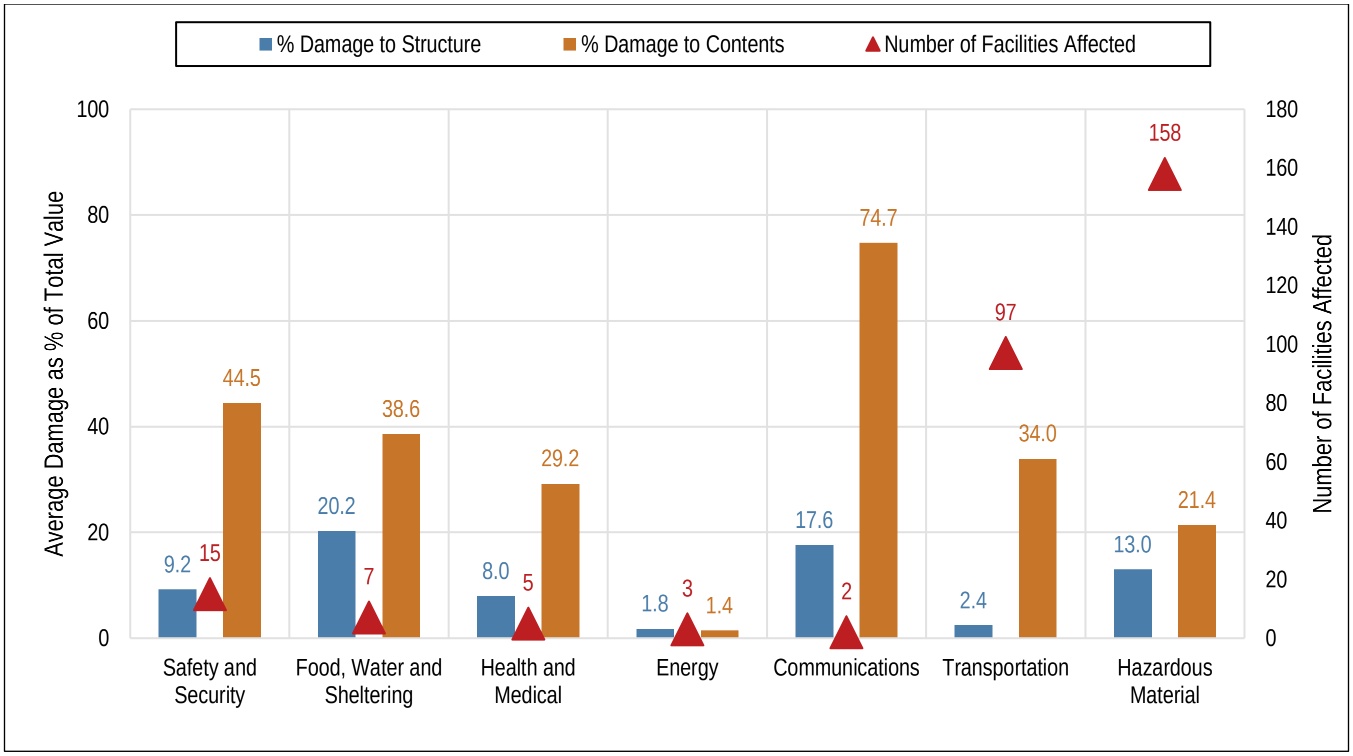


Figure 10-7. Estimated Damage to Critical Facilities from 1% Annual Chance Flood

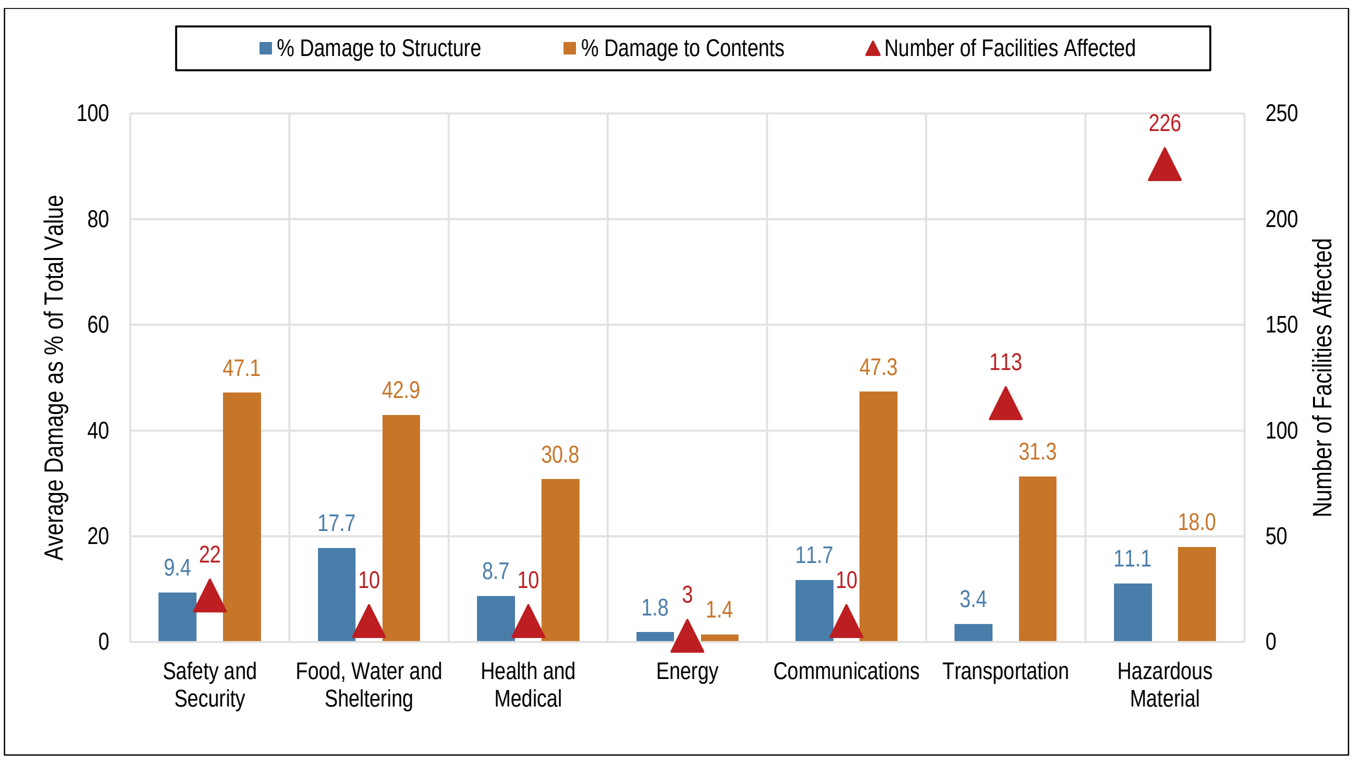


Figure 10-8. Estimated Damage to Critical Facilities from 0.2% Annual Chance Flood

Impacts on Hazardous Materials

During a flood event, containers holding hazardous materials can rupture and leak into the surrounding area. These facilities could release chemicals that cause cancer or other human health effects, significant adverse acute human health effects, or significant adverse environmental effects.

Impacts on Utilities and Infrastructure

Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area, including for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Underground utilities can be damaged. Levees can fail or be overtopped, inundating the land that they protect. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

10.4.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

Loss estimation platforms such as Hazus are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Capturing loss data from future events that segregates damage to the environment could be beneficial in measuring the vulnerability of the environment for future updates.

10.5 FUTURE TRENDS IN DEVELOPMENT

The County and its planning partners are equipped to handle future growth within flood hazard areas. All municipal planning partners have general plans that address frequently flooded areas in their safety elements. All partners have committed to linking their general plans to this hazard mitigation plan update. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas. In addition, partners who are participating in good standing in the NFIP have agreed to regulate new development in the mapped floodplain according to standards that equal or exceed those specified under 44 CFR Section 60.3. This will ensure that any development allowed in the floodplain will be constructed such that the flood risk exposure is eliminated or significantly reduced.

Development in floodplain areas outside of an urban service area is generally constrained by septic requirements. New standards of onsite wastewater treatment (septic) systems became effective in May 2016 pursuant to new regulations adopted by the State Water Resources Control Board. These standards establish a risk-based, tiered approach for the management of septic system installations and replacements. They mandate that these systems meet increasing levels of performance and protection if they are adversely affecting water quality in nearby water bodies. These higher standards may limit development on some parcels in the floodplain. The County Riparian

Corridor Zoning combining district further restricts development in many portions of the floodplain (County of Sonoma 2017).

10.6 SCENARIO

The major river systems in Sonoma County flood at irregular intervals, but generally in response to a succession of intense winter rainstorms. Storm patterns of warm, moist air usually occur between early November and late March. A series of such storms can cause severe flooding in Sonoma County. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time. This would overwhelm city and County response and floodplain management departments. Major roads would be blocked, preventing access for many residents and critical functions. High river flows could cause rivers to scour, possibly washing out roads and creating more isolation problems. In the case of multi-basin flooding, the County would not be able to make repairs quickly enough to restore critical facilities.

10.7 ISSUES

The planning team has identified the following flood-related issues relevant to the planning area:

- Structures in the planning area built before any regulations existed on floodplain development may be particularly vulnerable to the flood hazard.
- The accuracy of the existing flood hazard mapping produced by FEMA in reflecting the true flood risk within the planning area is questionable, especially along the Russian River.
- The extent of the flood-protection currently provided by flood control facilities (dams, dikes and levees) is not known due to the lack of an established national policy on flood protection standards.
- Older levees are subject to failure or do not meet current building practices for flood protection.
- The risk associated with the flood hazard overlaps the risk associated with other hazards such as earthquake, landslide, and severe weather. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- There is no area-wide degree of consistency in land-use and floodplain management practices.
- Climate change may cause more extensive flood problems due to possible sea level rise and more severe weather patterns. The 0.2 percent-annual-chance floodplain inundation area may become a higher probability risk. Coastal flood hazard ratings may also need to be reviewed.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.
- There needs to be a sustained effort to gather historical damage data, such as high-water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- Coordinated hazard mitigation efforts among jurisdictions affected by flood hazards in the county are recommended.
- Floodplain residents should continue to be educated about flood preparedness and the resources available during and after floods.
- The concept of residual risk should be considered in the design of future capital flood control projects and should be communicated with residents living in the floodplain.

- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.
- The economy affects a jurisdiction's ability to manage its floodplains. Budget cuts and personnel losses can strain resources needed to support floodplain management.
- Sonoma County is the State of California largest "repetitive loss" community. Challenges in the acquisition of repetitive loss data from FEMA have made it difficult to acquire data necessary to study the repetitive flood loss problem in depth.

11. LANDSLIDE/MASS MOVEMENT

11.1 GENERAL BACKGROUND

11.1.1 Mass Movement Types

Mass movement is the movement of rock and soil down slope under the influence of gravity. Landslides are the most commonly recognized type of mass movement. Other common mass movement types include the following:

- **Block slides**—Blocks of rock that slide along a slip plane as a unit down a slope.
- **Coastal bluff erosion—**The collapse of coastal bluffs due to undercutting erosive forces of wave action.
- **Creep**—A slow-moving landslide often only noticed through crooked trees and disturbed structures.
- **Debris avalanche**—A debris flow that travels faster than about 10 miles per hour (mph). Speeds in excess of 20 mph are not uncommon, and speeds in excess of 100 mph, although rare, can occur. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars, and anything else in its path.
- **Earth flows**—Fine-grained sediments that flow downhill and typically form a fan structure.
- **Mudslides or Debris Flows**—Rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt.
- **Rock falls**—Blocks of rock that fall away from a bedrock unit without a rotational component.
- **Rock topples**—Blocks of rock that fall away from a bedrock unit with a rotational component.
- **Rotational slumps**—Blocks of fine-grained sediment that rotate and move down slope.
- **Transitional slides**—Sediments that move along a flat surface without a rotational component.

11.1.2 Factors Causing Mass Movements

Mass movements are caused by a combination of geological and climate conditions, as well as encroaching urbanization. Vulnerable areas are affected by residential, agricultural, commercial, and industrial development and the infrastructure that supports it.

Factors causing mass movements fall into two categories:

- Factors that increase driving forces:
  - ➢ Steepening the slope
  - ➢ Adding weight to (loading) the slope, especially the upper parts

  - Increasing the height of a slope (either by human or natural downcutting)
  - Seismic shaking
- Factors that reduce resisting forces:
  - Adding water to the slope, which causes increased pore pressure, which reduces frictional strength
  - Steepening the slope, which reduces normal stress, and thus reduces internal friction
  - Bedding, jointing, or foliation parallel to slope or dipping out of slope—these discontinuities are low-strength zones along which the rock can fail and slide out of the slope
  - Intrinsically weak materials (e.g., deeply weathered, sheared, unconsolidated, or clay-rich materials)
  - Undercutting the slope, which reduces support
  - Removing vegetation, especially trees, which reduces root strength and leads to increased water in soil due to reduced evaporation losses
  - Seismic shaking
  - Coastal bluff erosion caused by wave action

11.2 HAZARD PROFILE

11.2.1 Past Events

Table 11-1 lists the known damage-causing mass movements that have occurred in the county. The following sections describe specific past significant events.

Table 11-1. Landslide/Mass Movement Events in Sonoma County

Dates of Event	Primary Event Type	FEMA Disaster #	Losses/Impacts
February 24 – March 1, 2019	Severe Winter Storms, Flooding, Landslides, and Mudslides	4434	
February 1 – 23, 2017	Severe Winter Storms, Flooding, Mudslides	4308	
January 3 – 12, 2017	Severe Winter Storms, Flooding, and Mudslides	4301	
December 23, 2012	Debris Flow		Mudslides closed Annapolis Road for several hours, east of Highway 1. $1,000 in property damage
December 5, 2012	Debris Flow		Highway 1 was closed north of Jenner due to a significant mud and rockslide blocking the lanes of the road. $15,000 in property damage.
March 29 – April 16, 2006	Severe Storms, Flooding, Landslides, and Mudslides	1646	
December 17, 2005 – January 3, 2006	Severe Storms, Flooding, Mudslides, and Landslides	1628	

Sources: FEMA 2020, National Centers for Environmental Information Storm Events Database, 2020

April 2006

One of the most recent and most destructive mass movements in Sonoma County occurred in April 2006. Persistent heavy rainfall caused a massive number of landslides across the Sonoma and Marin County valleys area during the first half of April. About $20 million of damage was done to agriculture, with over $9 million spent in road repair damage in Sonoma County alone. Over $5 million worth of damage was done to single family dwellings in Sonoma - with lesser (but still substantial) amounts of damage experienced to businesses and public buildings. In Marin County the hardest hit areas were Mill Valley, Fairfax, and San Rafael. In Mill Valley, a man was killed after he was buried in a mudslide in his backyard.

January – March 1998

Another example of Sonoma County's landslide risk occurred during the El Niño winter storms of January 6 – 7, 1998, in the community of Rio Nido. The upper portion of the slide consisted of a large rotational block failure that occurred near the top of the ridge, approximately 600 feet above the elevation of the canyon floor. Two debris flow failures, which are characterized by fluid and high speed downhill flows, were initiated from the face of the block. The southern debris flow traveled 1,500 feet down a narrow ravine, causing the destruction of three homes and damaging four others in Upper Canyon Three. The northern debris flow traveled down an adjacent drainage ravine north of the homes and came to rest within a long-jam 15 to 20 feet high, located about 800 feet from the canyon floor. Additional debris flows occurred in the same area on February 21 and March 12, 1998 as a result of additional moderate rainfall.

Residents were evacuated until the stability of the slides could be determined. Geologic studies were performed and movement of the slides monitored for years. Evacuation zones maps were periodically revised and residents gradually permitted to return to some areas. Other damaging slides occurred in the communities of Monte Rio, Gold Ridge, Hidden Acres, Blucher Valley, Fitch Mountain, and the coastal community of Gleason's Beach.

The widespread damage caused across the state by these storms prompted FEMA and Cal OES to initiate the first federally funded landslide acquisition program. The program was designed to permanently remove the properties destroyed, damaged, or still at risk from the landslides. Sonoma County received funds for the acquisition of 45 properties in the four communities that suffered the greatest damage.

11.2.2 Location

Dormant Sites of Previous Mass Movements

One of the best predictors of where mass movements might occur is the location of past landslides, which can be recognized by distinctive topographic shapes that can remain in place for thousands of years. Such sites range from a few acres to several square miles. Many show no evidence of recent movement and are not currently active. A few may become active in any given year. The recognition of ancient dormant landslide sites is important in the identification of areas susceptible to landslides because they can be reactivated by earthquakes or by exceptionally wet weather. These dormant sites are also vulnerable to construction-triggered sliding. The shoreline contains many large, deep-seated dormant landslides.

Landslide Susceptibility Mapping

In 2011, the California Geological Survey conducted a statewide analysis using a combination of regional rock strength and slope data to create classes of susceptibility to deep-seated landslides. The analysis assumed, in general, that susceptibility to deep-seated landslides is low on very low slopes in all rock materials and increases with slope and in weak rocks. The analysis also factored in locations of past landslides. Figure 11-1 shows deep-seated landslide susceptibility classes (none, low, moderate, high, and very high).

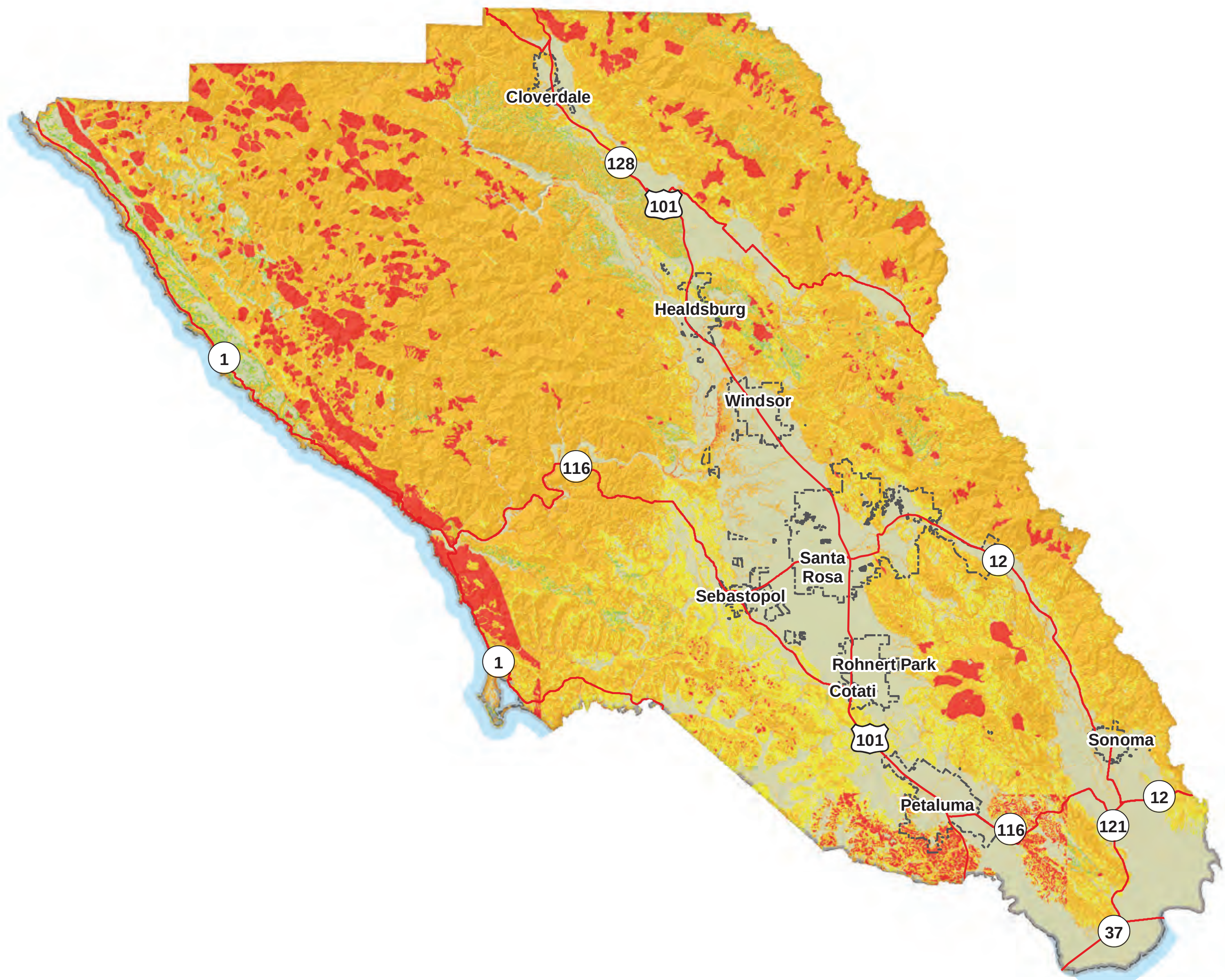


Figure 11-1. Susceptibility to Deep-Seated Landslides

low
moderate
high
very high
Cities
County Boundary
Highways

N
0 5 10 Miles

Data Sources: Sonoma Co., CGS

11.2.3 Frequency

Mass movements are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires, so their frequency is often related to the frequency of the precipitating hazards. In Sonoma County, landslides typically occur during and after severe storms, so the potential for landslides largely coincides with the potential for sequential severe storms that saturate steep, vulnerable soils. Most weather-induced landslides in the county occur in the winter after the water table has risen. Landslides that result from earthquakes can occur at any time.

The probability of a landslide event occurring in the county in any given year is high. Approximately 50 landslides occur each winter that block county roads (County of Sonoma 2017). Table 11-1 lists five landslide events in the county for which federal disaster declarations were issued between 2006 and 2019, an average of one such major event every three years.

11.2.4 Severity

Mass movements destroy property and infrastructure and can claim human lives. They have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. Slope failures in the United States result in an average of 25 to 50 lives lost per year (USGS, 2020). Movements can pose a serious hazard to properties on or below hillsides. They can cause block access to roads, which can isolate residents and businesses and delay commercial, public and private transportation. This can result in economic losses for businesses. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Mass movements also can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat.

Landslides along the county’s coastline, in conjunction with wave action, have resulted in seawall failure, severe erosion, cliff failure, and loss of bluff top area that threatens development. Lots have been significantly reduced in size in the last 25 years, and several houses have been damaged to the extent that they are no longer habitable. Poor road design and construction can contribute to landslide hazards through side-casting on sloping lands, over steepened cut slopes and inadequate drainage facilities (County of Sonoma 2017).

11.2.5 Warning Time

The velocity of landslides ranges from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor landslides can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include the following:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities

- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

11.2.6 Secondary Hazards

Mass movements are not generally known to result in secondary hazards. A landslide that blocks a river or stream does have the potential to cause flooding.

11.3 EXPOSURE

A quantitative assessment of exposure to the mass movement/landslide hazard was conducted using the landslide hazard mapping and the asset inventory developed for this plan, with an emphasis on the zones with the highest degree of susceptibility (Zones V through X). Detailed results by jurisdiction are provided in Appendix D. Results for the whole planning area are presented in the sections below.

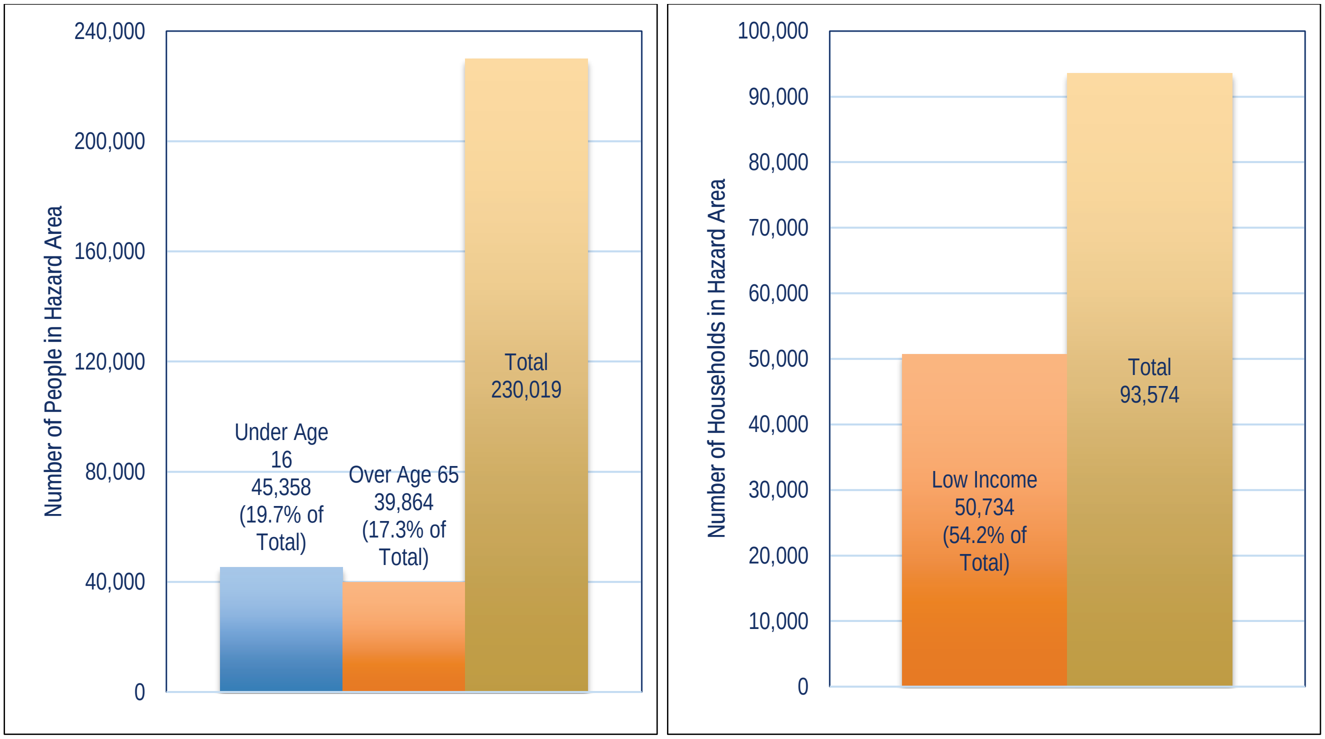
11.3.1 Population

Population exposure was estimated by calculating the number of buildings in each hazard area as a percent of total planning area buildings, and then applying this percentage to the estimated planning area population. Table 11-2 summarizes the estimated countywide population living in the mapped landslide risk areas.

Table 11-2. Exposed Population in Mapped Landslide Hazard Zones

	Moderate Landslide Risk (Susceptibility Categories V and VI)	High Landslide Risk (Susceptibility Categories VII, VIII, IX)	Very High Landslide Risk (Susceptibility Category X; Includes existing landslides)
Population Exposed	54,240	51,796	6,919
% of Total Planning Area Population	11.2%	10.7%	1.4%

Socially vulnerable populations exposed to the landslide hazard were estimated based on data for the Census-defined blocks that lie at least partially within the mapped high and very high landslide hazard zones. Because many of those Census blocks extend outside the mapped hazard zones, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 11-2 summarizes the estimated exposure of socially vulnerable populations.



See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 11-2. Socially Vulnerable Populations in High and Very High Landslide Risk Zones Census Blocks

11.3.2 Property

Table 11-3 summarizes the estimated property exposure in the evaluated landslide hazard areas. Figure 11-3 shows the occupancy class defined by Hazus for all buildings in the mapped landslide hazard areas. These occupancy classes provide an indication of land use within the mapped hazard area. Some land uses are more vulnerable to landslides, such as single-family homes, while others are less vulnerable, such as agricultural land or parks.

Table 11-3. Exposed Property in Mapped Landslide Hazard Zones

	Moderate Landslide Risk (Susceptibility Categories V and VI)	High Landslide Risk (Susceptibility Categories VII, VIII, IX)	Very High Landslide Risk (Susceptibility Category X; Includes existing landslides)
Number of Buildings Exposed	21,473	24,283	3,173
Value of Exposed Structures	$16,099,740,155	$27,506,743,592	$3,361,526,190
Value of Exposed Contents	$12,591,969,732	$24,546,419,412	$2,936,809,711
Total Exposed Property Value	$28,691,709,887	$52,053,163,004	$6,298,335,902
Total Exposed Value as % of Planning Area Total	*13.1%*	*23.8%*	*2.9%*

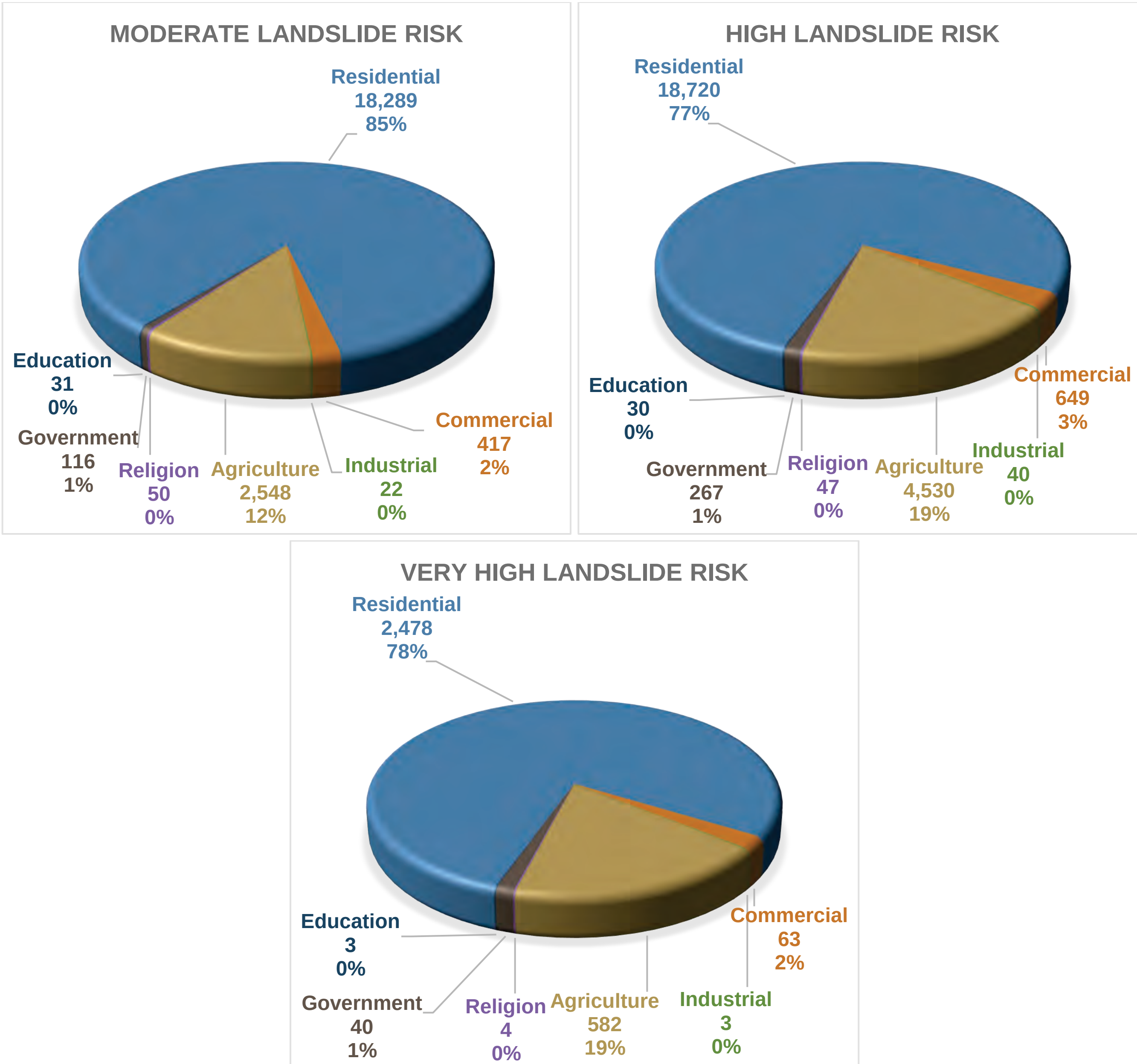


Figure 11-3. Building Occupancy Classes in the Mapped Landslide Hazard Zones

11.3.3 Critical Facilities

The breakdown of exposure of critical facilities by susceptibility class and facility type is shown in Figure 11-4.

11.3.4 Environment

All natural areas within the high susceptibility zones for landslide are considered to be exposed to the hazard.

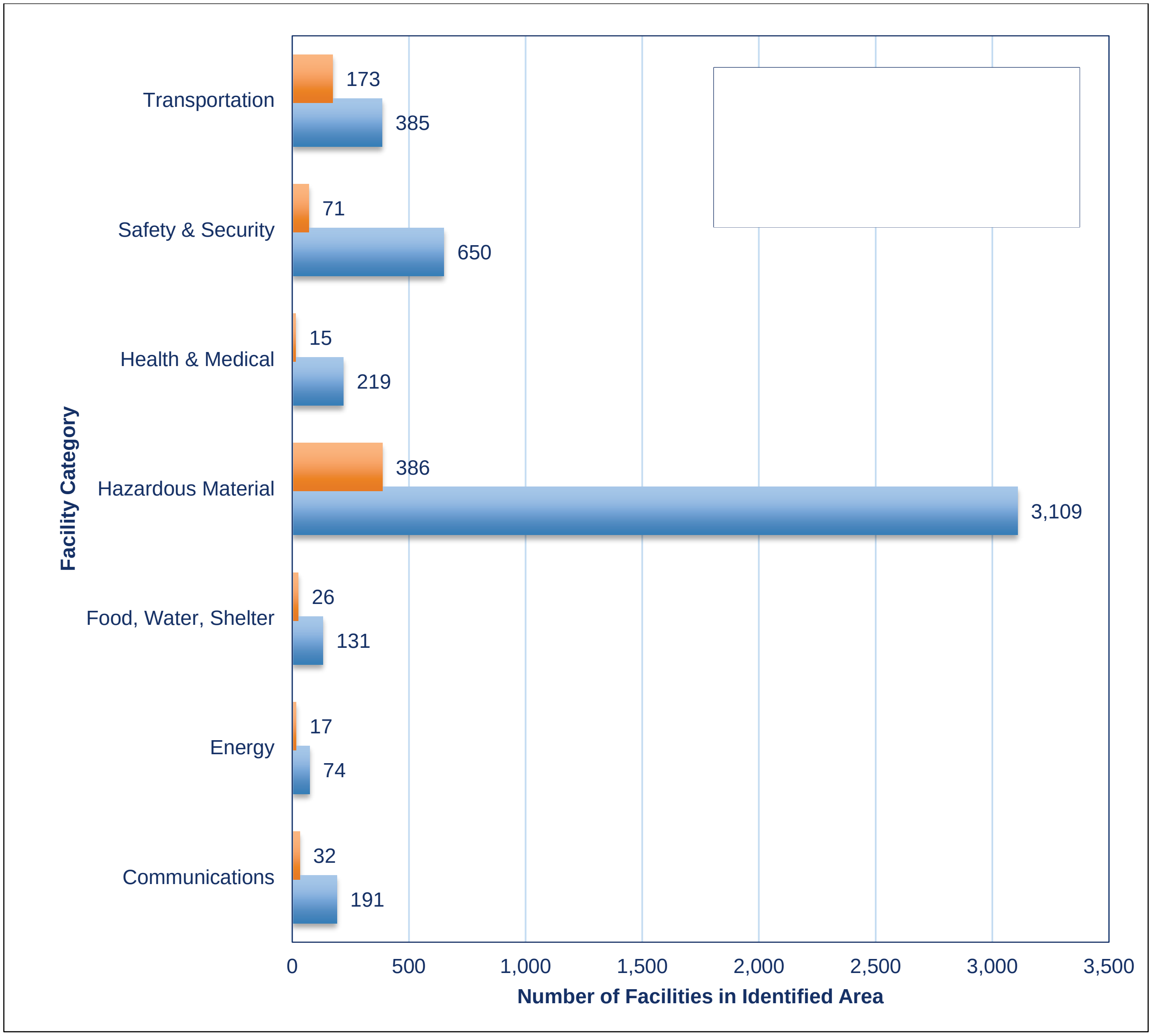


Figure 11-4. Critical Facilities in Mapped Landslide Susceptibility Classes and Countywide

11.4 VULNERABILITY

Vulnerability estimates for the landslide hazard are described qualitatively. No loss estimation of these facilities was performed because damage functions have not been established for the landslide hazard.

11.4.1 Population

All people exposed the landslide hazard are potentially vulnerable to landslide impacts. Populations with access and functional needs as well as elderly populations and the very young are more vulnerable to the landslide hazards as they may not be able to evacuate quickly enough to avoid the impacts of a landslide.

11.4.2 Property

Loss estimations for the landslide hazard are not based on modeling utilizing damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 1, 10, 30, and 50 percent of the replacement value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 11-4 shows potential losses in the areas with the highest degree of landslide susceptibility.

Table 11-4. Loss Estimation for Mass Movement

	Exposed Value	Loss Value	Loss as % of Total Planning Area Replacement Value
Moderate Landslide Susceptibility Zone			
Loss = 1% of Exposed Value	$28.7 billion	$287 million	less than 1%
Loss = 10% of Exposed Value		$2.9 billion	1.3%
Loss = 30% of Exposed Value		$8.7 billion	3.9%
Loss = 50% of Exposed Value		$14.4 billion	6.6%
High Landslide Susceptibility Zone			
Loss = 1% of Exposed Value	$52.0 billion	$520 million	less than 1%
Loss = 10% of Exposed Value		$5.2 billion	2.4%
Loss = 30% of Exposed Value		$15.6 billion	7.1%
Loss = 50% of Exposed Value		$26.0 billion	11.9%
Very High Landslide Susceptibility Zone			
Loss = 1% of Exposed Value	$6.3 billion	$63 million	less than 1%
Loss = 10% of Exposed Value		$630 million	less than 1%
Loss = 30% of Exposed Value		$1.9 billion	less than 1%
Loss = 50% of Exposed Value		$3.2 billion	1.5%

11.4.3 Critical Facilities

Highly susceptible areas of the county include mountain and coastal roads and transportation infrastructure. At this time all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available. A more in-depth analysis of the mitigation measures taken by landslide-exposed critical facilities to prevent damage from landslides should be done to determine if they could withstand impacts of a mass movement.

11.4.4 Environment

Natural Resources

Landslides can destroy natural assets that are highly valued by the community:

- Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality.
- Hillsides that provide wildlife habitat can be lost due to landslides.
- Endangered species and their critical habitat in the planning area may be located in landslide hazard areas.

Agricultural and Timber Resources

Agricultural resources include rangelands, timberlands, cultivated farmlands and dairy lands. Landslides can have major consequences to such resources, primarily timberland, due to the large percentage of such land in remote locations on steep slopes. Roads accessing timberlands are often susceptible to slides and frequently are contributing factors to landslides. Mass movement activity on these roads can remove them from production.

Cultural Resources

Many cultural sites are at risk from landslides, which can destroy artifacts and structures.

Scenic Resources

Sonoma County features a broad range of scenic resources, including the coastline and Pacific Ocean, mountains, hills, ridgelines, inland water features, forests, agricultural features, and distinctive rural communities. Many of these resources or access routes to them are vulnerable to landslides.

11.5 FUTURE TRENDS IN DEVELOPMENT

Land use controls (such as prohibiting development on unstable soils or steep slopes) are the most cost effective way to prevent loss of life and property. The County and its planning partners are equipped to handle future growth within landslide hazard areas. All municipal planning partners have general plans that address landslide risk areas in their safety elements. All partners have committed to linking their general plans to this hazard mitigation plan update. This will create an opportunity for wise land use decisions as future growth impacts landslide hazard areas.

The California Building Standards Code has adopted the International Building Code (IBC) by reference. The IBC includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions assure that new construction is built to standards that reduce the vulnerability to landslide risk. Building construction and grading activities are subject to County code that require a geotechnical report or slope stability analysis under specific slope conditions. The County requires a site evaluation prior to building plan check. Geologic maps are reviewed during the site evaluation and where building or grading is proposed in areas mapped with landslides, expansive soils, liquefaction potential, or fault rupture hazards, a geotechnical report is required and design mitigations identified.

11.6 SCENARIO

Major landslides in Sonoma County occur as a result of soil conditions that have been affected by severe storms, groundwater or human development. Landslides are most likely during late winter when the water table is high. After heavy rains, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm with heavy rain and flooding and/or high ocean waves, followed by a damaging earthquake. An earthquake that occurs when water tables are high and soils are saturated has the potential to trigger a significant number of landslides in the planning area.

11.7 ISSUES

Important issues associated with landslides in the planning area include the following:

- An accurate picture of where landslides occurred during previous storms is vital in making intelligent land use planning and mitigation decisions.
- Landslides may result in isolation of neighborhoods and communities, due to the fact that large portions of the transportation infrastructure are in areas of high and moderate slope instability. Isolation may result in food shortages, loss of power, and severely reduced economic productivity.
- There are critical facilities in areas of unstable slopes that could result in interruption to utility services, particularly water and power. This creates a need for mitigation and for continuity of operations planning to develop procedures for providing services without access to essential facilities.
- Landslides may result in loss of water quality to the environment and for drinking purposes, due to increased sediment delivery into surface waterways.
- There are existing homes in landslide hazard areas throughout the planning area. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- The impact of climate change on landslides is uncertain. If climate change impacts the timing and intensity of rain event, then the frequency of landslide events may increase.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- California’s Disclosures in Real Property Transactions law requires disclosure if a property is in a landslide hazard area. Such disclosure is dependent upon knowledge by the seller or the seller’s real estate agent or the posting of a landslide hazard map at the offices of the County recorder, County assessor, and County planning agency and a notice identifying the location of the map and any changes to it.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- Coastal bluff erosion is particularly susceptible to ocean wave height and the direction of wave approach. El Niño conditions often result in substantial increases in the of coastal bluff retreat. Roads and residential developments are most exposed to these hazards.

12. SEA LEVEL RISE

12.1 GENERAL BACKGROUND

In the past century, global mean sea level has increased by 7 to 8 inches. The two major causes of global sea level rise are thermal expansion of warming oceans and the melting of land-based glaciers and polar ice caps. Given current trends in greenhouse gas emissions and increasing global temperatures, sea level rise is expected to accelerate in the coming decades, with scientists projecting as much as a 66-inch increase in sea level along segments of California's coast by 2100. While over the next few decades, the most damaging events are likely to be dominated by large El Niño - driven storm events in combination with high tides and large waves, impacts will generally become more frequent and more severe in the latter half of this century (California Coastal Commission 2019).

Approximately 85 percent of California's population live and work in coastal counties. The sea level along California's coasts has risen nearly 8 inches in the past century and is projected to rise by as much as 20 to 55 inches by the end of the century. A 55-inch sea level rise could put nearly half a million people at risk of flooding by 2100, and threaten $100 billion in property and infrastructure, including roadways, buildings, hazardous waste sites, power plants, and parks and tourist destinations. Coastal erosion could have a significant impact on California's ocean-dependent economy, which is estimated to be $46 billion per year.

As sea levels rise, saltwater contamination of the State's delta and levee systems will increase. Saltwater contamination of the Sacramento/San Joaquin Delta will threaten wildlife and the source of drinking water for 20 million Californians. Farmland in low areas may also be harmed by salt-contaminated water (California Office of the Attorney General 2021). The third National Climate Assessment cites strong evidence showing that the cost of doing nothing exceeds the costs associated with adapting to sea level rise by 4 to 10 times.

12.2 HAZARD PROFILE

Sonoma County's ocean coast regularly experiences erosion, flooding, and significant storm events, and sea level rise would exacerbate these processes. Sea level at the San Francisco tide gauge has risen 8 inches over the past century, and the National Research Council projects that by 2100 sea level in California south of Cape Mendocino may rise 66 inches. It is critically important that Sonoma County plan and prepare to adapt to sea level rise to ensure public resources and coastal communities are resilient for present and future generations. Future development considerations should include future vulnerabilities to sea level rise and corresponding habitat migration (County of Sonoma, 2019).

The 2018 report *Conserving California's Coastal Habitats: A Legacy and a Future with Sea Level Rise* identifies numerous potential impacts of sea level rise on coastal and bay land natural resources and natural protections in Sonoma County (Heady et al. 2018):

- As sea levels rise, coastal habitats may be squeezed into an ever-shrinking area between rising seas and human development and infrastructure. Coastal habitats are at risk of being submerged, and their associated species will be lost without immediate conservation and management actions to give them the space and ability to move inland.
- Natural land and open space may become inundated, including important undeveloped areas that serve as protection of developed areas from flooding.
- Higher seas will mean a higher reach for storm surge, which will increase coastal flooding.
- Saltwater intrusion into surface and groundwater aquifers will push further and further inland, potentially altering natural habitat communities and impacting agricultural practices.
- Currently protected and conserved coastal areas in California and their habitat value, which represents a real and substantial investment for the future, may be impacted or lost.

The report highlights recommendations to conserve California's coastal habitats in the face of rising sea levels by maintaining resilient conservation lands, conserving resilient landscapes, and managing in place for resilience.

12.2.1 Previous Assessments

Sonoma County Local Coastal Plan

First mandated in 1979 by the California Coastal Act, the *Sonoma County Local Coastal Plan* is an important planning document in managing the conservation and development of the county's coastal regions. The current Local Coastal Plan was written in 1981 and amended in 2001. The County is currently in the process of updating the plan. General findings of the plan are as follows (County of Sonoma 2019):

- Rising seas increase the risk of coastal flooding, storm surge inundation, bluff and coastal erosion, shoreline retreat, saltwater intrusion, and wetland loss or migration.
- The net result of coastal storms and sea level rise is coastline retreat, ranging from a few centimeters per year for bluffs made of resistant bedrock to several meters for beaches and dunes. These rates of coastline retreat will increase with rising sea levels and are likely to further increase if waves become higher.
- The impacts of sea level rise will vary according to local factors such as shoreline characteristics and topography, the location and extent of development, and local drainage and wind patterns.
- Sea level rise will result in more frequent flooding and gradual inundation, as well as increased bluff, dune, and shoreline erosion. This flooding and erosion will affect transportation facilities, utility systems, storm water systems, ports and harbors, large wetland areas, and coastal development (i.e., homes and businesses).

Bodega Bay Vulnerability Assessment, Sonoma County Local Coastal Plan

Sonoma County's *Bodega Bay Focused Sea Level Rise Vulnerability Assessment and Adaptation Strategies* is an appendix to that Local Coastal Plan that focuses on Bodega Bay, the coastal community most at risk from the impacts of sea level rise. The Bodega Bay vulnerability assessment identifies coastal areas and assets in Bodega Bay exposed to sea level rise and storm events. It analyzes the location and extent of assets projected to be inundated by sea level rise and flooded by storm events and assesses the impacts of inundation and flooding. The assessment also identifies potential adaptation measures to minimize the risks and impacts of inundation and flooding. The sea level rise and storm scenarios used in the analysis are based California sea level rise projections adopted by the National Research Council in 2012 and the Our Coast Our Future website. The assessment selected five sea level rise and storm scenarios that cover a full range of impact to affected coastal communities by the end of the century. Its findings by area are as follows (Permit Sonoma 2017):

- The northern section of Bodega Bay—the Bodega Harbor area—contains all the marinas, the only rural residential development, and the largest area of urban residential development in the Bodega Bay study area. By 2100 under the worst-case scenario, permanent inundation from sea level rise would affect 59 to 99 percent of marinas; 28 to 76 percent of County roads; 53 percent of a coastal wetland, and up to 14 percent of residential areas.
- The eastern section of Bodega Bay—the Highway 1 area—contains all the commercial development and the only public utility (Bodega Bay PUD Wastewater Treatment Plant) in the Bodega Bay study area. By 2100 under the worst case scenario, permanent inundation from sea level rise would affect 9 to 70 percent of commercial areas, 51 percent of the Bodega Harbour Yacht Club, 13 to 22 percent of residential areas, and 2 percent of a public access and recreation area.
- The southern section of Bodega Bay—the County Regional Parks Area—contains the only County parks (Westside and Doran Beach Regional Parks) and institutional development (U.C. Davis Bodega Marine Laboratory) in the Bodega Bay study area. By 2100 under the worst case scenario, permanent inundation from sea level rise would affect 20 to 73 percent of coastal wetlands, almost 100 percent of Westside Regional Park and 36 percent of Doran Beach Regional Park, 26 to 39 percent of County roads, and 23 percent of the Links at Bodega Harbor Golf Course.

12.2.2 Location

Sea level rise is likely to affect all coastal areas of Sonoma County. The habitats fringing a coastline attenuate waves and thus reduce storm-related damage to shorelines from erosion and inundation. North of the Russian River mouth to the northern extent of Sonoma County, kelp forest habitat backed by rocky cliffs dominate the landscape and are generally low exposure. In contrast, south of the Russian River mouth, a greater diversity of habitats (e.g., wetlands, beaches, dune systems) are present and are habitats that are highly exposed to erosion and inundation during storms compared to north of the river mouth. As coastal development and rising sea levels alter or damage these habitats, coastlines and nearby infrastructure become increasingly vulnerable to storms (County of Sonoma 2019).

The USGS’s Coastal Storm Modeling System sea level rise data were used in the risk assessment for this hazard mitigation plan. The data indicate sea-level rise inundation areas for a sea-level rise of 200 centimeters with and without a 100-year storm event. The mapped inundation areas for these two scenarios (200-cm SLR and 200-cm SLR + 100-Yr) are shown on Figure 12-1 and Figure 12-2.

12.2.3 Frequency

Sea level rise is an ongoing phenomenon that will likely impact the frequency and severity of coastal storms. Storms and flooding in California typically occur during the winter from November to April and are influenced by several climate patterns, most prominently the El Niño Southern Oscillation. Every two to seven years, the Southern Oscillation alternates between two phases—La Niña and El Niño. El Niño years generally result in persistently low air pressure, greater rainfall, and high winds. The water levels reached during these large, short-term events have exceeded mean sea levels projected for 2100, so understanding their additive effects is crucial for coastal planning (County of Sonoma 2019).

Figure 12-1. Estimated Inundation Area for 200-Centimeter Sea Level Rise with No Storm

Data Sources: Sonoma Co., OCOF

Figure 12-2. Estimated Inundation Area for 200-Centimeter Sea Level Rise with a 100-Year Storm Event

Low air pressure during a storm causes an immediate rise in sea level above predicted tides, referred to as storm surge. It also increases wind activity, generating erosive waves on top of the already high sea level. This combination of factors during an El Niño event can cause widespread damage in coastal areas. As sea level rises, flooding from storms will become more frequent and potentially more hazardous (County of Sonoma 2019).

Severity

Models projecting sea level rise provide a range of severity scenarios based on assumptions about the rate of climate change. One medium-rate sea level rise scenario for Sonoma County predicts increases from the 1992 baseline sea level as shown in Figure 12-3. While Sonoma County's ocean coast regularly experiences erosion, flooding, and significant storm events, sea level rise would exacerbate these natural processes and lead to significant social, environmental, and economic impacts. The third National Climate Assessment cites strong evidence showing that the cost of doing nothing exceeds the costs associated with adapting to sea level rise by 4 to 10 times (County of Sonoma 2019).

Source: Climate Central, 2021

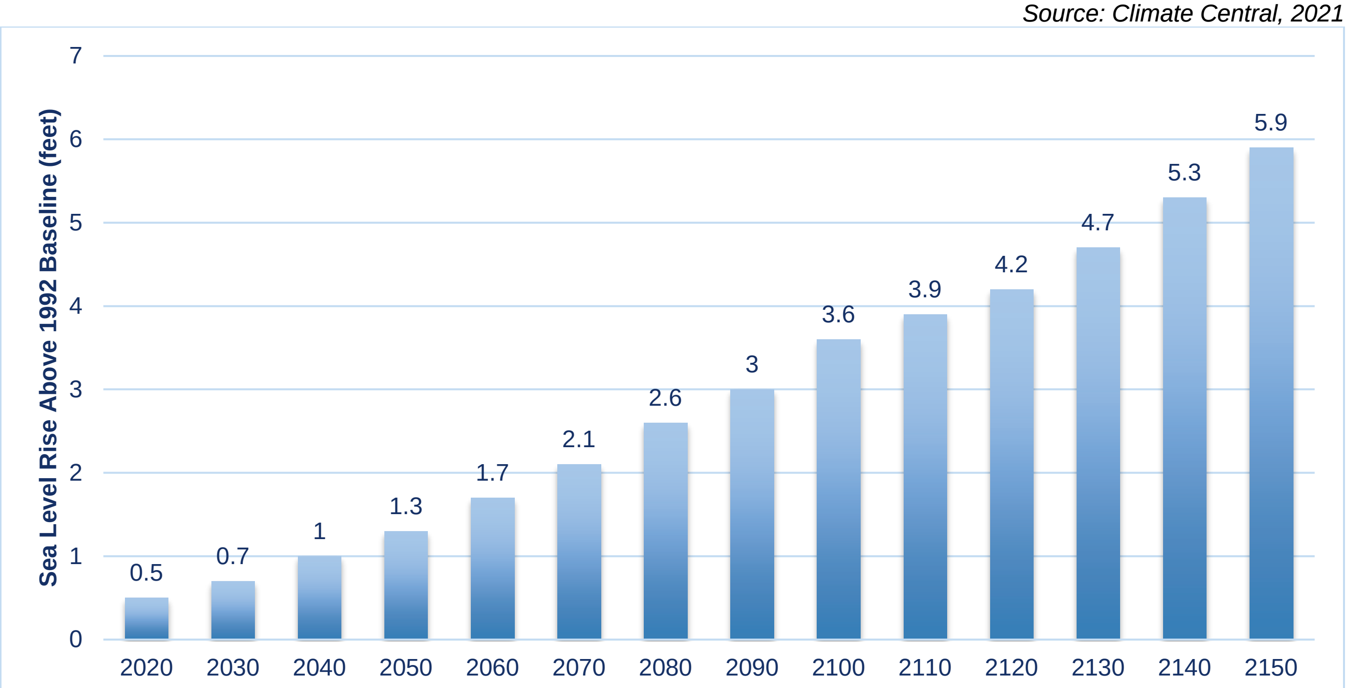


Figure 12-3. Medium Projection for Sonoma County Sea Level Rise Above 1992 Baseline

12.3 EXPOSURE

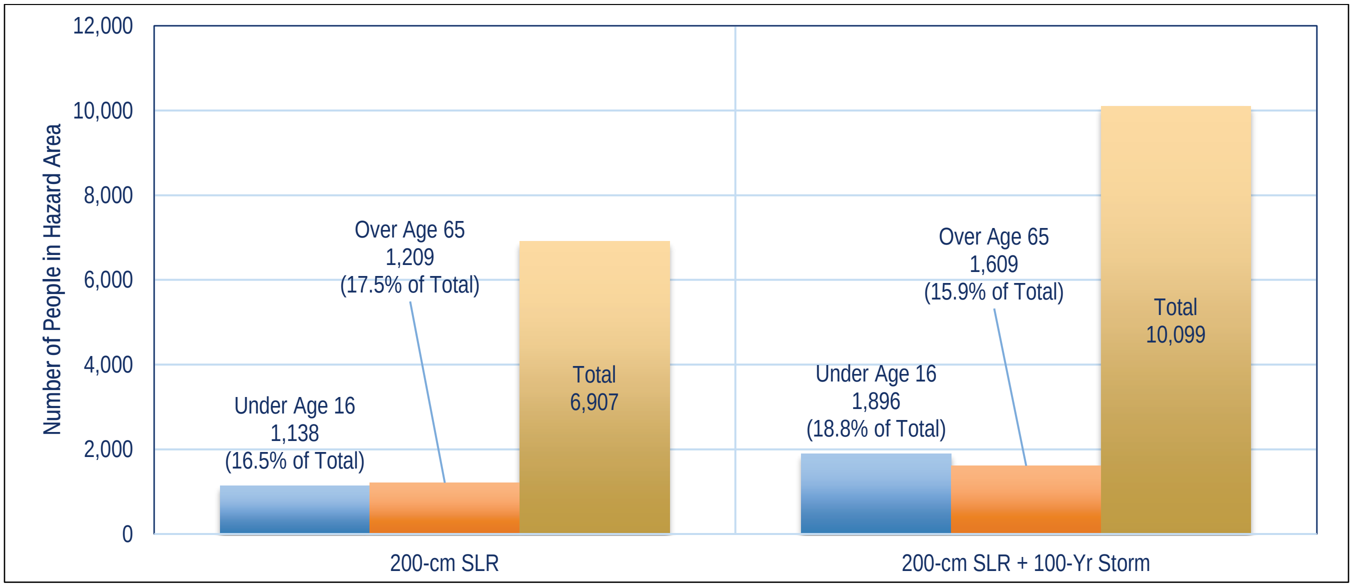
12.3.1 Population

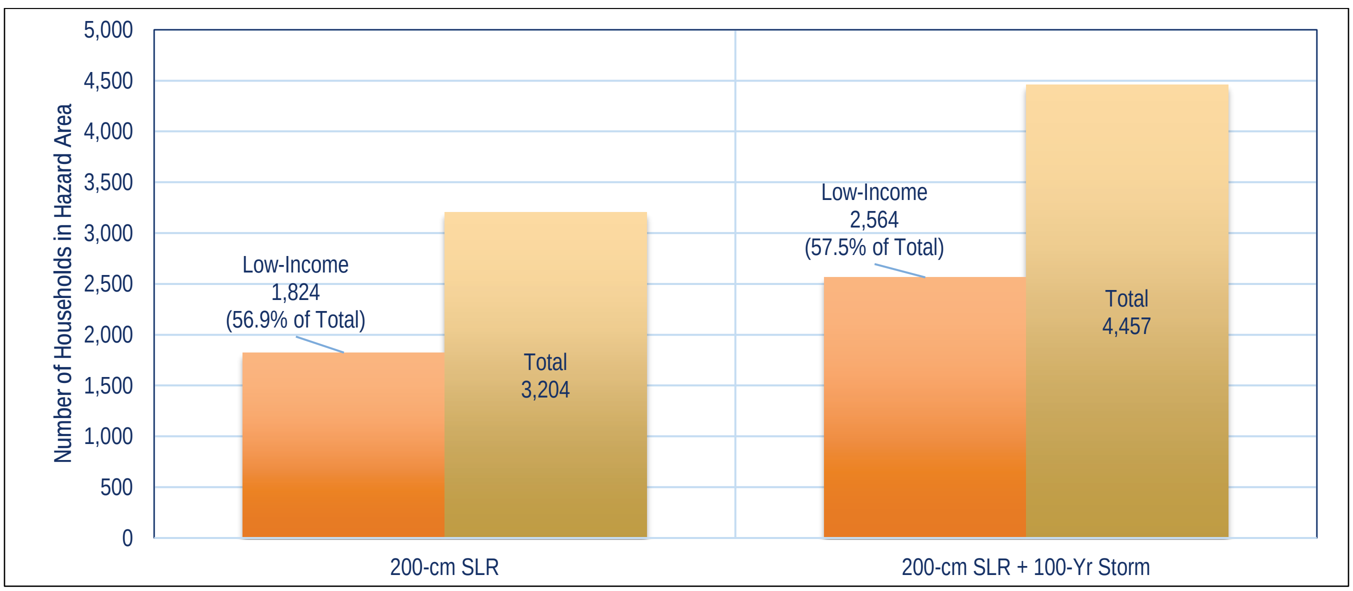
The planning team overlaid the sea-level-rise projection data on the population and asset data developed for the hazard risk assessment for this plan. Detailed results by district are provided in Appendix D; results for the total planning area are presented in Table 12-1.

Table 12-1. Estimated Population Exposure for Sea Level Rise

	200 cm SLR	200 cm SLR + 100 Yr
Population Exposed	356	1,106
% of Total Planning Area Population	0.07%	0.23%

Socially vulnerable populations exposed to the sea level rise hazard were estimated based on data for the Census-defined blocks that lie at least partially within the mapped 200-cm SLR + 100-Yr inundation zone. Because many of those Census blocks extend outside the mapped inundation zone, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 12-4 summarizes the estimated exposure of socially vulnerable populations.





See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 12-4. Socially Vulnerable Populations in 200-cm SLR + 100-Yr Inundation Zone Census Blocks

12.3.2 Property

Detailed results for property exposed to the sea-level rise hazard by district are provided in Appendix D; results for the total planning area are presented in Table 12-2. Current land use distribution, as represented by building occupancy class, in the areas affected by sea level rise is shown in Figure 12-5 for the 200-centimeter sea level rise scenarios with and without a 100-year storm event.

Table 12-2. Estimated Property Exposure for Sea Level Rise

	200 cm SLR	200 cm SLR + 100 Yr
Number of Buildings Exposed	328	737
Value of Exposed Structures	$871,633,025	$1,487,128,142
Value of Exposed Contents	$832,486,802	$1,434,604,620
Total Exposed Property Value	$1,704,119,828	$2,921,732,763
Total Exposed Value as % of Planning Area Total	*0.78%*	*1.34%*

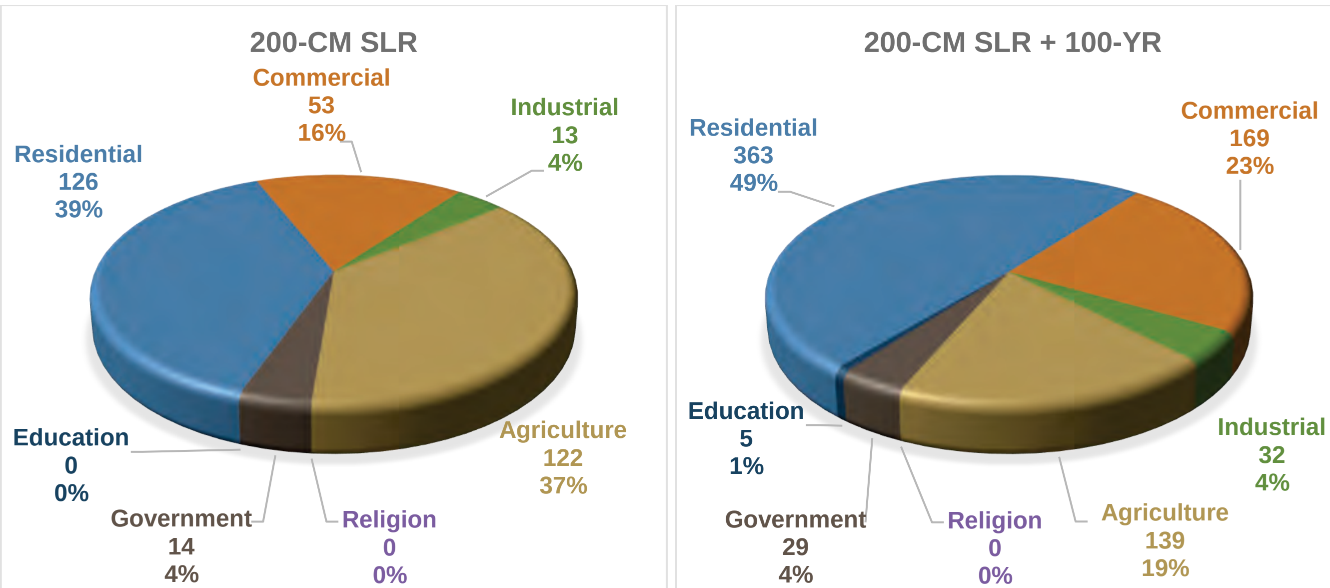


Figure 12-5. Building Occupancy Classes in the Mapped Flood Zones

12.3.3 Critical Facilities

The exposure of critical facilities by sea level rise inundation zone and facility type is shown in Figure 12-6. There are over 50 hazardous waste facilities in the 200-Centimeter SLR + 100-Year Storm inundation zone. Inundation of hazardous waste facilities poses a number of important risks to the immediate community, including public health concerns.

12.3.4 Environment

All sea level rise inundation areas are exposed and vulnerable to impacts. Many of the SLR inundation areas include important environmental and natural resources, which are often important elements in nature-based SLR and flooding strategies.

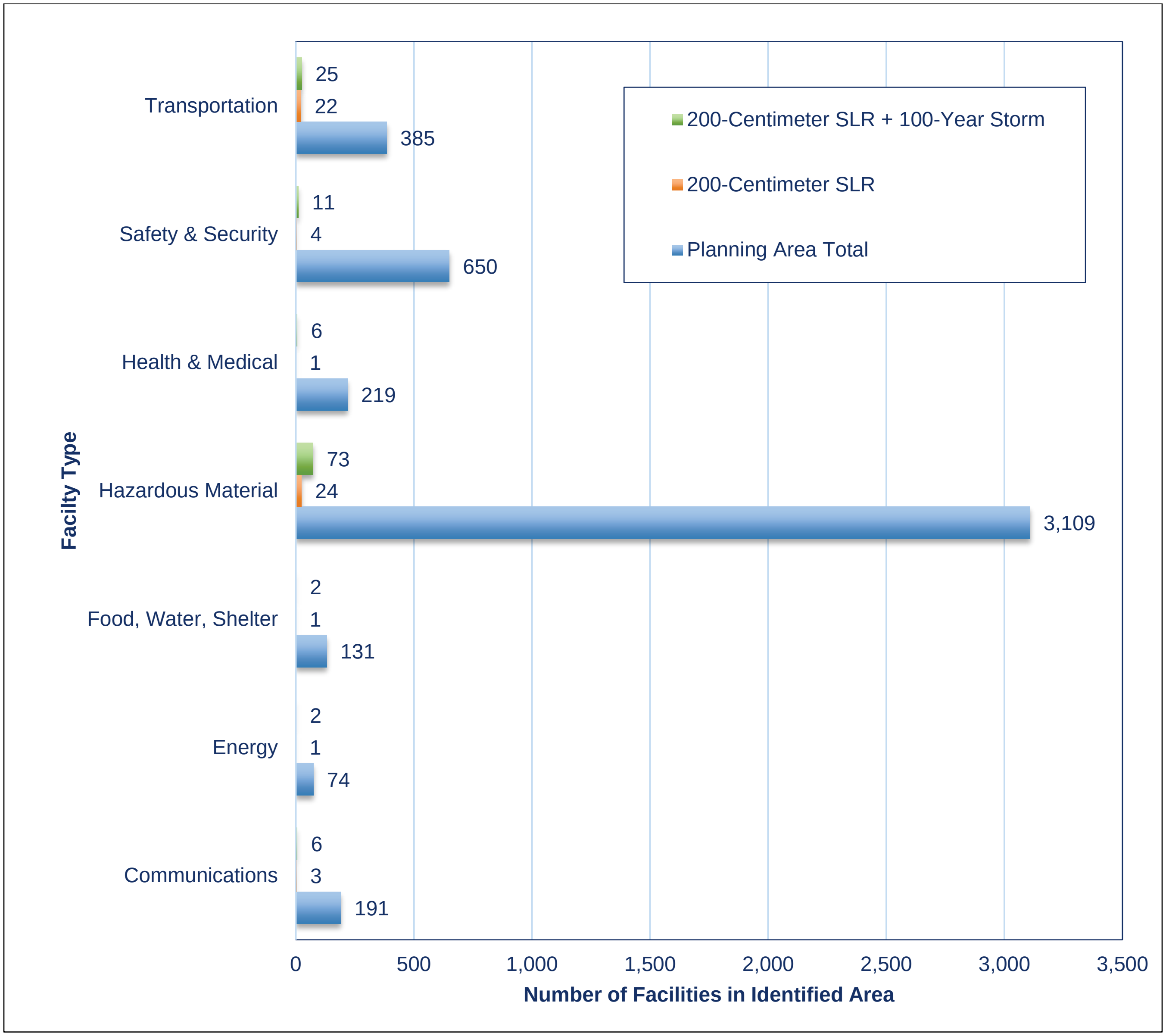


Figure 12-6. Critical Facilities in Sea-Level Rise Inundation Areas

12.4 VULNERABILITY

No quantitative vulnerability analysis was performed for the sea level rise hazard, as no hazard mitigation models for quantitative analysis have yet been developed or validated. The vulnerability analysis for this hazard is based on qualitative projections. The following potential and critical impacts were identified in a qualitative review of recent scientific research on the topic of sea level rise in California:

- Storm drainage systems may experience backups as a result of higher level of daily tidal flooding, especially if outfalls are located within sea level rise inundation areas.
- Important coastal habitat may be lost as sea level rise permanently inundates areas, or it may be damaged due to extreme tide and storm surge events.

- Saltwater intrusion into freshwater resources may occur, further altering habitat and ecosystems. Protective ecosystem services may be lost as land area and wetlands are permanently inundated.

Residents, businesses, and industries that currently thrive on the shoreline will be at risk of flooding by the middle of the century if nothing is done to protect, elevate or relocate them. A 16-inch sea level rise (relative to sea level in 2000) could expose 281 square miles of Bay shoreline to flooding, and a 55-inch rise could expose 333 square miles. If no adaptation measures were taken, a 55-inch rise would place an estimated 270,000 people in the Bay Area at risk from flooding, 98 percent more than are currently at risk. The estimated value of Bay Area shoreline development at risk from a 55-inch rise in sea level is $62 billion—two-thirds of all the estimated value of development vulnerable to sea level rise along California's entire coastline. Any increased storm activity resulting from climate change, in combination with higher sea level, could cause even greater flooding (San Francisco Bay Conversation and Development Commission, 2011).

Populations seeking areas to relocate as they retreat from rising sea levels could significantly affect Sonoma County. This could impact housing needs, thus increasing exposure within Sonoma County to the other hazards profiled in this plan (San Francisco Bay Conversation and Development Commission, 2011).

12.5 FUTURE TRENDS IN DEVELOPMENT

The overall land area of Sonoma County will decrease as sea level rise permanently inundates the County's lowest areas. This will have significant impacts on land use and planning in local communities. Local general plans as well as climate action/adaptation plans in the planning area will guide this future development. State mandates have sought to strengthen land use application in areas impacted by sea level rise. Local general plans should be referenced and cross-referenced with the results of this Plan to mitigate future development in areas most vulnerable to sea level rise.

12.6 SCENARIO

Sea levels along the Sonoma County coast will rise over the next 80 years and beyond, and the county and coastal cities will be adversely impacted by that rise. The impacts are already happening and will progress over time. The planning partners are already preparing for these impacts using programs such as the Local Coastal Plan and other current projections customized for the immediate region. Mitigating the impacts from sea-level rise will take resources and tough land use decisions over the next 30 years, starting immediately.

12.7 ISSUES

The planning team has identified the following sea-level-rise-related issues:

- Available funding is not adequate to mitigate the impacts from sea level rise.
- The County should consider the adoption of higher regulatory standards to mitigate impacts of sea-level rise on redevelopment.
- The data and science that measure sea-level rise impacts progress rapidly. The County should commit to staying in line with the best available data and science on sea-level rise as it evolves.
- The costs to mitigate impacts from sea-level rise will be extensive and potentially beyond the County's means.

- There needs to be a determination of where people can go when the only option to mitigate the impacts from sea-level rise is to retreat.
- The County will need to find ways to equitably mitigate impacts from sea-level rise.
- Risk communication will be crucial to the successful mitigation of this hazard.

13. SEVERE WEATHER

13.1 GENERAL BACKGROUND

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. The most common severe weather events to impact the planning area are thunderstorms, damaging winds and extreme heat. For this risk assessment, the term “severe weather” refers to these three event types in aggregate. They are assessed as a single hazard for the following reasons:

- Records indicate that each of these weather event types has impacted the planning area to some degree, and all have similar frequencies of occurrence.
- None of these weather event types have a clearly defined extent or location. Therefore, no quantitative, geospatial analysis is available to support exposure or vulnerability analysis; the analyses for this hazard are qualitative.

13.1.1 Thunderstorms, Lightning and Hail

NOAA classifies a thunderstorm as a storm with lightning and thunder produced by cumulonimbus clouds, usually producing gusty winds, heavy rain, and sometimes hail. Thunderstorms are usually short in duration (seldom more than two hours), but they may deliver enough rainfall to cause urban or flash flooding.

Lightning is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a “bolt.” This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000 ºF. The rapid heating and cooling of air near the lightning causes thunder.

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Eventually, the hailstones encounter downdraft air and fall to the ground. Hailstones can begin to melt and then re-freeze together, forming large and very irregularly shaped hail.

13.1.2 Damaging Winds

Straight-Line Winds

Straight-line wind is a general term used to describe damaging winds that are not tornadoes. They are many different types of straight-line winds. Most damaging straight-line winds are generated by thunderstorm systems, although some result from other types of weather phenomena. Damaging winds are those that exceed 50 to 60 mph. The Beaufort Wind Chart (Table 13-1) provides terminology and a description of potential impacts at different levels (National Severe Storms Laboratory, 2018).

Table 13-1. Beaufort Wind Chart

Beaufort Number	Range (mph)	Terminology	Description
0	0	Calm	Calm. Smoke rises vertically.
1	1-3	Light air	Wind motion visible in smoke.
2	4-7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	Fresh breeze	Smaller trees sway
6	25-31	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use is difficult.
7	32-38	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Sever gale	Light structure damage.
10	55-63	Storm	Trees uprooted. Considerable structural damage.
11	64-73	Violent storm	Widespread structural damage.
12	74-95	Hurricane	Considerable and widespread damage to structures.

Source: Lewis, n.d.

Tornado

A tornado is a violently rotating column of air with circulation reaching the ground. It almost always starts as a funnel cloud and may be accompanied by a loud roaring noise. Tornadoes are extremely destructive on a local scale (NOAA, NWS, 2009). A tornado is the smallest and potentially most dangerous of local storms. It is formed by the turbulent mixing of layers of air with contrasting temperature, moisture, density, and wind flow. The mixing layers of air account for most of the tornadoes occurring in April, May, and June, when cold, dry air meets warm, moister air moving up from the south. Tornado severity classified on the Fujita Tornado Damage Scale is shown in Table 13-2.

Table 13-2. Operational Enhanced Fujita Scale

Enhanced Fujita Number	3 Second Gust (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

Source: NOAA, 2018a

13.1.3 Extreme Heat

Extreme heat is defined as temperatures that hover 10 ºF or more above the average high temperatures for a region for several days or weeks. Extreme heat events can lead to an increase in heat-related illnesses and deaths, cause drought, and impact water supplies. Such events do not typically impact buildings; however, losses may be associated with the urban heat island effect and overheating of heating, ventilation, and air conditioning systems..

Extreme heat is the primary weather-related cause of death in the United States. In a 10-year record of weather fatalities across the nation (2006 – 2015), excessive heat claimed more lives each year than floods, lightning, tornadoes, and hurricanes. According to the *California Climate Adaptation Strategy*, heat waves have claimed more lives in California than all other declared disaster events combined. Despite this history, not a single heat emergency was proclaimed in California at the state or federal level between 1960 and 2016. Heat waves do not strike victims immediately, but their cumulative effects slowly cause harm to vulnerable populations. Older adults, children, and sick or overweight individuals are at greater risk from extreme heat.

13.1.4 Public Safety Power Shutoff Events

Some combinations of weather conditions—particularly high winds, extreme heat, and low humidity—pose increased risks of wildfire. In 2012, the California Public Utilities Commission ruled that California Public Utilities Code gives electric utilities authority to shut off electric power to protect public safety, since power supply systems have the potential ignite wildfires (California Public Utilities Commission 2021). Such shutoffs are referred to as public safety power shutoff events. Given the long, connected nature of power supply systems, a shutoff event targeted to a small at-risk area can affect a larger area outside the risk zone. The duration of a shutoff is tied directly to the severe weather that triggers it; the shutoff typically ends within 24 hours after the severe weather has passed (Pacific Gas & Electric n.d.).

13.2 HAZARD PROFILE

13.2.1 Past Events

Table 13-3 summarizes severe storm, wind, and heat events in the planning area since 2020 with recorded deaths, injuries, or property damage.

Table 13-3. Recorded Past Severe Weather Events in the Planning Area

Date	Event Type	Deaths (Direct or Indirect)	Injuries (Direct or Indirect)	Property or Crop Damage
10/27/2019	Strong Wind	0	0	$3,000
6/11/2019	Heat	1	0	$0
5/16/2019	Strong Wind	0	0	$1,000
4/16/2019	Strong Wind	0	4	$0
1/16/2019	Heavy Rain	1	0	$0
1/16/2019	Strong Wind	1	0	$0
12/31/2018	Strong Wind	1	0	$0
11/29/2018	Strong Wind	0	0	$10,000
2/8/2015	Heavy Rain	0	0	$25,000
2/6/2015	High Wind	0	0	$23,500
12/30/2014	Strong Wind	0	0	$70,600
2/28/2014	Strong Wind	0	0	$5,000
11/21/2013	Strong Wind	0	1	$35,000
10/4/2013	Strong Wind	0	0	$2,000
5/1/2013	Strong Wind	0	0	$80,000
4/8/2013	Strong Wind	0	0	$9,500
12/23/2012	Strong Wind	0	0	$13,000

Date	Event Type	Deaths (Direct or Indirect)	Injuries (Direct or Indirect)	Property or Crop Damage
12/22/2012	Heavy Rain	1	2	$30,000
12/5/2012	Strong Wind	0	0	$5,000
12/2/2012	Strong Wind	0	0	$134,000
11/30/2012	Strong Wind	1	0	$50,100
11/28/2012	Strong Wind	0	0	$1,000
3/27/2012	Strong Wind	0	0	$150,000
3/16/2012	Strong Wind	0	0	$412,500
3/14/2012	Strong Wind	0	0	$24,000
3/13/2012	Strong Wind	0	0	$65,000
1/23/2012	Strong Wind	0	0	$22,500
1/21/2012	Strong Wind	0	0	$60,000
1/20/2012	Strong Wind	0	0	$4,500
12/3/2011	Strong Wind	0	0	$200,000
11/30/2011	Strong Wind	0	0	$62,000
11/1/2011	Strong Wind	0	0	$17,000
10/5/2011	Strong Wind	0	0	$500
6/4/2011	Heavy Rain	0	0	$20,015,000
3/24/2011	Heavy Rain	0	0	$43,500
3/19/2011	High Wind	1	0	$35,000
3/18/2011	Tornado	0	0	$50,000
2/17/2011	Strong Wind	0	0	$35,000
2/16/2011	Heavy Rain	0	0	$25,000
2/15/2011	High Wind	0	0	$250,000
12/28/2010	Strong Wind	1	0	$85,000
12/20/2010	Strong Wind	0	0	$25,000
12/6/2010	Strong Wind	0	0	$45,000
10/24/2010	Strong Wind	0	0	$85,000
2/23/2010	Strong Wind	0	0	$15,000
1/25/2010	Strong Wind	0	0	$50,000
1/20/2010	Strong Wind	0	0	$435,000
1/19/2010	High Wind	0	0	$225,000
1/18/2010	Strong Wind	0	0	$110,000
11/28/2009	Strong Wind	0	0	$85,000
10/13/2009	High Wind	0	0	$160,000
5/5/2009	Heavy Rain	1	1	$50,000
4/14/2009	Strong Wind	0	0	$140,000
3/22/2009	Strong Wind	0	0	$2,000
2/26/2009	Strong Wind	0	0	$15,000
2/22/2009	Strong Wind	1	0	$5,000
2/15/2009	High Wind	0	0	$50,000
12/16/2008	Heavy Rain	1	0	$25,000
11/1/2008	Strong Wind	0	0	$16,000
12/27/2006	Strong Wind	1	0	$500,000

Date	Event Type	Deaths (Direct or Indirect)	Injuries (Direct or Indirect)	Property or Crop Damage
7/21/2006	Heat	1	0	$0
1/27/2005	Tornado	0	0	$150,000
12/29/2004	Tornado	0	0	$3,000
1/1/2002	Heavy Rain	0	0	$200,000
1/25/2001	Lightning	0	1	$1,000,000
Total		13	9	$25,445,200

Source: NOAA Storm Events Database, 2021

13.2.2 Location

Severe weather events have the potential to happen anywhere in the planning area. Mountainous regions experience heavier snowfall and a greater risk of road closures. Wind events are most damaging to areas that are heavily wooded. Under most conditions, the planning area's highest winds come from the southwest.

13.2.3 Frequency

Table 13-3 lists 65 storm, wind, or heat severe weather events in the planning area since 2000 that caused death, injury or property damage. This amounts to a little more than three damaging severe weather events every year on average. The probability of a severe weather event impacting the planning area is high.

13.2.4 Severity

Of the 65 damaging weather events listed in Table 13-3:

- 53 were associated with high winds, including three tornadoes. These events caused seven deaths and five injuries, and resulted in $4 million in property or crop damage.
- Two deaths were caused by extreme heat.
- One injury was caused by lightning. Lightning also caused $1 million in property or crop damage.
- Nine heavy rain events caused four deaths, three injuries, and $20.4 million in property or crop damage.

13.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe weather event. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of a storm. Some storms may come on quickly, with only a few hours of warning time.

13.2.6 Secondary Hazards

Major riverine or urban flooding can result from heavy rain. Rain falling on saturated soils on slopes or on areas recently burned by wildfire may lead to landslides. Lightning during thunderstorms presents a risk of starting a wildfire. Extreme heat can contribute to fire-prone dry vegetation.

13.3 EXPOSURE

All people and property and the entire environment of the planning area is exposed to some degree to the severe weather hazard.

13.4 VULNERABILITY

13.4.1 Population

The most common problems associated with severe weather events are immobility and loss of utilities. Although all populations in the planning area are exposed to severe weather events, some populations are more vulnerable. Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding. In general, populations who lack adequate shelter during severe weather events, those who are reliant on sustained sources of power in order to survive, and those who live in isolated areas with limited ingress and egress options are the most vulnerable. The most common impacts of specific weather event types on people are as follows:

- **Thunderstorms, Lightning and Hail**—California and the planning area are not particularly prone to thunderstorm events and there are no recorded fatalities from lightning within the planning area. Thunderstorm-related deaths and injuries in the planning area are most likely to result from accompanying wind and heavy rain.
- **Damaging Winds**—Damaging winds can cause injuries and fatalities in a number of ways. Downed trees may fall on homes or cars, killing or injuring those inside. Objects that are not secured can be picked up in wind events and become projectiles. Structures that collapse or blow over during damaging wind events, especially tornadoes, may kill or injure those inside.
- **Extreme Heat**—Individuals with physical or mobility constraints, cognitive impairments, economic constraints, or social isolation are typically at greater risk from the adverse effects of excessive heat events. The average summertime mortality for excessive heat events is dependent upon the methodology used to derive such estimates. Certain medical conditions, such as heat stroke, can be directly attributable to excessive heat, while others may be exacerbated by excessive heat, resulting in medical emergencies. Individuals who lack shelter and heating are particularly vulnerable to extreme cold and wind chill.

13.4.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. The most common impacts of specific weather event types on property are as follows:

- **Thunderstorms, Lightning and Hail**—Damage from thunderstorms in the planning area is most likely to be related to secondary hazards accompanying the event, such as flooding, landslides or damaging winds. If lightning directly strikes a building, it may cause substantial damage and may even set the structure on fire.
- **Damaging Winds**—Mobile homes can be seriously damaged by wind gusts over 80 mph, even if they are anchored (National Severe Storms Laboratory, 2018). Properties at higher elevations or on ridges may be

more prone to wind damage. Falling trees can result in significant damage to structures. A major tornado could cause widespread damage to property in the planning area, but such an event is unlikely.

- **Extreme Heat**—Extreme heat is generally not a threat to damage property.

No modeling is available for quantitative loss estimations for the severe weather hazard. Instead, loss estimates were developed representing 1 percent, 3 percent and 5 percent of the replacement value of exposed structures:

- Loss of 1 percent of planning area replacement value—$2.2 billion
- Loss of 3 percent of planning area replacement value—$6.6 billion
- Loss of 5 percent of planning area replacement value—$11 billion

13.4.3 Critical Facilities

All critical facilities are vulnerable during severe weather events, especially those that lack backup power generation capabilities. When facilities supplying power to planning area land line telephone systems are frequently disrupted, significant issues arise with communication in the planning area. In addition, some facilities are particularly vulnerable to specific types of severe weather events:

- **Thunderstorms**—Facilities located in areas prone to localized or major flooding are vulnerable. Transportation systems are vulnerable to disruption from flooding or secondary hazard such as landslides.
- **Damaging Winds**—Critical facilities in the direct path of a tornado would be particularly vulnerable. Facilities located near trees or power lines that are likely to fall are also vulnerable. Roads and other transportation infrastructure could be blocked by downed trees or other debris.
- **Extreme Heat**— Extreme heat is generally not a threat to damage facilities or infrastructure.

13.4.4 Environment

The environment is highly vulnerable to severe weather events. Natural habitats such as streams and trees exposed to the elements during a severe storm risk major damage. Prolonged rains can saturate soils and lead to slope failure. Flood events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads.

13.5 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe weather events. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The planning partners have adopted the International Building Code in response to California mandates. This code is equipped to deal with the impacts of severe weather events. Land use policies identified in general plans within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partners are well equipped to deal with future growth and the associated impacts of severe weather.

13.6 SCENARIO

A worst-case severe-weather event would involve prolonged high winds during a thunderstorm with large amounts of precipitation after soils are already saturated. Such an event would have both short-term and long-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. Some areas of the county could experience limited ingress and egress. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, mud over roadways, and landslides on steep slopes. Floods and landslides could further obstruct roads and bridges, further isolating residents. If major landslides impact major highways in the planning area, significant transportation disruption could result.

13.7 ISSUES

Important issues associated with severe weather in the planning area include the following:

- The most common direct impact from severe weather events is loss of power. Power outages that disrupt land line service could cause significant communication disruption.
- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as damaging winds.
- Redundancy of power supply must be evaluated, especially for critical facilities.
- Those residing in higher elevations with limited transportation routes may have the greatest vulnerability to isolation from storms. Another group at risk is the portion of the county population that is over the age of 65.
- Climate change may cause more severe weather patterns that could impact vulnerable populations within the planning area. Increased frequency and intensity of storms may result in greater damage.
- Detailed spatial analysis is needed to locate the most vulnerable populations, followed by focused public education and outreach mitigation activities for these populations.
- The risk associated with the severe weather hazard overlaps the risk associated with other hazards such as earthquake, landslide, and flood. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- Isolated population centers are most vulnerable to the severe weather hazard. Rural areas frequently experience extended power outages, loss of communications, and damage to roads due to severe weather.

14. TSUNAMI

14.1 GENERAL BACKGROUND

A tsunami is a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs, arriving at shorelines over an extended period. Tsunamis can be induced by earthquakes, landslides and submarine volcanic explosions (see Figure 14-1). Tsunamis are typically classified as local or distant, depending on the location of their source in comparison to where waves occur:

- The waves nearest to the generating source represent a local tsunami. Such events have minimal warning time, leaving few options except to run to high ground after a strong, prolonged local earthquake. Damage from the tsunami adds to damage from the triggering earthquake due to ground shaking, surface faulting, liquefaction, and landslides.
- The waves far from the generating source represent a distant tsunami. Distant tsunamis may travel for hours before striking a coastline, giving a community a chance to implement evacuation plans if a warning is received.

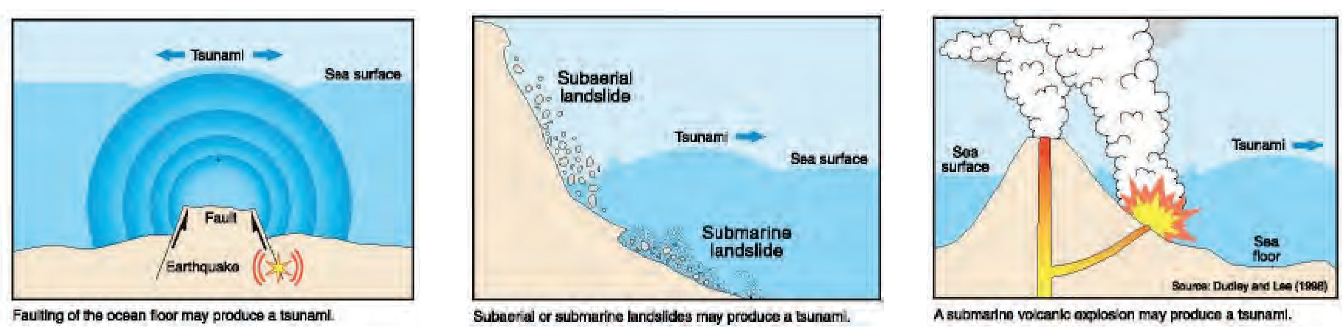


Figure 14-1. Common Sources of Tsunamis

In the open ocean, a tsunami may be only a few inches or feet high, but it can travel with speeds approaching 600 miles per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on a coast and much larger at other points. The inundation area for a tsunami event is often described as runup as illustrated in Figure 14-2.

Source: UNESCO, Retrieved from Different Directions: Tsunami, n.d.

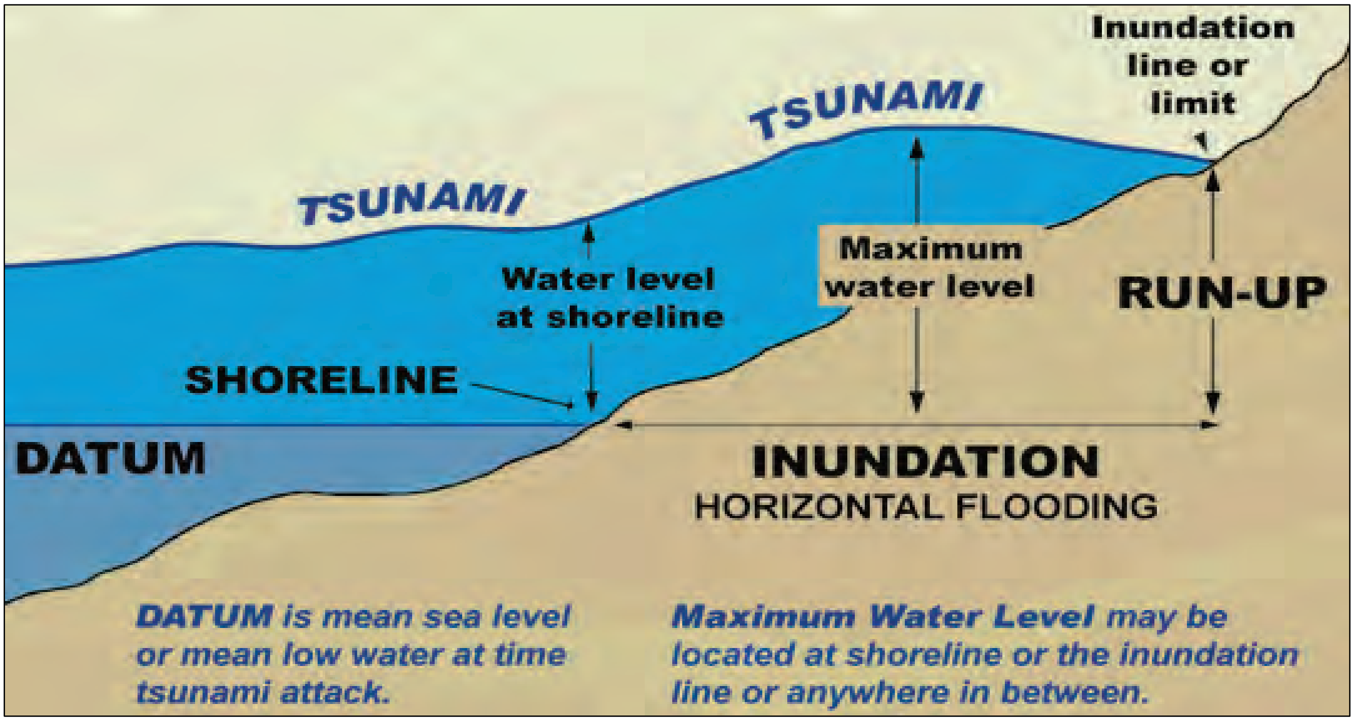


Figure 14-2. Runup Distance and Height in Relation to the Datum and Shoreline

14.2 HAZARD PROFILE

14.2.1 Past Events

California is at risk from both local and distant tsunamis. About 80 possible or confirmed tsunamis in California have been observed or recorded, including the following:

- The most recent recorded tsunamis affecting California were the March 11, 2011 tsunami caused by an earthquake near Japan, which resulted in nearly $100 million in damage to the California maritime community, and the February 27, 2010 minor recorded tsunami inundation in California caused by an earthquake near Chile.
- A 1960 Chilean earthquake produced a tsunami that impacted the entire Pacific basin. Damage was reported in California ports and harbors from San Diego to Crescent City and losses exceeded $1 million.
- A 1964 tsunami generated by a Magnitude-9.2 Alaska earthquake (see Figure 14-3) killed 12 in Northern California and caused over $15 million in damage. Wave oscillations in San Francisco Bay lasted more than 12 hours, causing nearly $200,000 in damage to boats and harbor structures. Sonoma County experienced slight tsunami impacts from this event.

Source: National Centers for Environmental Information, 2018

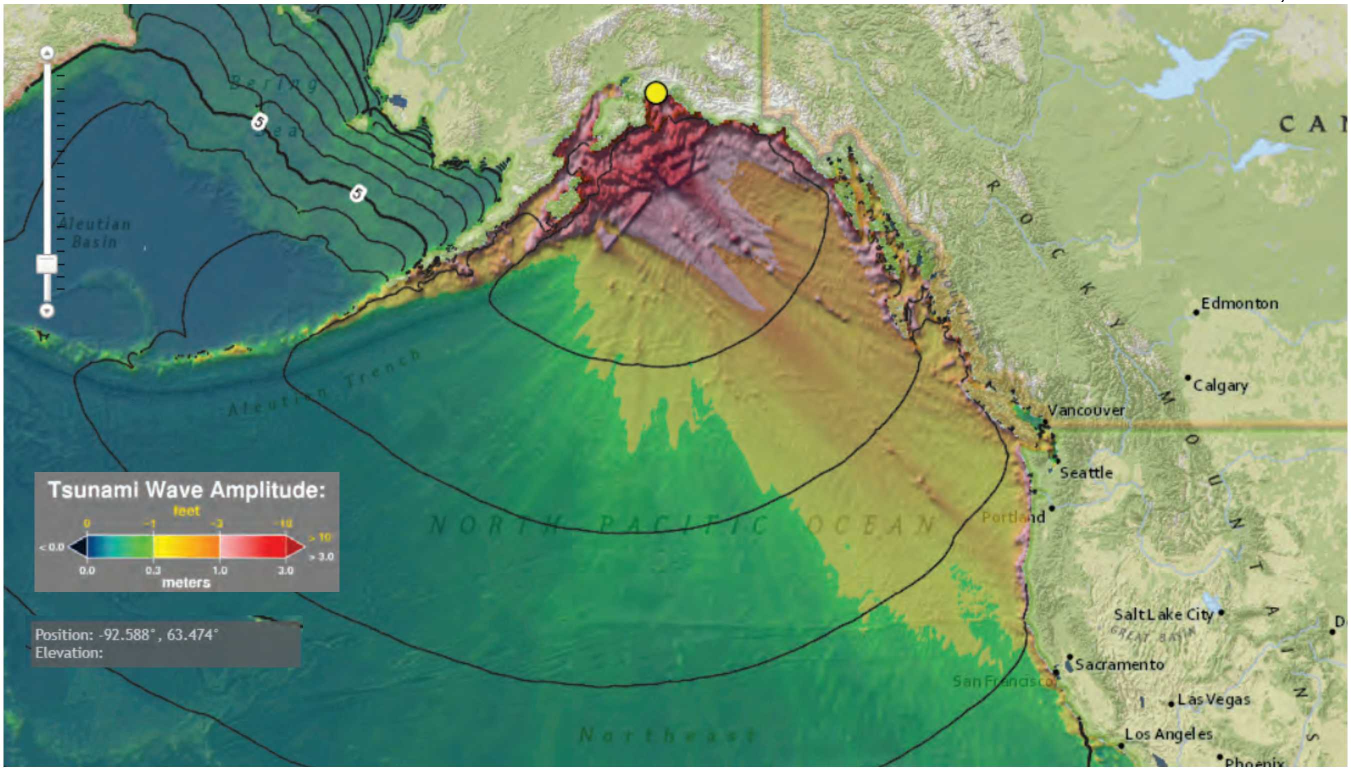


Figure 14-3. 1964 Alaska Earthquake Tsunami Event

14.2.2 Location

Sonoma County's rugged cliffs and generally elevated coastline reduces its exposure and vulnerability to tsunamis. The areas in Sonoma County that have the greatest exposure to potential damages by a tsunami are those coastal communities along the southern Sonoma County coast from Jenner to Bodega Bay. Tsunami inundation maps for the Sonoma Coast area near Jenner, Bodega Bay, and the San Pablo Bay were released in 2009 and form the basis for the County's Tsunami Response Plan.

Spud Point Marina is on the coast in Bodega Bay near the San Andreas Fault. Port Sonoma Marina is at the mouth of the Petaluma River in an area of potentially high liquefaction 3 miles west of the Rodgers Creek Fault. Both of these facilities face a potential risk from earthquake-induced tsunamis.

Figure 14-4 shows the mapped extent of the tsunami inundation areas for the Sonoma County planning area used for this risk assessment, as developed by the California Department of Conservation.

14.2.3 Frequency

The National Tsunami Hazard Mitigation Program rates the risk from the tsunami hazard to the U.S. west coast as a whole as high to very high (Dunbar and Weaver 2015). However, the historical record of tsunami events in Sonoma County includes only one minor event. The frequency of tsunami events in the planning area can be assumed to be low.

Figure 14-4. Tsunami Inundation Zones

Tsunami Inundation Zones

Highways

Cities

N

0 5 10 Miles

Data Sources: Sonoma Co., CGS

14.2.4 Severity

In 2009 Cal OES, the California Geological Survey, and the University of Southern California mapped the tsunami run-up zone for the maximum credible earthquake along the Sonoma Coast, using NOAA's National Tsunami Hazard Mitigation Program. The modeling projected that a tsunami of 25 feet could occur in the coastal areas of Sonoma County, and that areas off San Pablo Bay could experience a 5 foot tsunami. According to the National Tsunami Hazard Mitigation Program, tsunami events with runups of more than 3 feet are the most likely to be dangerous to people and property.

A tsunami's size and speed, as well as the coastal area's form and depth, affect the impact of the tsunami. At some locations, the advancing turbulent wave front will be the most destructive part of the tsunami wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests, sweeping away items on the surface and undermining roads, buildings, bulkheads, and other structures. This outflow action can carry enormous amounts of highly damaging debris, resulting in further destruction. Ships and boats, unless moved away from shore, may be forced against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater (National Tsunami Hazard Mitigation Program, 2001).

14.2.5 Warning Time

Visible Indications

Tsunamis are difficult to detect in the open ocean; with waves generally less than 3 feet high. The first visible indication of an approaching tsunami may be either a rise or drop in water surface levels (National Tsunami Hazard Mitigation Program, 2001):

- A drop in water level (draw down) can be caused by the trough preceding the advancing, large inbound wave crest. Rapid draw down can create strong currents in harbor inlets and channels that can severely damage coastal structures due to erosive scour around piers and pilings. As the water's surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom.
- The advancing tsunami may initially arrive as a strong surge increasing the sea level. This can be similar to the rising tide, but the tsunami surge rises faster and does not stop at the shoreline. Even if the wave height appears to be small, 3 to 6 feet for example, the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, other debris, and hazardous materials. Boats and debris are often carried inland by the surge and left stranded when the water recedes.

Warning System

Tsunami Warning System for the Pacific Ocean

The tsunami warning system for the Pacific Ocean evolved from a program initiated in 1946. It is a cooperative effort involving 26 countries along with numerous seismic stations, water level stations and information distribution centers. The National Weather Service operates two regional information distribution centers: The Pacific Tsunami Warning Center in Ewa Beach, Hawaii; and the National Tsunami Warning Center covering the California coast in Palmer, Alaska. The warning centers issue tsunami watches, warnings, and advisories. A watch is issued when a large earthquake has occurred far away from the region and the threat is still being determined. A warning is issued when damaging tsunami waves inundating dry land are expected. An advisory is issued when tsunami waves less than 1 meter high and dangerous strong currents will occur in harbors. The warning system is activated when a Pacific basin earthquake of magnitude 6.5 occurs or an earthquake is widely felt along the North American coast. When this occurs, the following sequence of actions occurs:

- Data is interpolated to determine epicenter and magnitude of the event.
- If the earthquake is of the right type, depth, magnitude, and is far away from California coast, a TSUNAMI WATCH is typically issued for the California coastline.
- A TSUNAMI WATCH is upgraded to a TSUNAMI WARNING if tsunami wave heights are forecast to be 1 meter or larger. A TSUNAMI ADVISORY is issued if tsunami wave heights are forecast to be 0.3 meters to less than 1 meter.
- Tsunami travel times are calculated, and the warning is transmitted to disseminating agencies who relay it to the public.
- The National Tsunami Warning Center will cancel/expire watches, warnings, or advisories if tide gauges and buoys indicate no significant tsunami was generated or if tsunami waves no longer meet the criteria for at least 3 hours.

This system is not considered to be effective for communities close to the tsunami source, because the first wave would arrive before the data can be processed and analyzed, and communications systems may be impacted by the precipitating event. In this case, strong ground shaking would provide the first warning of a potential tsunami and evacuations should begin immediately.

2010 Sonoma County Operational Area Tsunami Response Plan

Sonoma County's 2010 Tsunami Response Plan incorporates the 2009 mapping of the tsunami run-up zone for the maximum credible earthquake along the Sonoma Coast. The plan establishes notification and evacuation response procedures to help minimize casualties from tsunamis.

NOAA, Cal OES, and local emergency managers coordinate tsunami warning communications for the planning area. This emergency notification system is routinely tested and includes broadcasts on NOAA Weather Radio All Hazards, social media, local television and radio stations, sirens, and aircraft public address system. The Wireless Emergency Alert System will also be activated during a real event.

Estimated Travel Times

The NOAA National Centers for Environmental Information website provides maps that show estimated travel times to coastal locations for various tsunami-generating events. Figure 14-5 shows one example of the travel time for a tsunami generated in Aburatsu, Japan to reach the planning area—approximately 11 hours.

14.2.6 Secondary Hazards

Wherever water transport is a vital means of supply, disruption of coastal systems caused by tsunamis can have far-reaching economic effects.

Source: National Centers for Environmental Information, 2018c

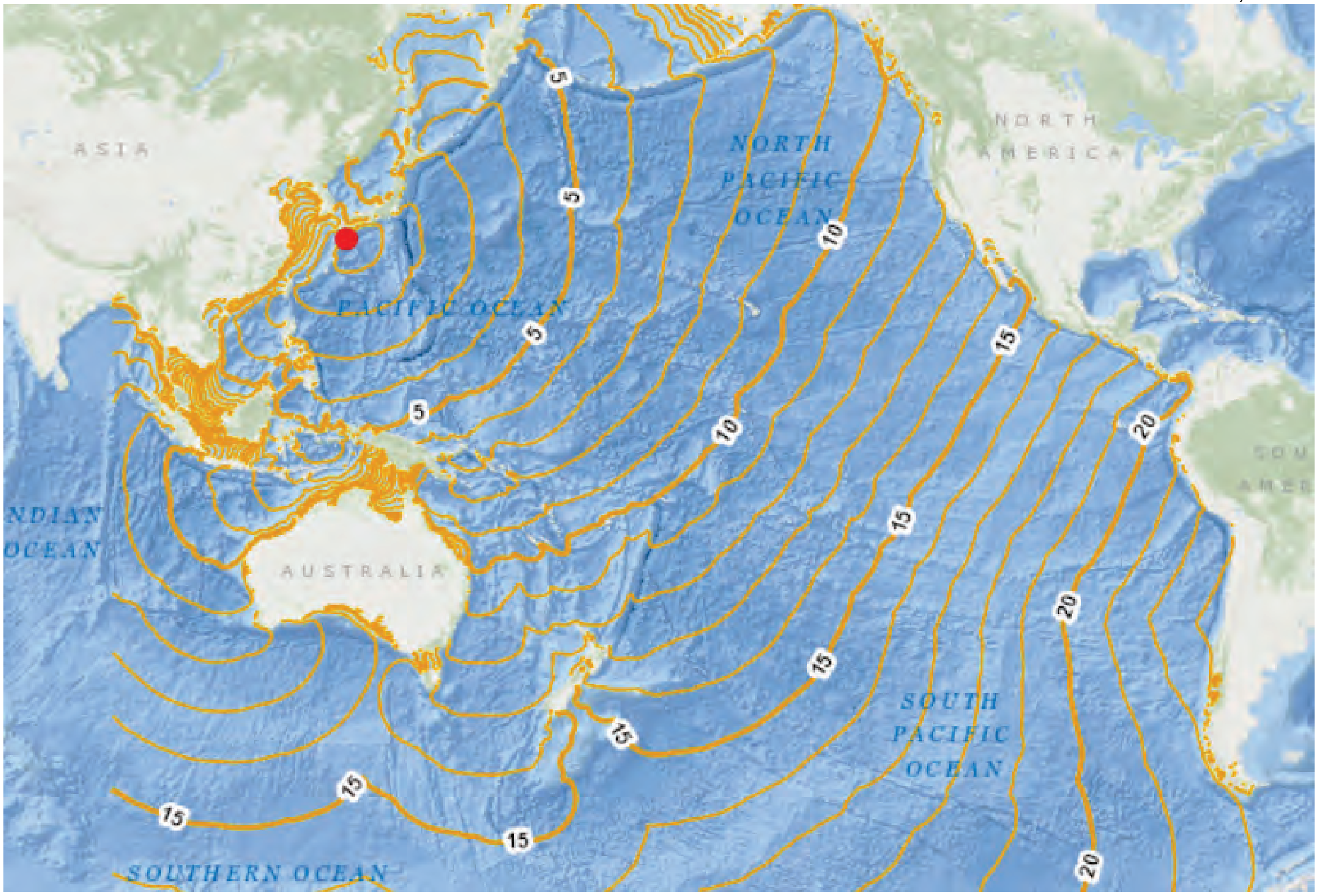


Figure 14-5. Potential Tsunami Travel Times in the Pacific Ocean, in Hours

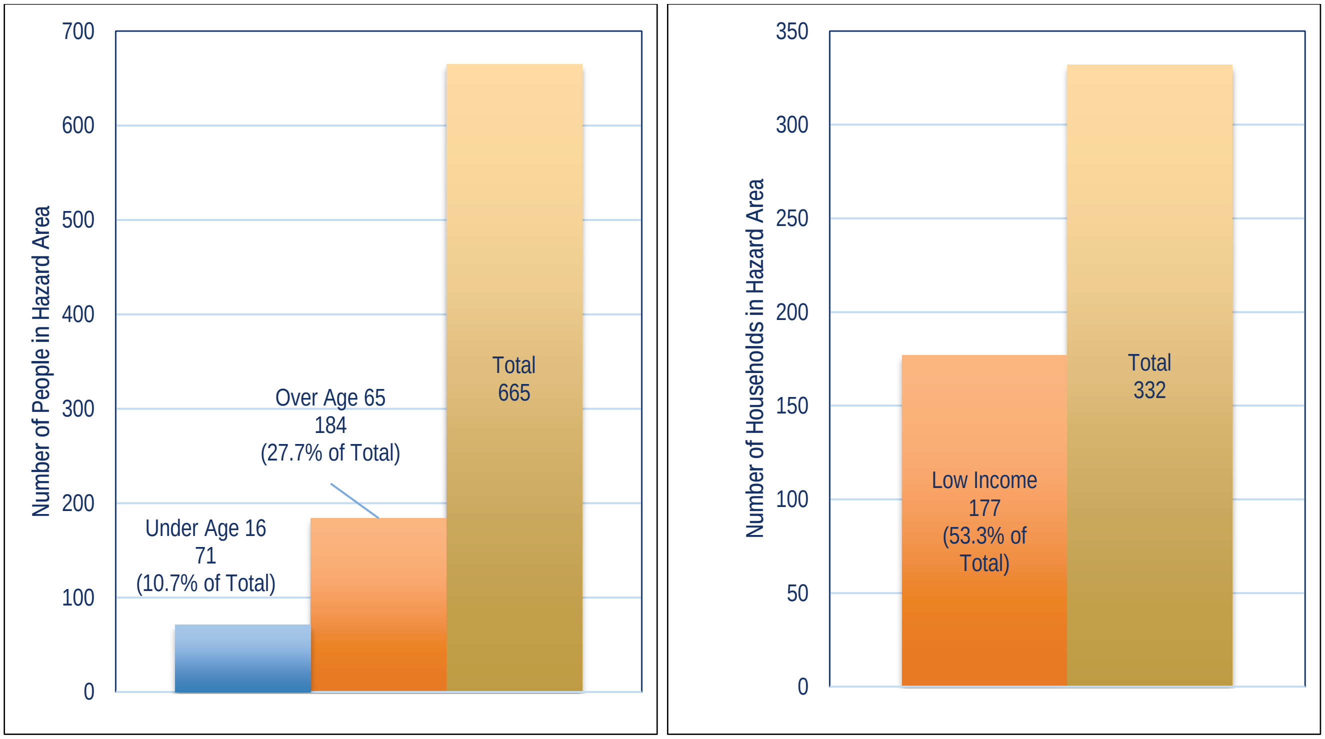
14.3 EXPOSURE

Exposure and vulnerability estimates are based on tsunami inundation maps. The value of exposed buildings in the tsunami inundation zone was generated by overlaying the inundation areas on the general building stock. The population living in tsunami hazard zones was estimated using the percent of buildings within the tsunami inundation areas and applying this percent to the estimated planning area population. Detailed results by jurisdiction are provided in Appendix D; results for the total planning area are presented below.

14.3.1 Population

The estimated total population living in the evaluated dam failure inundation zone is 102 (0.02 percent of the total planning area population). People recreating along beaches, low-lying coastal areas, tidal flats, and stream deltas that empty into ocean-going waters also would be exposed.

Socially vulnerable populations exposed to the tsunami hazard were estimated based on data for the Census-defined blocks that lie at least partially within the mapped inundation zone. Because many of those Census blocks extend outside the mapped inundation zone, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 14-6 summarizes the estimated exposure of socially vulnerable populations.



See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 14-6. Socially Vulnerable Populations in the Mapped Tsunami Inundation Zone Census Blocks

14.3.2 Property

Table 14-1 summarizes the estimated property exposure in the evaluated tsunami inundation areas. Figure 14-7 shows the Hazus-defined occupancy class of all buildings in the tsunami inundation areas. These occupancy classes provide an indication of land use within the mapped hazard area. Some land uses are more vulnerable to inundation, such as single-family homes, while others are less vulnerable, such as agricultural land or parks.

Table 14-1. Exposed Property in the Tsunami Inundation Zone

Number of Buildings Exposed	77
Value of Exposed Structures	$41,894,144
Value of Exposed Contents	$44,710,276
Total Exposed Property Value	$86,604,420
Total Exposed Value as % of Planning Area Total	*0.04%*

14.3.3 Critical Facilities

The breakdown of critical facility exposure by facility type is shown in Figure 14-8. The total exposed facilities (22) is a very small percentage of total critical facilities in the planning area. They include two wastewater treatment facilities, one fire station, one school, one bridge and 14 port facilities.

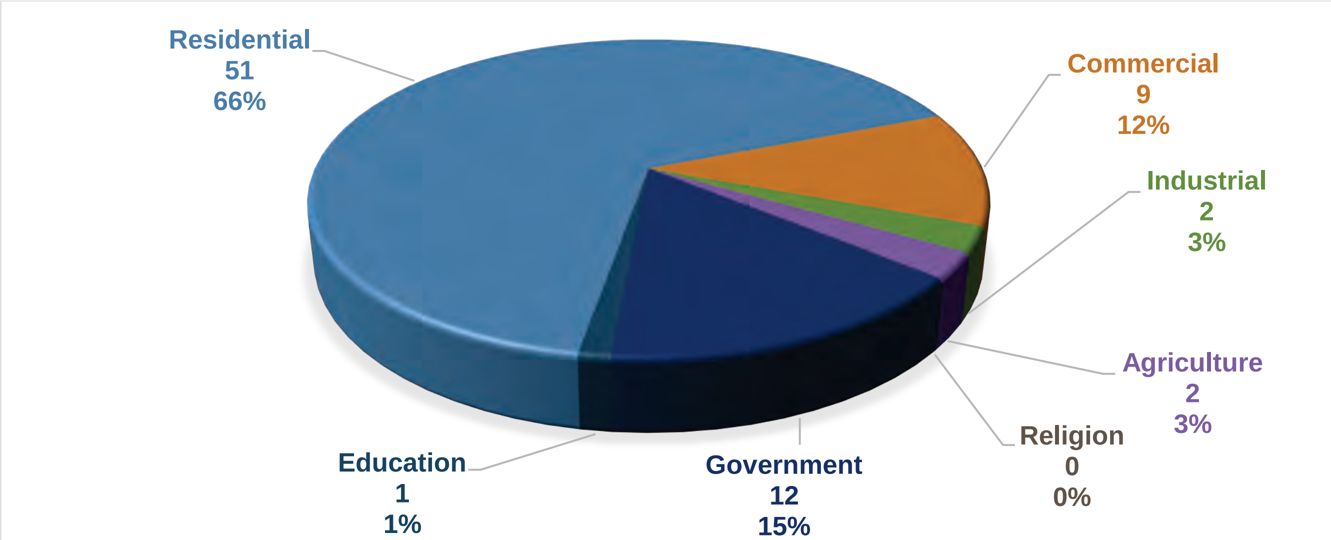


Figure 14-7. Structures in the Tsunami Inundation Zone, by Building Occupancy Class

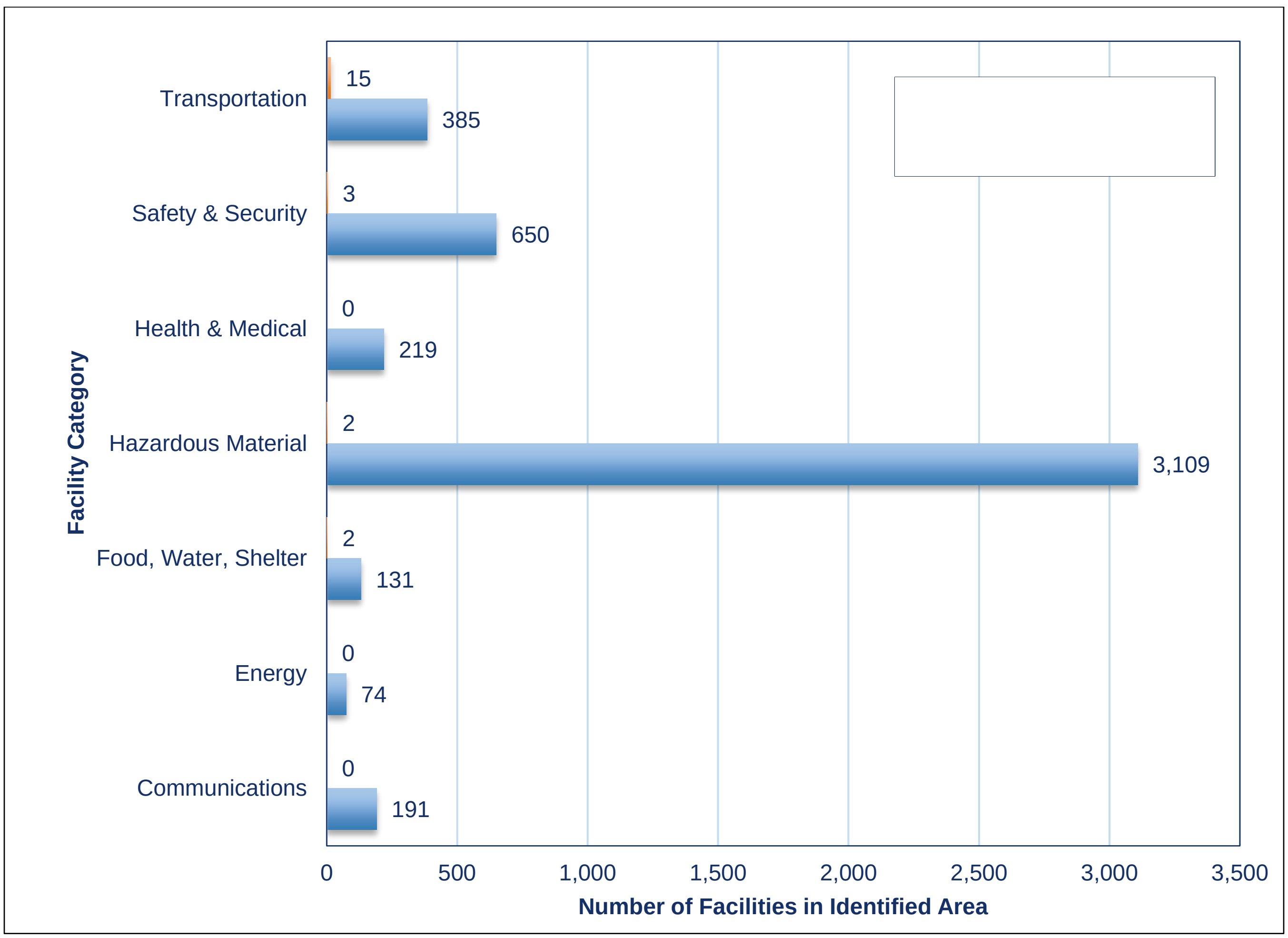


Figure 14-8. Critical Facilities in Mapped Tsunami Inundation Zone and Countywide

14.3.4 Environment

All waterways and beaches would be exposed to the effects of a tsunami; inundation of water and introduction of foreign debris could be hazardous to the environment. All wildlife inhabiting the area also is exposed.

14.4 VULNERABILITY

No quantitative vulnerability analysis was performed for the tsunami hazard. The following potential impacts were identified:

- The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats, and river deltas that empty into ocean going waters.
- In the event of a local tsunami generated in or near the planning area, there would be little warning time, so more of the population would be vulnerable.
- The impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats and river deltas. The most vulnerable are those in the front line of tsunami impact and those that are structurally unsound.
- Structures that were built to current floodplain regulations in the tsunami inundation area may have some level of protection, particularly if they were built to withstand wave action. In addition to structure damage, ships moored at piers and in harbors often are swamped and sunk or are left battered and stranded high on the shore.
- The following infrastructure is vulnerable to damage:
  - **Water Proximate Infrastructure**—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.
  - **Flood Control Systems**—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.
  - **Utility Systems—**Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.
- Tsunami waves can carry destructive debris and pollutants that can have devastating impacts on all facets of the environment. Environmental impacts on local waterways and wildlife would be most significant in areas closest to the point of impact. The vulnerability of aquatic habit and associated ecosystems in low-lying areas close to the coastline is high.

14.5 FUTURE TRENDS IN DEVELOPMENT

According to population projections by the California Department of Finance, Sonoma County’s population should decrease to 485,017 by 2040. This represents a 3.8 percent decrease from the 2018 population. Though new development will continue, the rate of development to accommodate future county growth will not be high. The County is subject to state general planning laws and the California Coastal Act. The County and its cities have adopted critical areas and resources lands regulations pursuant to these laws. The information in this plan provides the planning partners a tool to ensure that there is no increase in exposure within the mapped tsunami inundation area of the planning area.

The County of Sonoma was officially recognized as a TsunamiReady community in March 2016 by National Weather Service representatives. This designation recognizes voluntary community programs that promote collaborative tsunami hazard preparedness efforts. In order to become a TsunamiReady community, the County developed a local Tsunami Response Plan, mapped inundation areas along the coast, identified evacuation routes, established refuge areas, installed over 160 tsunami signs in the hazard zones, provided education to the public, deployed and maintained redundant and reliable means to disseminate tsunami warnings and participated in readiness exercises (County of Sonoma 2017).

14.6 SCENARIO

The tsunami scenario with the greatest potential impact on the planning area is a tsunami triggered by a major seismic event along the Cascadia subduction zone. Historical records suggest that tsunami wave heights on the order of 15 to 60 feet could be generated by a Cascadia subduction event (see Figure 14-9). The most destructive tsunami will be associated with a local source Cascadia event and will be preceded by strong ground shaking. Significant damage will result from the ground shaking, tsunami wave forces, and impacts associated with debris. A major tsunami event in the region would have devastating impacts on the people, property, and economy of the planning area.

Source: National Centers for Environmental Information, 2018

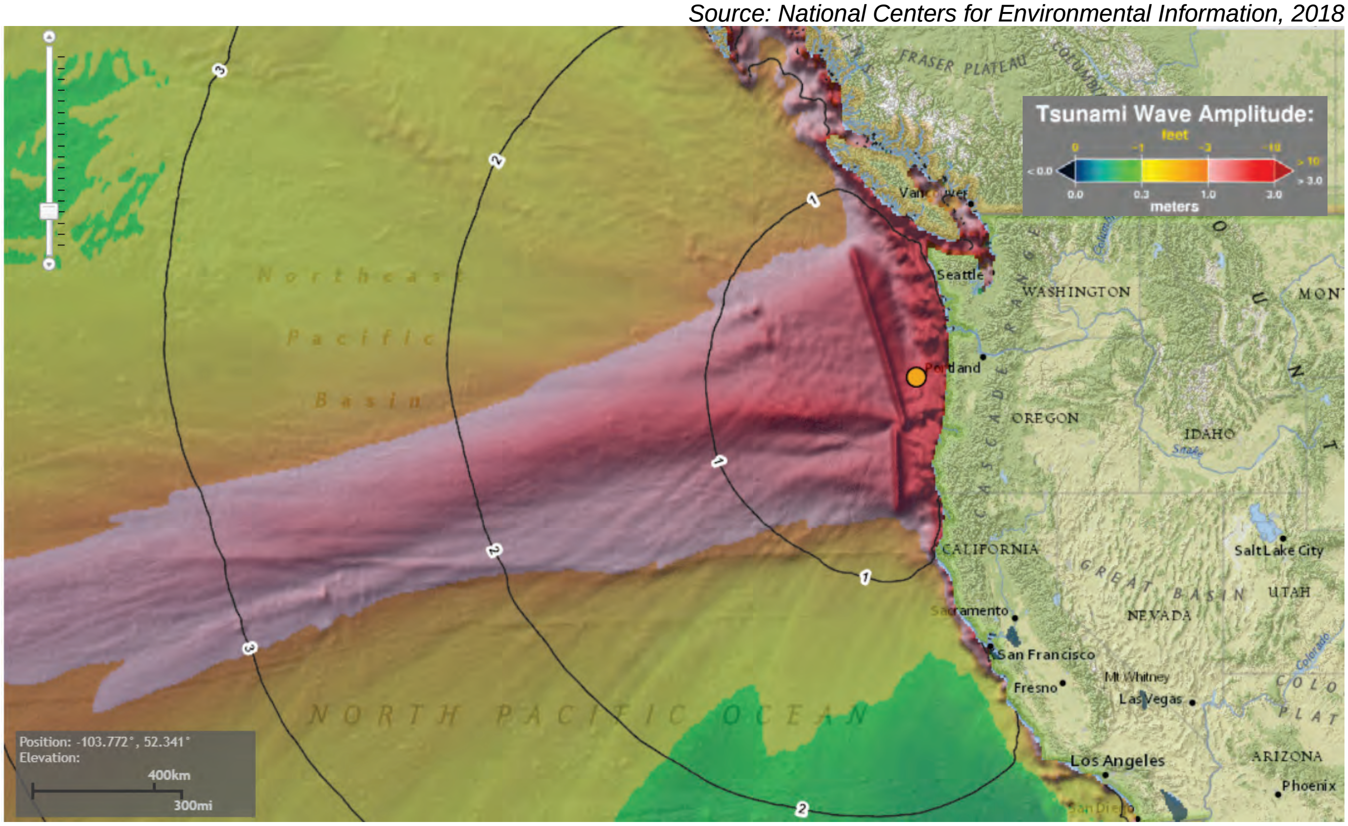


Figure 14-9. 1700 Cascadia Subduction zone Earthquake Tsunami Event

A tsunami from a more local earthquake, such along the San Andreas fault, might be less severe than a Cascadia subduction event. Tsunamis are less commonly associated with strike-slip faults such as the San Andreas system (County of Sonoma 2017). However, a local source tsunami presents a high risk to people, as there would not be time to initiate evacuation; the first surge could arrive in as few as 10 minutes. Strong ground shaking preceding the tsunami could damage buildings, communications and electric utility infrastructure, roads, and bridges, further impairing the community's ability to evacuate safely.

14.7 ISSUES

Important issues associated with a tsunami in the planning area include the following:

- Risk from tsunami inundation is not subject to the State of California real estate disclosure law at this time.
- Structures in the planning area built before the cities and County entered the NFIP may not be designed to resist tsunami forces.
- Present building codes and guidelines do not adequately address the impacts of tsunamis on structures. It is anticipated that future updates to the California Building Code will include amendments that address these issues.
- As tsunami warning technologies evolve, the tsunami warning capability within the planning area will need to be enhanced to provide the highest degree of warning to planning partners with tsunami risk exposure.
- With the future impacts from climate change, the issue of sea level rise may become an important consideration as probable tsunami inundation areas are identified through future studies.
- Special attention will be focused on vulnerable communities and tourists in the tsunami zone and on hazard mitigation through public education and outreach.

15. WILDFIRE

15.1 GENERAL BACKGROUND

A wildfire is an unplanned, unwanted, uncontrolled fire in an area of combustible vegetation. Wildfires typically start in rural areas but can burn into urban areas. A wildfire requires fire suppression to prevent damage to the natural or human environment. Though most wildfires are started by humans, they can occur naturally, and are important to many ecosystem processes.

15.1.1 Factors Affecting Fire Behavior

Fire behavior is based on factors such as the following:

- **Fuel**—Fuel may include living and dead vegetation on the ground, along the surface as brush and small trees, and above the ground in tree canopies. Lighter fuels such as grasses, leaves and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite. Trees killed or defoliated by forest insects and diseases can be more susceptible to wildfire. Structures in the human-built environment also represent a fuel component.
- **Weather**—Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. When the temperature is high, relative humidity is low, wind speed is increasing and coming from the east (offshore flow), and there has been little or no precipitation so vegetation is dry, conditions are very favorable for extensive and severe wildfires. These conditions occur more frequently inland where temperatures are higher and fog is less prevalent.
- **Topography**—Topography includes slope and elevation. The topography of a region influences the amount of moisture retained in fuels; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as roads, vineyards, and lakes; and elevation and slope of landforms (fire spreads more easily uphill than downhill). In steep terrain, common geographic features such as drainages, gulches and canyons can funnel air to act as chimneys, pulling hot air, gases, and embers ahead or outside of the main fire. The direction that a slope faces also has a major influence on fire behavior. South-facing slopes receive heating and drying solar radiation from early in the morning until sunset, whereas north-facing slopes only receive solar radiation during a short period of the day when the sun is high in the sky.

15.1.2 Secondary Hazards

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding. These secondary impacts of wildfire can also affect the quantity and quality of water, which can pose a significant challenge to drinking water utilities.

15.2 HAZARD PROFILE

Virtually all of Sonoma County is at risk to wildfire. Risks include, but are not limited to, the following:

- Extensive building in wildland urban interface/intermix (WUI) areas
- Lack of vegetation management near homes and in wildland areas
- Structures not built or retrofitted with ignition-resistant building materials that can increase resistance to a wildfire's heat and embers
- A significant likelihood of high wind events during the dry fall months

Common fire causes in Sonoma County include electrical transmission line failures, equipment use, vehicle fires spreading into wildlands, and accidental starts from warming or debris fires. Due to heavy fuel loading, when fires start during high wind conditions, rapid rates of wildfire spread can result.

15.2.1 Wildfire Factors for the Planning area

Topography

Two steep ranges dominate the western and eastern lengths of Sonoma County, and most of the county's wildland-urban interface is in the hills and valleys of these two ranges. The hills of the Coastal Range rise abruptly from the Pacific shoreline to over 2,000 feet. The slopes of the Mayacamas Mountains on the county's eastern boundary rise from sea level valleys, including the Santa Rosa Plain, up to 4,500 feet on the slopes of Mount St. Helena. Sonoma County's valleys and foothills are predominantly devoted to agriculture but also contain most of the urbanized areas and population.

Weather

Sonoma County's primary wildland fire season typically spans the months May through November, with possible extension on both ends. In the fall, strong and dry northeast "Foehn" or "Diablo" winds significantly increase the likelihood and severity of wildland fires across California. With the exception of areas immediately along the coast, the weather during fire season is generally warm and dry during the day. Gradient winds, generally out of the south/southwest, typically strengthen in the late afternoon and diminish by dark.

Vegetation and Fuels

According to Sonoma County's 2016 *Community Wildfire Protection Plan*, there were 513,388 acres of coniferous forests and oak woodlands in Sonoma County at that time—more than 50.5 percent of county land area. Most of the oak woodland, and over 68 percent of the coniferous forestland (132,000 acres), is in private ownerships of 50 acres and less. Much of this forest acreage is not regularly maintained and contains dry/dead material and overcrowded trees and brush. The wide variation of ecosystems and microclimates in Sonoma

County make for a wide variety of vegetative fuels. In cooler climates there are redwood ecosystems as well as coastal prairie grasses. In the hills of the Mayacamas, chaparral, Douglas fir and other conifers, as well as oak grass lands, dominate (Fire Safe Sonoma 2016).

Firefighting Resources

A planning area's ability to suppress or fight fires when they start is a key factor affecting wildfire impacts. Federal, state, and local fire protection agencies that share resources and knowledge experience more effective and coordinated outcomes. Initial response to all fire, medical, and similar emergencies is the responsibility of 23 local fire departments in the Sonoma County Operational Area (FireDepartment.net, 2021). The County is divided into two types of responsibility areas:

- Local Responsibility Areas (LRA) and municipalities, where a local agency has primary responsibility for fire and emergency response. In LRA areas, local agencies have primary command, though they may request support from CAL FIRE.
- State Responsibility Areas (SRA), where the state firefighting agency, CAL FIRE, has primary responsibility for wildland fires and fires that pose a threat of spreading into the wildland. CAL FIRE has primary command of SRA fires as soon as their units arrive on the scene. SRAs cover 793,793 acres in Sonoma County—78 percent of the county.

Sonoma County is in CAL FIRE's Sonoma-Lake-Napa Unit, one of 21 CAL FIRE administrative units statewide. This unit covers 2.1 million acres in Sonoma, Lake, Napa, Yolo, Colusa, and Solano counties. It is served by three divisions and 10 field battalions. Sonoma County is the West Division, which contains four battalions and covers 793,793 acres.

The 23 local fire agencies in Sonoma County include fire protection districts, community services districts, and municipal fire departments. The City of Santa Rosa has its own fire department. The cities of Sonoma and Cotati and the Town of Windsor are served by local fire districts. Many of the fire districts in unincorporated areas are staffed by paid firefighters and supplemented by volunteers. In the areas most prone to wildland fires, fire suppression services are highly dependent on part-time and volunteer fire-fighting personnel, and the number of volunteer fire fighters has decreased in recent years. Volume 2 of this plan provides more information on the local fire protection districts participating in this multi-jurisdictional hazard mitigation planning effort.

15.2.2 Past Events

Wildland fires, particularly wildland/urban interface fires, have historically occurred in Sonoma County. As development and human activity in Sonoma County increased over the decades, the incidence of human-caused fires increased. Some of the largest or costliest fires since 1964 are listed in Table 15-1.

County residents today are greatly aware of the dangers that wildfire poses. From 2017 through 2020, a series of large, damaging wildfires directly affected Sonoma County. These fires burned over 300,000 acres in Sonoma County, destroyed nearly 7,000 structures, and killed 24 people. Wildfire has become an overwhelming and constant presence throughout the summer and fall, bringing long periods of toxic smoke, multiple red-flag warnings, planned power shutdowns, large-scale evacuations, and fear and trauma on the part of urban and rural residents alike.

Table 15-1. Sonoma County Fires Since 1964

	Name	Acres Burned	Structures Burned
1964	Hanley	52,700	108
1964	Nuns Canyon	10,400	27
1965	Knight's Valley	6,000	0
1965	Pocket Ranch	4,000	0
1965	Austin Creek	7,000	0
1972	Bradford	1,760	4
1978	Creighton Ridge	11,405	64
1988	Cloverdale	1,833	100
1988	Geysers	9,000	7
1996	Porter Creek	300	0
1996	Cavedale	2,100	0
1999	Geyser Road	1,300	0
2000	Berryessa	5,731	15
2004	Geysers	12,000	6
2008	85	322	0
2008	Pine	989	0
2013	McCabe	3,505	—
2015	Valley	76,067 (5,000 in Sonoma County)	1,955
2017	Sonoma Complex Fires (Tubbs, Nuns, Pocket, Presley, Young)	86,039	5,636
2017	Tubbs	36,807	5,643
2019	Kincade	77,753	371
2020	LNU Lightning Complex (Walbridge and Meyers)	57,563	303
2020	Glass	67,484	661

Wildfire Chronology

When humans moved into the landscape some 14,000 years ago, fire became a common feature on the landscape, as native people used fire to increase food production, keep more open landscapes, and promote other ecological values. It is estimated that grasslands and oak woodlands were burned about every 5 years, with forested areas burning about every 12 to 20 years.

Fire frequency decreased during post-statehood years, as European settlers did not perceive the ecological value of burning as it had been practiced by Native Americans. However, wildfires continued to ignite and burn, especially in historical wildfire corridors, These were primarily in the Mayacamas Mountains on the county's eastern boundary in the Coast Ridges on the west. Large destructive fires have occurred in both areas, most significantly in 1923, 1954, 1964, 1978, and 2017, 2019, and 2020.

In 1964, the Hanley and Nuns Canyon fires simultaneously burned 63,100 acres and 135 structures near the cities of Santa Rosa and Sonoma. Since then, there has been significant growth in rural WUI areas in the county, vastly increasing risks to life and property. The conversion of properties from agriculture, timber production, and grazing uses to residential use has left much of the county's wildland vegetation to grow unchecked by human activity or fire, significantly increasing potential for destructive wildfire.

In 2017, the Sonoma Complex fires (the Tubbs, Nuns, Adobe, and Pocket and Young fires) killed 24 residents and burned 110,716 acres. The 2017 Tubbs and Nuns Fires burned in nearly identical footprints to 1964's Hanley and Nuns Canyon fires, but because of development in the area nearly 6,000 structures were lost, compared with 135 in the earlier fire. Impacts like those from the 2017 fires will continue to impact the County and its residents for decades.

Sonoma County's recent wildfires reflect increasing fire size and intensity across California and the west. Table 15-2, derived from CAL FIRE data, shows the increasing frequency of destructive fires over the past 80 years. The 20 most destructive fires in state history all occurred in the previous 30 years. Of those 20 most destructive fires, the last 5 years represent:

- 75 percent of the number of events
- 85 percent of acres burned
- 82 percent of structures lost
- 76 percent of lives lost.

Table 15-2. CAL FIRE Destructive Wildfire Statistics, 1939-2020

Years	Number of fires	Acres Burned	Structures Burned	Lives Lost
20 Most Destructive Fires				
2015-2020	15	255,080	42,418	158
1991-2014	5	30,201	9,327	49
Total	*20*	*285,281*	*51,745*	*207*
Other Major Fires in Previous 50 Years				
1939 -1990	90	209,999	Not Available	Not Available
Total	110	495,280	51,745	207

Source: CAL FIRE, Created by Permit Sonoma GIS. Data subject to change as better data and analysis become available

Twelve of the 15 destructive wildfires in the past five years took place in Northern California, and seven of them burned within Sonoma County and/or in a bordering county. These data indicate a future characterized by increasing fire frequency, size, and destruction. With climate change, the potential for drought, hotter temperatures year-round, and increasing lightning events as experienced in 2020 is cause for significant concern.

Recent fires also indicate that wildfire does not impact only rural residents or forested areas. More than half (2,575) of the structures lost in the 2017 Tubbs Fire were in urban areas rated as "moderate" Fire Hazard Severity Zone or "urban/unzoned." Only 1,205 structures were lost in areas ranked as "very high" or "high" Fire Hazard Severity Zones

1964 Nuns Canyon Fire

The Nuns Canyon fire in the Sonoma Valley started on the same day as the Hanley fire and burned for six days. By the third and fourth days, the fire had burned 9,500 acres and reached Highway 12 and Boyes Hot Springs. By the sixth day, when the fire was brought under control, it had destroyed 27 homes and more than 10,000 acres.

1964 Hanley Fire

The Hanley fire started on September 19, 1964, on the Hanley property off Highway 29 on the slopes of Mt. St. Helena in Napa County. By the end of the next day, firefighters had contained the fire, but late in the night, winds drove the flames down the slopes to encircle Calistoga on two sides. Several homes on the perimeter of town were burned. On the third day, an ember ignited a spot fire on the ridge west of Highway 128 between Calistoga and Kellogg, in Sonoma County. The fire then raced into Knights Valley and turned southward into Franz Valley. By nightfall, the fire, driven by 70 mph winds, headed down Mark West Canyon toward Santa Rosa. The Sonoma County Hospital was threatened, with embers falling on the rooftop, and 40-foot high flames in nearby trees. To the east, the fire burned over the hills and down into the Rincon Valley area, where it was again stopped. The fire was not brought under control until the morning of September 26. The fire consumed 105 million board feet of timber valued at $1.5 million and destroyed 84 homes and 24 summer cabins. More than 52,000 acres were blackened. No human lives were lost.

2004 Geysers Fire

A number of fires have ignited in the area known as the Geysers. A fire on Labor Day weekend 2004 burned 12,500 acres in the Mayacamas Mountains in Sonoma and Lake counties over a five-day period, cost over $14 million to suppress, and caused over $10 million in property damage. The fire consumed six cabins and destroyed equipment and vehicles belonging to several companies operating in the area, including Calpine Corp., PG&E and AT&T. Firefighters were able to save pumping stations and geothermal power plants worth hundreds of millions of dollars. The 2004 *Sonoma Lake Napa Fire Management Plan* indicated that vegetation management was one of the primary reasons the geothermal facilities were not destroyed.

2015 Valley Fire

The Valley Fire was located mainly in southern Lake County but moved into Sonoma County, where it burned 5,000 acres near the Geysers and destroyed four steam cooling towers at the CalPine geothermal facility. Starting on September 12, 2015, the fire burned 76,067 acres and destroyed 1,958 structures including 1,280 homes, 27 multi-family structures, 66 commercial properties, and 585 minor structures such as outbuildings and sheds. An additional 93 structures were damaged, including 41 homes, 7 commercial properties and 45 other minor structures. Four firefighters were injured and there were 4 civilian fatalities.

2017 Sonoma Complex Fires—Tubbs, Nuns, and Pocket

On October 8, 2017, an historic wind event led to the worst firestorms in Sonoma County history, followed by almost three weeks of fire. In total, the Nuns, Tubbs, Pocket and Young fires (together comprising the 2017 Sonoma Complex Fire) claimed 24 lives, burned over 110,700 acres in Sonoma, Napa, and Lake counties, and destroyed 6,997 structures with total direct losses exceeding $7.8 billion. The following sections describe the three main fires in the complex that affected Sonoma County.

Tubbs Fire

The Tubbs Fire was the most destructive wildfire in California history when it occurred, burning parts of Napa, Sonoma, and Lake counties. The greatest losses were in the city of Santa Rosa. The Tubbs Fire was one of more than a dozen large fires that broke out in early October 2017 and simultaneously burned eight northern California counties. By the time of its containment on October 31, the fire was estimated to have burned 36,810 acres. At least 24 people in Sonoma County were believed to have been killed by the fire. The fire destroyed more than

5,643 structures, half of which were homes in Santa Rosa. Santa Rosa's economic loss from the Tubbs Fire was estimated at $1.2 billion, with 5 percent of the city's housing stock destroyed. The fire incurred $100 million in fire suppression costs.

Nuns Fire

The Nuns Fire broke out in a field in the community of Glen Ellen when strong winds knocked an alder tree into a powerline conductor. It merged with five other fires that together burned an area larger than the city of Oakland. It burned 56,556 acres and destroyed about 1,527 structures before being contained on October 31, 2017.

Pocket Fire

The Pocket Fire started on October 9, 2017 and was contained on October 31, 2017. The fire burned 17,357 acres within Sonoma County (Wildfire Today, 2018). This was a vegetation fire that started near Pocket Ranch Road east of the community of Geyserville. It began during a red flag warning issued by the National Weather Service. The fire was reported to have destroyed six structures and damaged two others (CalFire Investigation Report, 107CALNU010057, 10/9/2017).

2019 Kincade Fire

The Kincade Fire started northeast of Geyserville in the Mayacamas Mountains on October 23, 2019, and burned 77,753 acres and 371 structures before it was fully contained on November 6, 2019. The fire threatened over 90,000 structures and caused widespread evacuations (198,785 residents) throughout Sonoma County, including the communities of Geyserville, Healdsburg, and Windsor. The majority of Sonoma County and parts of Lake County were under evacuation warnings. The fire was the largest of the 2019 California wildfire season, and the largest ever in Sonoma County.

2020: LNU Lightning Complex Fire

Early on August 16, 2020, following a series of very hot days, thunderstorms hit California. Within the next 72 to 96 hours, over 12,000 lightning strikes were recorded over Northern California. These lightning strikes sparked up to 585 wildfires, many of which grew to be very large at a rapid pace due to parched brush (Wikipedia, 2021).

The Sonoma Lightning Complex, consisting of the Walbridge Fire (55,209 acres), and Meyers Fire (2,616 acres) burned 61,875 acres and 303 structures within Sonoma County. At the same time, in the Sonoma-Lake-Napa CAL FIRE Unit (LNU), the Hennessey Fire consumed 305,651 acres and caused six fatalities.

Firefighting resources were so stretched by the more than 500 wildfires burning across the state during the 2020 lightning siege that each engine company assigned to the fires in Sonoma County was responsible for more than 700 acres (Nicholls, 2020).

2020 Glass Fire

The 2020 Glass fire burned 67,484 acres and 611 structures in Sonoma County, threatening urban neighborhoods in eastern Santa Rosa, and prompting large-scale evacuations from Santa Rosa to Glen Ellen. The Glass Fire sparked in Napa Valley early on Sunday, September 27, 2020, growing at a rate of around 1 acre every five seconds between Sunday night and Monday morning, according to satellite images from the National Oceanic and

Atmospheric Administration. An estimated 70,000 people were under evacuation orders in the region surrounding the Glass Fire.

15.2.3 Location

CAL FIRE has identified several “historic wildland fire corridors” in Sonoma County, including the steep ridges of the coastal ridges in the northwest county, which experienced fires in 1923, 1951, and 1978; and the Geysers area in the northeast Mayacamas range, which has experienced fires in 2004, 2013 and 2019. The 1964 Hanley and Nunn’s fire footprints were nearly identical to the 2017 Tubbs and Nuns fires. The Mayacamas mountains south of Santa Rosa above the Sonoma Valley also have a history of repetitive fire loss, where the Cavedale fires of 1925 and 1996 and the 1964 Nunns fire, and 2017 Sonoma Complex fires caused significant damage.

Figure 15-1 shows the Sonoma County Wildfire Hazard Index, a model that predicts relative wildfire hazard on the landscape. The hazard index has the following categories: Very Low Relative Hazard, Low Relative Hazard, Moderate Relative Hazard, High Relative Hazard, and Very High Relative Hazard. The index is based on inputs that inform potential fire behavior, inputs that represent fire probability occurrence at any location, and a model of wildfire suppression difficulty. The hazard index reflects landscape conditions through the 2018 fire season. The wildfire hazard data was developed for the 2021 update of the County’s Community Wildfire Protection Plan Update. The data is preliminary, pending further peer review.

In general, the mapping shows higher-hazard areas on the hills and mountains of the Coast and Mayacamas ranges. Lower-hazard areas line the Pacific coast, San Pablo Bay, and the Sonoma valley.

15.2.4 Frequency

The overall probability of some wildfire event impacting the planning area is high. Table 15-1 shows 23 fires of 300 acres or more in Sonoma County between 1964 and 2020, an average of one large fire every 2.6 years.

Wildfire probability varies with time of year and size of fire. Wildland fire season in Sonoma County spans the months after the last spring rains have fallen and until the first significant fall or winter rains occur. August, September, and October have the greatest potential for wildland fires as vegetation dries out, humidity levels fall, and offshore winds blow. Changing climate conditions are beginning to extend the local fire season. Drought conditions are of special concern, as is the potential for changing weather patterns, including the potential for more dry lightning storms during fire season.

15.2.5 Severity

As seen in Figure 15-2, the frequency and severity of wildfires in Sonoma County has changed over the past 60 years, especially over the last five years (2015 to 2020). As the size of fire has increased, so has the number of structures burned. This correlates to an increase in fire severity. The more structures that burn, the higher the probability for fatalities, which is the ultimate measure for severity in a mitigation planning context. Except for the Hanley fire in 1964, no fires prior to 2015 had burned more than 12,000 acres, but the burn areas for fires from 2015 to 2020 range from 37,000 to 78,000 acres. Similarly, no fire before 2015 burned more than 108 structures, but fires from 2015 to 2020 burned from 370 to 5,600 structures.

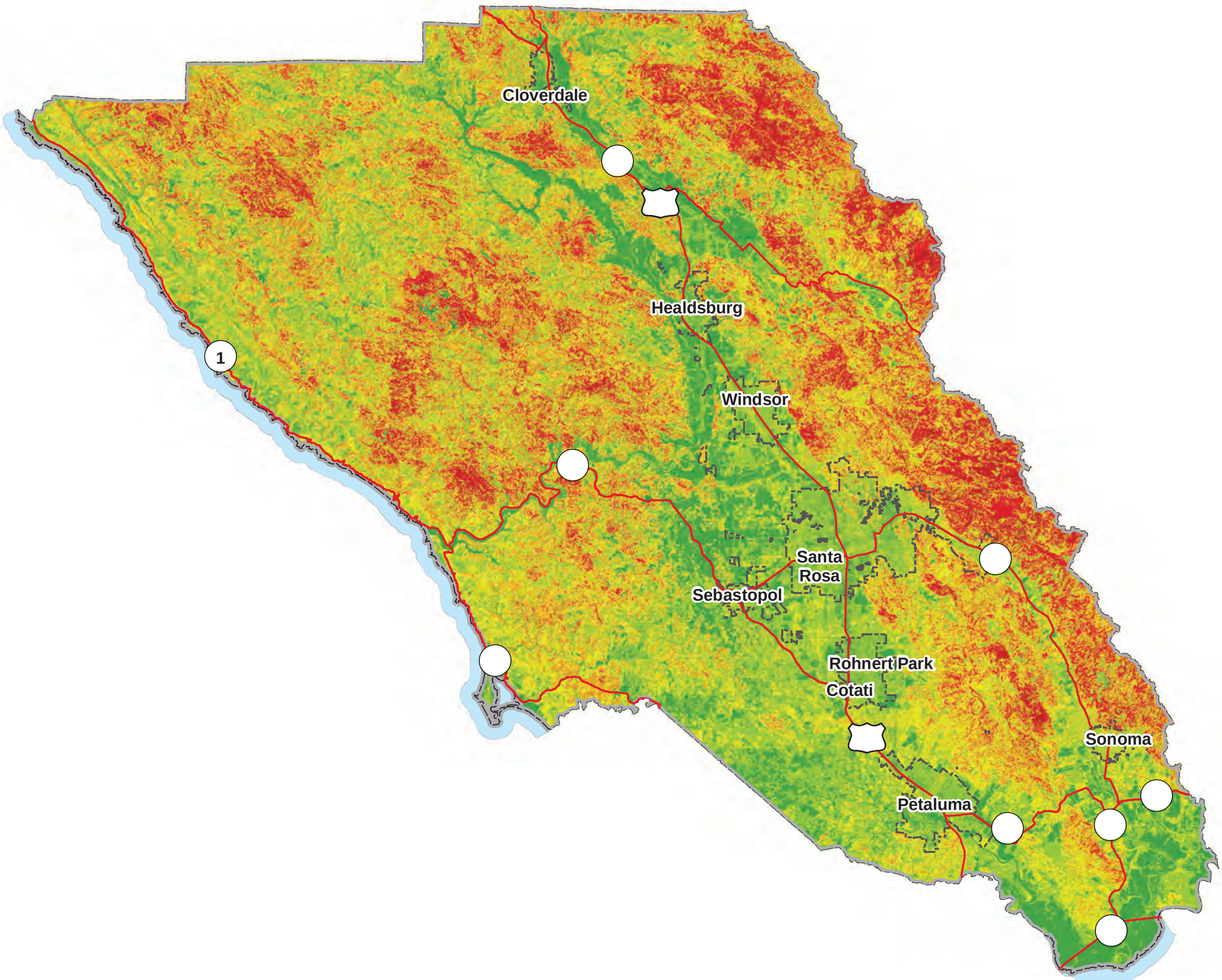
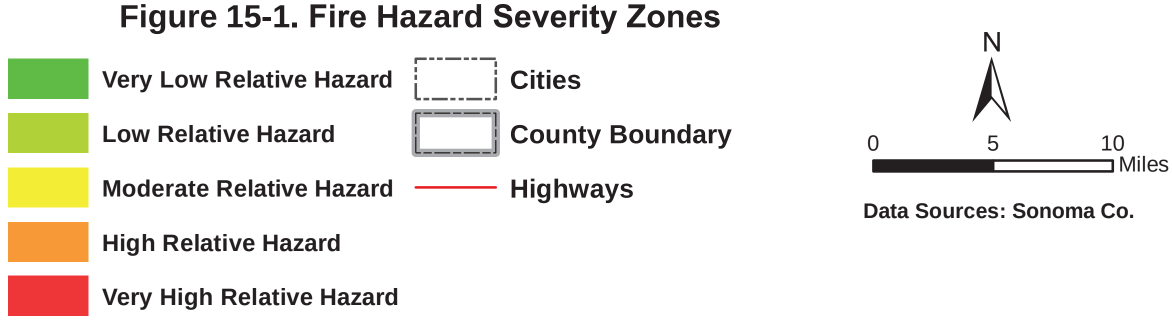


Figure 15-1. Fire Hazard Severity Zones



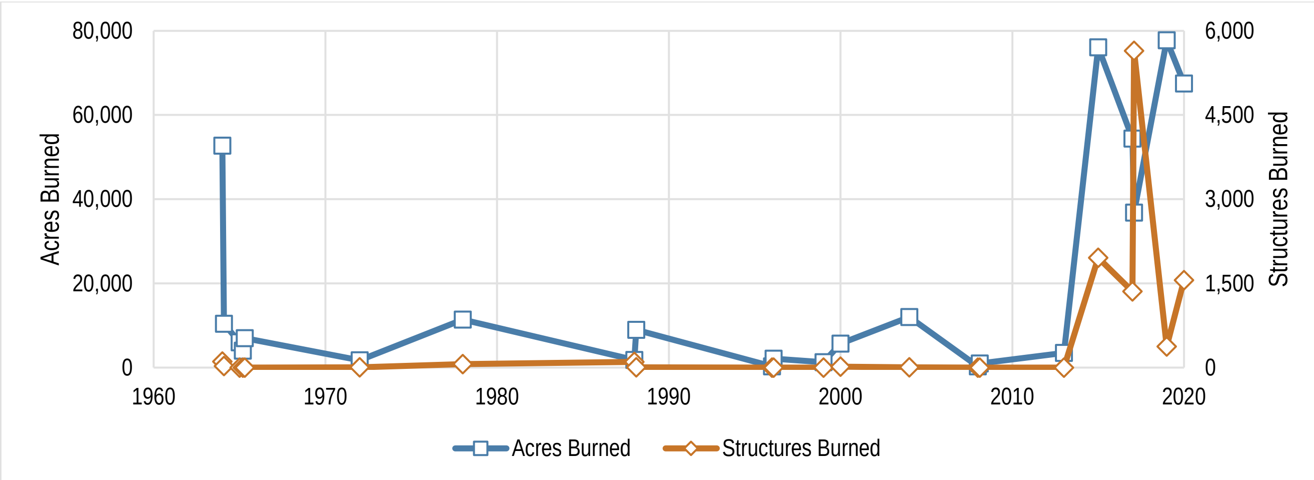


Figure 15-2. Acres and Structures burned, 1964 - 2020

Potential losses from wildfire include human life, structures and other improvements, natural resources, and natural systems such as water and watersheds. Damage to local economy can include loss of jobs due to direct fire losses or disruption from power safety shutoffs, or loss of crops from fire or smoke damage.

In 2017, at least 24 Sonoma County residents lost their lives due to wildfires. Reducing potential for loss of life should remain a top focus for planning and project implementation. Likewise, efforts should continue to help county residents create homes and communities that can better withstand exposure to the heat and embers of wildfires such as defensible space, structure hardening, and near-community “wildfire calming zones.”

Fire hazards present a significant risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of watersheds, timber, wildlife habitat, and scenic vistas. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. In addition, wildfire can lead to ancillary impacts such as landslides and flooding due to the impacts of silt in local watersheds.

Economic impacts due to wildfires include costs and losses due to burned or smoke-damaged crops, damaged public infrastructure and private property, interrupted transportation corridors, and disrupted communication lines. They also include diminished real property values and thus tax revenues, loss of retail sales, and relocation expenses of temporarily or permanently displaced residents. Power safety shutoffs also have significant impacts on local businesses and residents. Likewise, large-scale evacuations can have enormous impacts on local businesses.

Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations. Smoke generated by wildfire contains particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides) and toxics (formaldehyde, benzene). There has been a significant increase in scientific research regarding the impacts of wildfire smoke on public health. Impacts associated with wildfire include difficulty in breathing and increases in incidence of asthma, heart attacks and strokes. People who are over 65 years of age have a higher chance of heart attacks and strokes after two to three days of bad air quality due to wildfire smoke. Smoke worsens health conditions that are already more prevalent in lower-income locations, including some communities of color. One 2016 study in northern California found that people in lower-income zip code areas were disproportionately likely on wildfire smoke days to visit emergency rooms for asthma complications (Climate Connections, 2021).

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

15.2.6 Warning Time

If a fire breaks out and spread rapidly, residents may need to evacuate within hours or minutes. Wildfires are mostly caused by human activities and systems, intentionally or accidentally. There is no way to predict when one might break out. Dry conditions, wind and droughts greatly increase fire likelihood. Dry lightning, whose incidence may increase due to changing climate, triggered devastating wildfires across Sonoma County and the state in 2020. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm, so special attention can be paid during weather events that may include lightning.

Typically, fires burn with the greatest severity between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. However, when fires start under red flag conditions late at night, as was the case with the Sonoma Complex fires of 2017, alerting and evacuation can pose greater challenges for agencies and the public. Sonoma County has augmented systems and methodologies for alerting and evacuations since 2017 by developing and publicizing evacuation zones, and increasing the means for delivery of evacuation notification. Many Sonoma County communities, through programs such as Citizens Organized to Prepare for Emergencies (COPE) have organized to help notify their neighborhoods of emergencies.

Following a series of natural disasters, including Hurricane Katrina, that revealed shortcomings in the nation's ability to effectively alert populations at risk, Congress passed the Warning, Alert, and Response Network (WARN) Act in 2006. Today, new technologies such as smart phones and social media platforms offer new ways to communicate with the public, and the information ecosystem is much broader, including additional official channels, such as government social media accounts, opt-in short message service (SMS)-based alerting systems, and reverse 911 systems. Less official channels include mainstream media outlets and weather applications on connected devices. Unofficial channels include first-person reports via social media (National Academies of Sciences, Engineering, and Medicine, 2018).

15.3 EXPOSURE

A quantitative assessment of exposure to the wildfire hazard was conducted using the wildfire hazard mapping and the asset inventory developed for this plan, with an emphasis on the zones with the highest degree of susceptibility (moderate, high and very high fire risk). Summary results for the complete planning area are presented below. Detailed results by jurisdiction are provided in Appendix D.

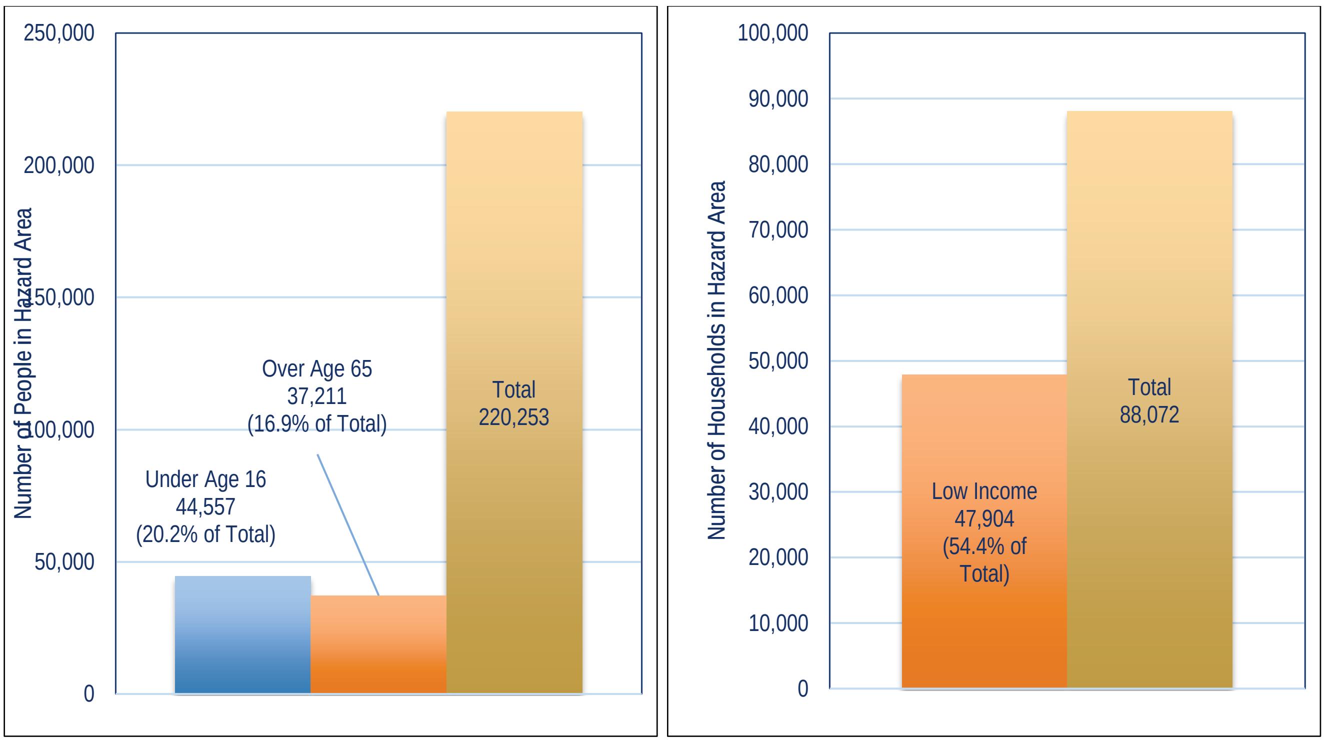
15.3.1 Population

Population exposure was estimated by calculating the number of buildings in each hazard area as a percent of total planning area buildings and applying this percentage to the planning area population. Table 15-3 summarizes the estimated countywide population living in the mapped risk areas. In addition to populations who reside in risk areas where fires may occur, visitors, hikers and campers may be exposed to wildfires. The entire population of the planning area has the potential to be exposed to smoke from nearby wildfires.

Table 15-3. Exposed Population in Mapped Relative Fire Hazard Zones

	Moderate Relative Hazard	High Relative Hazard	Very High Relative Hazard
Population Exposed	68,365	8,368	1,158
% of Total Planning Area Population	14.1%	1.7%	0.2%

Socially vulnerable populations exposed to the wildfire hazard were estimated based on data for the Census-defined blocks that lie at least partially within the mapped high and very high relative fire hazard zones. Because many of those Census blocks extend outside the mapped hazard zones, the estimates are greater than the actual exposed populations, but they provide reasonable relative data for use in mitigation planning. Figure 15-3 summarizes the estimated exposure of socially vulnerable populations.



See Section 4.8.1 for the definition of "low income" used in this analysis

Figure 15-3. Socially Vulnerable Populations in High and Very High Fire Hazard Zones Census Blocks

15.3.2 Property

Table 15-4 summarizes the estimated countywide property exposure in the mapped landslide risk areas. Figure 15-4 shows the occupancy class for all buildings in the mapped fire hazard areas. These occupancy classes provide an indication of land use within the mapped hazard area. Some land uses are more vulnerable to fire, such as single-family homes, while others are less vulnerable, such as agricultural land or parks.

15.3.3 Critical Facilities

The breakdown of critical facilities exposure in the high and very high severity zones by facility type is shown in Figure 15-5.

Table 15-4. Exposed Property in Mapped Relative Fire Hazard Zones

	Moderate Relative Hazard	High Relative Hazard	Very High Relative Hazard
Number of Buildings Exposed	26,245	4,798	1,175
Value of Exposed Structures	$20,143,725,511	$9,058,841,363	$3,802,457,456
Value of Exposed Contents	$16,645,566,386	$8,613,600,440	$3,746,872,248
Total Exposed Property Value	$36,789,291,897	$17,672,441,803	$7,549,329,704
Total Exposed Value as % of Planning Area Total	*16.8%*	*8.1%*	*3.5%*

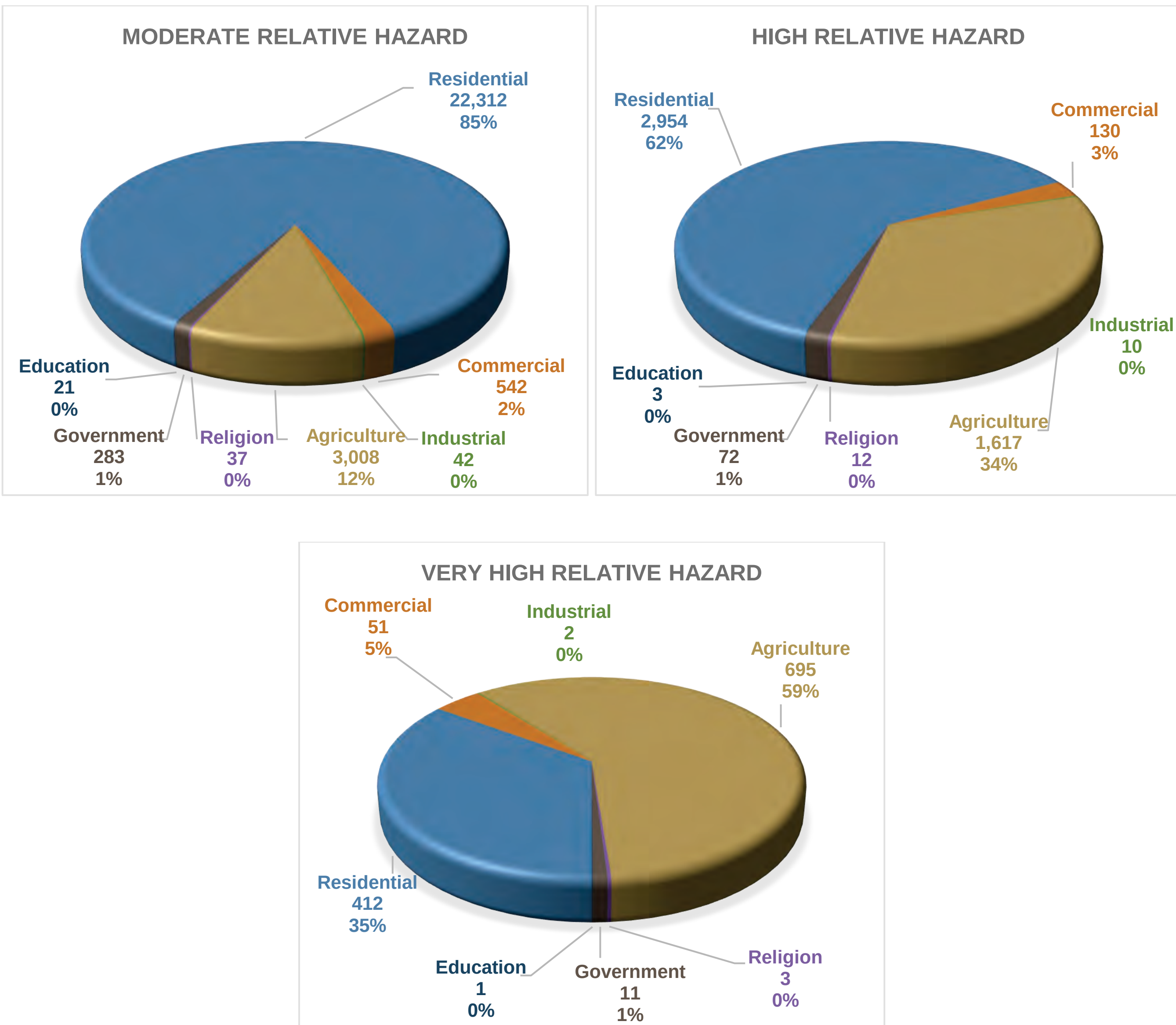


Figure 15-4. Structures in the High or Very High Relative Fire Hazard Zones, by Land Use Type

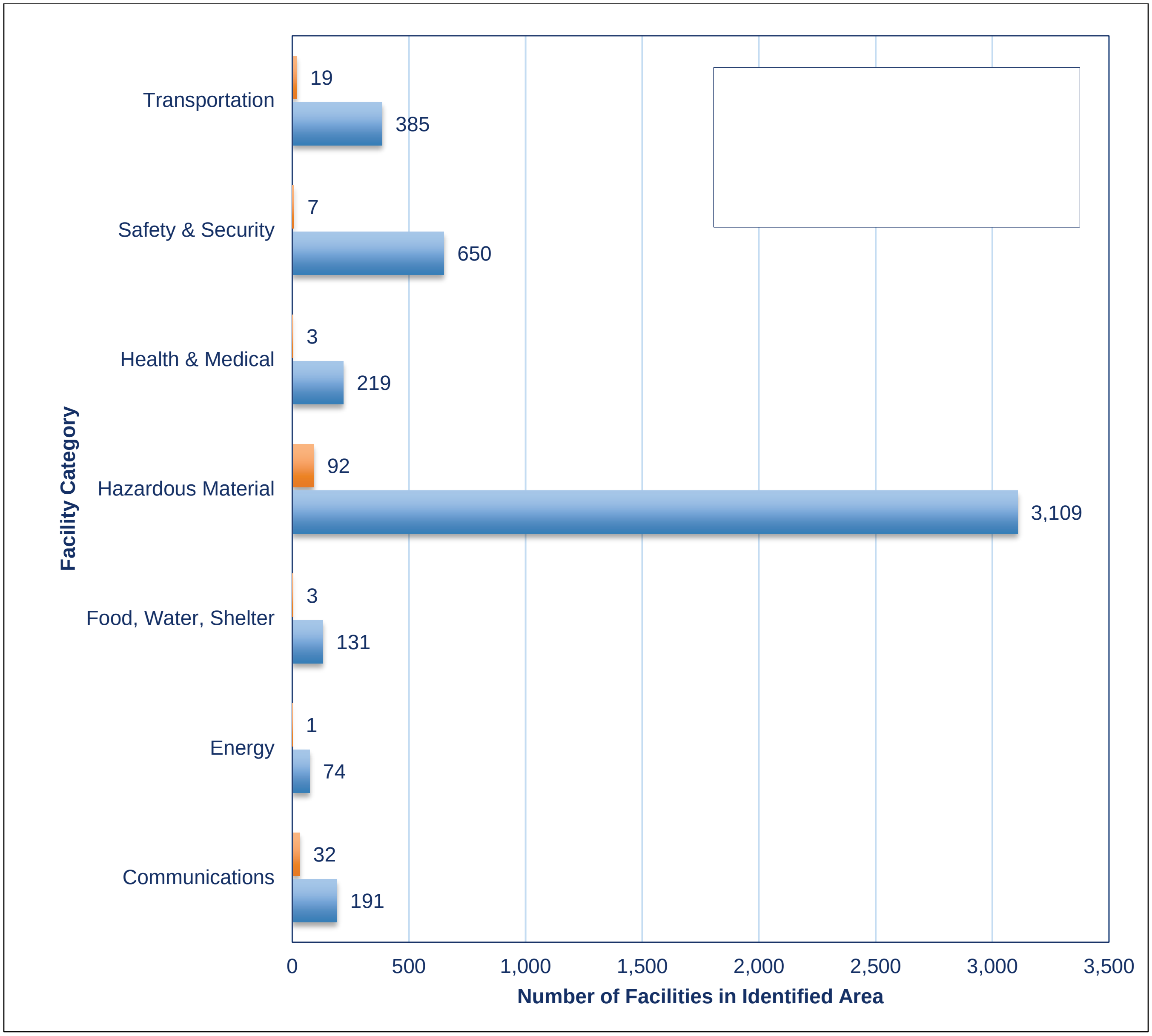


Figure 15-5. Critical Facilities in Mapped Relative Fire Hazard Zones and Countywide

15.3.4 Environment

All natural resources and habitats in mapped relative fire hazard zones are exposed to the risk of wildfire.

15.4 VULNERABILITY

15.4.1 Population

All people exposed to the wildfire hazard are potentially vulnerable to wildfire impacts. Persons with access and functional needs, the elderly and very young may be especially vulnerable to a wildfire if there is not adequate warning time for them to evacuate. People outside the mapped risk areas are susceptible to health hazards associated with smoke and air pollution from wildfires, especially sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Wildfires also threaten the health and safety of those fighting the fires.

15.4.2 Property

All property exposed to the wildfire hazard is vulnerable. Structures that were not constructed to standards designed to protect a building from a wildfire may be especially vulnerable. As of 2008, California State Building code requires minimum standards be met for new buildings in relative fire hazard zones. Less than 10 percent of housing in the planning area was built since this code requirement (U.S. Census Bureau n.d.).

Estimates were developed to indicate the loss that would occur if wildfire damage were equal to 1, 10, 30 or 50 percent of the exposed property value, as summarized in Table 15-5. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure.

Table 15-5. Loss Estimates for Wildfire Hazard

	Exposed Value	Loss Value	Loss as % of Total Planning Area Replacement Value
Moderate Relative Hazard			
Loss = 1% of Exposed Value	$36.79 billion	$370 million	less than 1%
Loss = 10% of Exposed Value		$3.68 billion	1.7%
Loss = 30% of Exposed Value		$11.04 billion	5.0%
Loss = 50% of Exposed Value		$18.40 billion	8.4%
High Relative Hazard			
Loss = 1% of Exposed Value	$17.67 billion	$180 million	less than 1%
Loss = 10% of Exposed Value		$1.77 billion	less than 1%
Loss = 30% of Exposed Value		$5.30 billion	2.4%
Loss = 50% of Exposed Value		$8.84 billion	4.0%
Very Relative Hazard			
Loss = 1% of Exposed Value	$7.55 billion	$80 million	less than 1%
Loss = 10% of Exposed Value		$760 million	less than 1%
Loss = 30% of Exposed Value		$2.26 billion	1.0%
Loss = 50% of Exposed Value		$3.78 billion	1.8%

15.4.3 Critical Facilities

Critical facilities not built to fire protection standards, utility poles and lines, and facilities containing hazardous materials are most vulnerable to the wildfire hazard. Most roads would not be damaged except in the worst scenarios, although roads and bridges can be blocked by debris or other wildfire-related conditions and become impassable. Additionally, heavy vehicle traffic during incidents and in post-fire recovery and rebuild can have significant impact on road surfaces. The following critical facilities are located in very high and high severity zones and their vulnerability could complicate response and recovery efforts during and following an event:

- **Hazardous Materials and Fuel Storage**—During a wildfire event, these materials could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels. In addition, they could leak into surrounding areas, saturating soils and seeping into surface waters, and have a disastrous effect on the environment.
- **Communication Facilities**—If these facilities are damaged and become inoperable, it would exacerbate already difficult communication in the planning area.

15.4.4 Environment

Sonoma County's ecosystems are fire adapted. Native plant species have evolved with fire in the landscape, and occurrence of fire is an integral component of forest health. Over millennia, nature has selected for species that survive the passage of wildfire, and for the healthiest, best-placed trees to survive. Some species require fire in order to propagate or germinate seeds. However, severe wildfire behavior, can also cause severe environmental impacts, such as the following:

- **Soil Erosion**—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species**—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- **Disease and Insect Infestations**—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- **Damaged Fisheries**—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- **Destroyed Endangered Species Habitat—**Wildfire can have negative consequences for endangered species by degrading their habitat.
- **Soil Sterilization**—Some wildfires burn so hot that they can sterilize the soil. Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost.
- **Reduced Timber Harvesting**—Timber can be destroyed and lead to smaller available timber harvests.
- **Reduced Agricultural Resources**—Wildfire can have disastrous consequences on agricultural resources, removing them from production and necessitating lengthy restoration programs. In addition to fire directly impacting winery facilities and vineyards, smoke can impact grapes on the vine, tainting the grapes so that they become unusable for wine production.
- **Damaged Cultural and Historical Resources**—The destruction of cultural and historic resources may occur, scenic vistas can be damaged, and access to recreational areas can be reduced.

15.5 FUTURE TRENDS IN DEVELOPMENT

Urbanization tends to alter the natural fire regime and can lead to expansion of urbanized areas into wildland areas. Placement of additional housing in the wildland/urban interface areas located in high or very high relative fire hazard zones can increase the fire threat, particularly in the historical fire corridors north and east of Santa Rosa and in the Sonoma Valley. Development in these areas can burden existing fire protection services, particularly in areas dependent on volunteer firefighters.

Most of the homes in Sonoma County's WUI areas were constructed before 2008, when California's WUI Building Code (California Code Chapter 7A) went into effect. This code requires ignition-resistant building materials in WUI areas. Structures built before it took effect and those without adequate vegetation management are at higher risk to wildland fire ignition. In Sonoma County, there are 27,286 structures in the WUI. Approximately 12,600 of those (all structures with a footprint greater than 1,500 square feet) are in areas with high and very high risk of wildland fires.

Patterns of land use and development have placed extensive residential infrastructure into places that recent, large fires have placed at severe risk. These fires have resulted in the loss of over 6,000 homes in Sonoma County, as well as thousands of other structures. This risk is expected to increase in coming decades. Fire will likely recur within similar footprints and place the same infrastructure at risk into the foreseeable future, as well as occurring in previously unburned areas.

The expansion of development toward wildfire hazard areas can be managed with strong land use and building codes. State and local policies and regulations require landowners to carry out activities such as maintaining defensible space and reducing vulnerability to damage or loss from wildfire. In Sonoma County, defensible space is regulated in Local Responsibility Areas through Sonoma County Code Chapter 13A. In the State Responsibility areas, the California Building Code includes minimum standards related to the design and construction of buildings in fire hazard zones. Any newly permitted buildings must conform to standards that manage flammable materials from around the building (defensible space laws) and construct buildings from fire-resistant material. New residential construction in high hazard areas in the State Responsibility Areas must be built according to the standards of the 2007 WUI Building Code. Defensible SPACE in the SRA is regulated through Public Resource Code 4290 and 4291, Title 14 of the California Code of Regulations, and Government Code Sections 51175 through 51189.

The State of California has enacted significant legislation that attempts to manage and mitigate wildfire risk. Appendix B provides a summary of this legislation, much of which will have an impact on future development that interfaces a wildfire hazard severity zone. In addition, the planning partners' general plans include policies that address managing development in relative fire hazard zones. The planning area is well equipped with these tools, and this planning process has asked each planning partner to assess its capabilities with regards to the tools. As the planning area experiences future growth, it is anticipated that the exposure to this hazard will remain as assessed or even decrease over time due to these capabilities.

15.6 SCENARIO

A major wildfire in the planning area might begin with a wet spring, which could encourage growth of light flashy fuels, such as grasses and brush. The summer could see the onset of insect infestation or plant pathogens that increase tree mortality. A dry summer could follow the wet spring, exacerbated by dry hot winds. Carelessness with combustible materials, equipment use, a vehicle fire, a tossed lit cigarette, or a lightning storm could trigger a multitude of small isolated fires.

The embers from these smaller fires could be carried miles by hot, dry winds. The deposition zone for these embers could be deep in forested areas or in urban areas. Fires that start in flat areas move slower, but wind still pushes them. It is not unusual for a wildfire pushed by wind to burn the ground fuel and later climb into the crown and reverse its track. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These new small fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving lives, homes, and communities. In 2017, the Tubbs fire became an urban conflagration fire, as embers from wildland areas carried across multiple lane Highway 101 to ignite businesses and the community of Coffey Park, where approximately 1,300 homes were lost along with commercial buildings.

The worst-case scenario would include an active fire season throughout the American west, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing floodplains and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Floods that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and floodplain elevations would increase.

15.7 ISSUES

Wildfire is an inevitable and normal ecological process in the fire-adapted landscape of Sonoma County. Nearly 100 years of aggressive fire suppression has contributed to the high wildfire risk of today. Absent fire for many years, wildland areas became overstocked with highly flammable vegetation. At the same time, expansion of homes into rural WUI areas increased the number of homes in high-risk areas. Typically, residential property owners do not maintain forested lands, exacerbating wildfire potential. On public lands, available budget for large-scale wildland fuels maintenance is an ongoing issue. Overcrowded conditions degrade overall forest health and degrade the environmental values provided by forest ecosystems.

While in a few areas, recent wildfires burned hot enough to damage wildland ecosystems, in general wildland ecosystems have not sustained irrevocable damage. In many cases fires were beneficial. Large, uncontrolled wildfires can cause significant damage to ecosystem services, however life, home and economic losses to residents and communities must be considered along with environmental consequences.

Research shows that home loss in wildland fires is primarily driven by two equally important factors:

- The vulnerabilities of buildings that make them prone to ignition—Embers cause 80 percent of wildland fire home ignitions. The following elements are most vulnerable to embers but can be retrofitted on existing homes to reduce risk of ignition:
  - Non-Class A roofs
  - Roof edges and soffits
  - Combustible plants and materials within 5 feet of house walls
  - Non-WUI approved venting products that allow for ember entry into structures
  - Wooden attachments, such as fences and decks
  - Non-WUI rated windows
  - Siding

- The vegetative fuels within 100 feet of structures (the area referred to as defensible space)—Good defensible space, wherein vegetation has been reduced to reduce fire intensity and spread, is critical to reduce ignition.

Most of the homes in Sonoma County's WUI areas were constructed before 2008, when the WUI Building Code went into effect. This code requires ignition-resistant building materials in WUI areas. Structures built before it took effect and those without adequate vegetation management are at higher risk to wildland fire ignition.

Outside of the home and the 100-foot defensible space zone, surrounding wildland fuels can play a role in home destruction, as fire and embers can spread from nearby wildland areas into communities. It is in this area that vegetation management can come into play. This refers to actions taken to alter natural vegetation or plant communities that abut communities, usually on the scale of 10s to 1,000s of acres. Vegetation management can include prescribed fire, prescribed grazing, timber harvest techniques, invasive plant removal, or mechanical treatment to remove fine fuels, dense stands of fire-prone species, shrubs, and dead and dying vegetation. Fuels are reduced in order to create "community calming zones" or restore ecosystems to less flammable conditions. Strategically placed calming zones can reduce near-community fire intensity and spread, provide safe anchors that firefighters can use to stop forward progress of the fire, and supplement and support near-home mitigation strategies. Roadside fuels treatment can support emergency ingress and egress, increasing community and firefighter safety.

Although the patterns of land use, natural plant communities, topography, weather, soils, and geology vary across the landscapes of Sonoma County, notable patterns are discernible. An approach is needed for deploying existing techniques at the scale of whole communities. Such an approach would be informed by the principles of landscape ecology. It would view the natural lands where fires tend to originate and the built infrastructure of human communities that abut the natural landscapes as a coupled system. Mitigating large-scale loss of life and property can be achieved using relatively well-established techniques of home hardening, defensible space and vegetation management at the scale of whole communities and the natural landscapes that surround them.

16. CLIMATE CHANGE

16.1 GENERAL BACKGROUND

16.1.1 What is Climate Change?

Climate is the result of long-term weather patterns—including temperature, precipitation, humidity, wind and seasons—and plays a fundamental role in shaping natural ecosystems and the human economies and cultures that depend on them. “Climate change” refers to changes over a long period of time, with units of climate change measurements often conducted in 30-year increments.

The well-established worldwide warming trend of recent decades and its related impacts are caused by increasing concentrations of carbon dioxide and other greenhouse gases in the earth’s atmosphere. Greenhouse gases are gases that trap heat in the atmosphere, resulting in a warming effect. Carbon dioxide is the most commonly known greenhouse gas; however, methane, nitrous oxide and fluorinated gases also contribute to warming. Emissions of these gases come from a variety of sources, such as the combustion of fossil fuels, agricultural production and changes in land use. According to the National Aeronautics and Space Administration (NASA), carbon dioxide concentrations measured about 280 parts per million (ppm) before the industrial era began in the late 1700s and have risen dramatically since then, surpassing 400 ppm in 2013 for the first time in recorded history (see Figure 16-1).

16.1.2 How Climate Change Affects Hazard Mitigation

Climate change will affect the people, property, economy, and ecosystems of the planning area in a variety of ways. Consequences of climate change include increased flood vulnerability, and increased heat-related illnesses. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every 5 years for the past 100 years, then it can be expected to continue to flood an average of once every 5 years.

Source: NASA, 2020

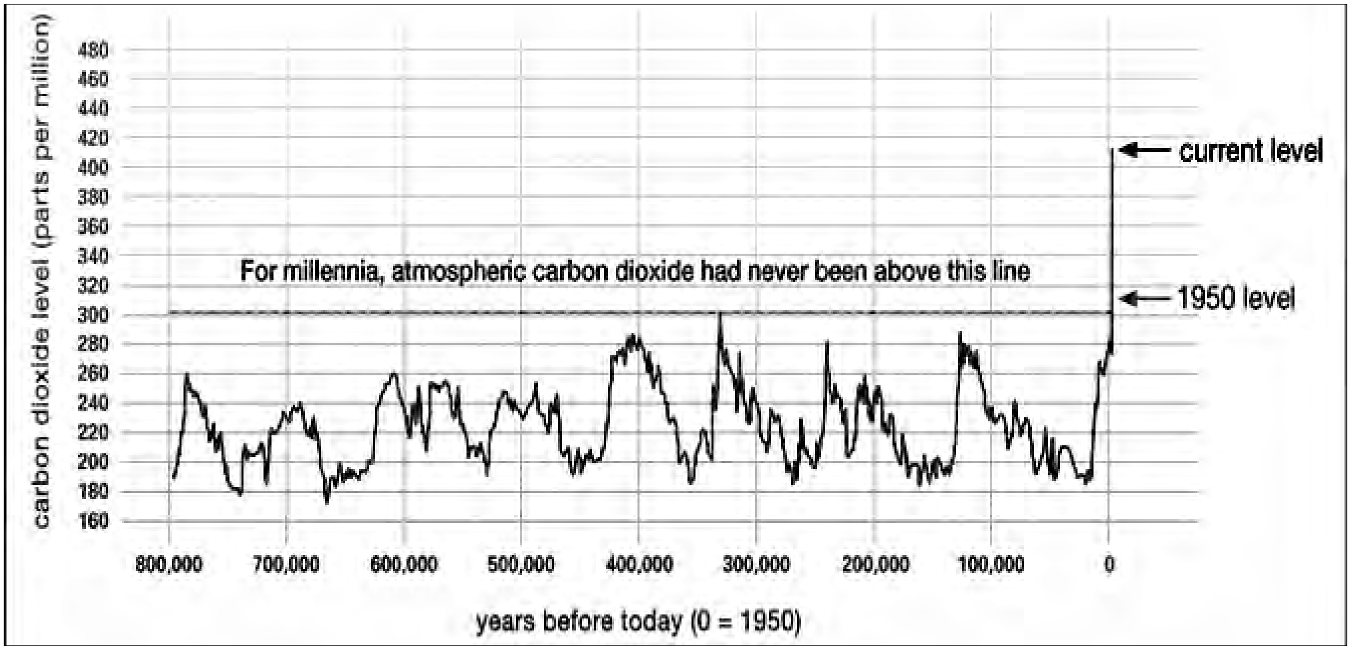


Figure 16-1. Global Carbon Dioxide Concentrations Over Time

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. Specifically, as hydrology changes, storms currently considered to be the 100-year flood might strike more often, leaving many communities at greater risk.

The risks of landslide, severe storms, and wildfire are all affected by climate patterns as well. For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis.

16.1.3 Current Indicators of Climate Change

Global Indicators

The major scientific agencies of the United States—including NASA and the National Oceanic and Atmospheric Administration (NOAA)—have presented evidence that climate change is occurring. NASA summarizes key evidence as follows (NASA, 2020a):

- **Global Temperature Rise**—The planet's average surface temperature has risen about 1.62 ºF since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the warming occurred in the past 35 years, with the five warmest years on record taking place since 2010.
- **Warming Oceans**—The oceans have absorbed much of this increased heat, with the top 2,300 feet of ocean showing warming of more than 0.4 ºF since 1969.

- **Shrinking Ice Sheets**—The Greenland and Antarctic ice sheets have decreased in mass. Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, and Antarctica lost about 127 billion tons of ice per year during the same time period. The rate of Antarctica ice mass loss has tripled in the last decade.
- **Glacial Retreat**—Glaciers are retreating almost everywhere around the world—including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.
- **Decreased Snow Cover**—Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier
- **Sea Level Rise**—Global sea level rose about 8 inches in the last century. The rate in the last two decades is nearly double that of the last century and is accelerating slightly every year.
- **Declining Arctic Sea Ice**—Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades
- **Extreme Events**—The number of record high temperature events in the United States has been increasing since 1950, while the number of record low temperature events has been decreasing. The U.S. has also witnessed increasing numbers of intense rainfall events.
- **Ocean Acidification**—Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.

California Indicators

Climate change poses an immediate and growing threat to California's environment, public health, and economic vitality. Monitoring and research efforts across the state generate observational data that describe changes that are already underway. These data can serve as the basis for indicators that track trends over time. Climate change indicators help to track, evaluate, and report on the climate change issues the state is working to address. They facilitate the communication of climate-related information to a broad audience by synthesizing large volumes of complex data into a concise, easily understood format. The *California Fourth Climate Assessment* identifies temperature, precipitation, drought, snowpack, fog, wildfire, and sea level rise as the most dynamic and indicative elements of a changing climate in the greater Bay Area (Ackerly et al. 2018).

Impact on Physical Systems

California's Office of Environmental Health Hazard Assessment has identified the following physical impacts as indicators of climate change in the state (California Office of Environmental Health Hazard Assessment 2018):

- **Dissolved Oxygen in Coastal Waters**—Throughout the south coast survey region, dissolved oxygen levels to at least 500-meter depths have declined.
- **Lake Water Temperature**—Average water temperatures in Lake Tahoe—derived from measurements from the bottom to the surface of the lake—have gone up by nearly a full degree Fahrenheit since 1970, at an average rate of 0.02 ºF each year. In the last four years, Lake Tahoe's waters warmed at a rate about 10 times faster than the long-term rate. This rapid warming is of special concern, because Lake Tahoe's enormous volume should make it less vulnerable to change.
- **Snow-Water Content**—Snow-water content has ranged from over 200 percent of average in 1952, 1969 and 1983 to a record-low 5 percent of average in 2015 during the extreme drought. Regional differences in snow-water content have been noted in the Sierra Nevada. Cooler air temperatures at higher elevations

generally allow for more snow to accumulate. Since 1950, the northern Sierra Nevada showed an overall decline of 7.4 inches. Less of a decline (1.2 inches) has occurred in the southern region, where elevations are higher. These declines are part of a broader pattern of decreasing snowpack in the western United States. This pattern correlates with warming spring temperatures and earlier snowmelt in recent years.

- **Coastal Ocean Temperature—**Sea surface temperature increased at the rate of 0.2 °F per decade at Pacific Grove (between 1920 and 2014) and at La Jolla (between 1917 and 2016). Since 1973, however, warming at La Jolla occurred at a faster rate of 0.6 °F per decade. At Trinidad Bay, sea surface temperatures increased at the rate of 0.4 °F per decade over the same shorter time period (1973 - 2016). Unusually warm waters occurred in the Pacific Ocean in 2014-2015, leading to widespread impacts on marine life, including shifts in species distribution, mass stranding of sea lions and sea birds, and fishery closures (further discussed below). This marine heat wave first appeared as a large area of exceptionally high sea surface temperatures in the Gulf of Alaska in November 2013 (nicknamed "the warm blob"). It later extended along the entire west coast of North America.
- **Glacier Change—**The surface area of seven Sierra Nevada glaciers has decreased dramatically since the beginning of the twentieth century. The graph on the right shows the fraction of the area of these glaciers relative to the year 1903. These glaciers are among the largest at higher elevations for which data are available. In 2014, the size of these glaciers ranged from 14 to 52 percent of their 1903 area—a reduction of 48 to 86 percent.
- **Sea Level Rise—**Sea level has risen by about 7 inches at San Francisco since 1900 and by about 6 inches at La Jolla since 1924. Sea levels show year-to-year variability but are rising overall at almost all tide gauge locations in California.
- **Snowmelt Runoff**—Since 1906, the fraction of annual snowmelt runoff that flows into the Sacramento River between April and July has decreased by about 9 percent. The 2015 water year had the third lowest percentage of spring runoff on record. Compared to the 50-year period between 1906 and 1955, peak monthly runoff (when runoff volume is at its maximum) occurred nearly a month earlier in 1956 – 2007. This shift indicates an earlier onset of springtime temperatures.

Impact on Biological Systems

California's Office of Environmental Health Hazard Assessment has identified the following biological impacts as indicators of climate change in the state (California Office of Environmental Health Hazard Assessment 2018):

- **Changes in Forests and Woodlands**—Compared to the 1930s, forests across much of California today have lower densities of large trees (over 24 inches in diameter), and higher densities of small trees (4 to 12 inches in diameter). Pines have declined in all regions, while oaks have increased in two Sierra Nevada regions but decreased in the South and Central Coast ranges. Water stress, which increases in a warming climate, poses a greater risk to large trees and pines than to small trees and oaks. Other factors that influence forest structure and composition and are exacerbated by climate change include fire suppression, logging practices and wildfires.
- **Forest Tree Mortality**—Annual tree mortality in California forests increased in 2014, two years into the 2012 – 2016 drought. Steep increases in mortality followed in subsequent years; the highest number, 62 million tree deaths, was recorded in 2016. The drought may foreshadow an increasingly common condition known as a "hotter drought," where warm temperatures coincide with periodic dry years. When temperatures are high, plant water demand increases while soil moisture decreases, creating a stress on trees. This stress in combination with bark beetle infestation led to the dramatic number of tree deaths.

- **Heat-Related Mortality and Morbidity**—Heat-related deaths and illnesses in California increased dramatically in 2006 following a record-breaking heatwave. That year, at least 140 deaths occurred between July 15 and August 1. About 16,000 more emergency room visits, and about 1,100 more hospitalizations than usual occurred during this period (compared to a similar time period in the summer of 2006 when there was not a heat wave). Multiple locations in California broke records for the highest number of uninterrupted days over 100 °F ever recorded: 11 in Sacramento; 12 in Modesto; and 21 in Woodland Hills near Los Angeles. Deaths related to this heat wave were largely attributed to elevated nighttime temperatures.
- **Wildfires—**The number of acres burned by wildfires statewide has increased since 1950. Although fires are fewer in number, large fires—affecting 1,000 acres or more—account for most of the area burned. On average, there are about half as many large fires each year as fires affecting less than 1,000 acres.

16.1.4 Projected Future Impacts

Climate change projections contain inherent uncertainty, for example, dependence upon future greenhouse gas emission scenarios. Generally, the uncertainty in greenhouse gas emissions is addressed by the presentation of differing scenarios: low-emissions or high-emissions scenarios. In low-emissions scenarios, greenhouse gas emissions are reduced substantially from current levels. In high-emissions scenarios, greenhouse gas emissions generally increase or continue at current levels. Uncertainty in outcomes is generally addressed by averaging a variety of model outcomes. Despite this uncertainty, climate change projections present valuable information to help guide decision-making for possible future conditions.

Global Projections

The Intergovernmental Panel on Climate Change (IPCC), which includes more than 1,300 scientists from the United States and other countries, projects that Earth's average temperatures will rise between 2.5 and 10 ºF over the next 100 years (NASA, 2020). Some research has concluded that every increase of 2 ºF in average global average temperature can have the following impacts (National Research Council, 2011):

- 3 to 10 percent increases in the amount of rain falling during the heaviest precipitation events, which can increase flooding risks
- 200 to 400 percent increases in the area burned by wildfire in parts of the western United States
- 5 to 10 percent decreases in stream flow in some river basins
- 5 to 15 percent reductions in the yields of crops as currently grown.

Sea level is rising at increasing rates due to global warming of the atmosphere and oceans and melting of the glaciers and ice sheets. Rising sea level and projections of stronger and more frequent El Niño events indicate a growing vulnerability to coastal flooding and erosion. While the IPCC's "business as usual" scenario, in which greenhouse gas emissions continue at the current rate of increase, predicts up to 3.61 feet of global sea level rise by 2100 (Intergovernmental Panel on Climate Change (IPCC) n.d.), other observations and projections suggest that these ranges do not capture the full range of physically plausible global average sea level rise over the 21st century (National Oceanic and Atmospheric Administration 2017). The National Climate Assessment completed by NOAA suggested that sea levels could rise as much as 8.2 feet by the end of the century if rapid loss of Antarctic ice occurred (U.S. Global Change Research Program (USGCRP) 2018).

Projections for California

The following sections summarize information developed for the planning area by Cal-Adapt, a resource for public information on how climate change might impact local communities, based on the most current data available. The projections are averaged across the county-wide planning area and include information from two emissions scenarios developed by the IPCC (low emissions and high emissions).

Modeled Climate Changes

Table 16-1 summarizes projected impacts for three potential climate change scenarios. By the end of the century under a high-emissions scenario, the following changes are projected, depending on the scenario:

- Average maximum temperatures would rise by up to 11.7 °F.
- Average minimum temperatures would rise by up to 8.4 °F.
- Average precipitation could increase by 35 percent or decrease by 21 percent
- The water deficit would increase by up to 22 percent

Table 16-1. Historical and Future Projections for Climate Information in Sonoma County

	Change from Current (1981 2010) Average					
	Moderate Warming, High Rainfall		Moderate Warming, Moderate Rainfall		Hot, Low Rainfall	
Variable	2040 2069	2070 2099	2040 2069	2070 2099	2040 2069	2070 2099
Precipitation	25%	35%	-2%	6%	-19%	-21%
Minimum Winter Temperature	3.4 ºF	6.2 ºF	2.7 ºF	5.5 ºF	4.8 ºF	8. 4ºF
Maximum Summer Temperature	4.8 ºF	8.6 ºF	3.9 ºF	7.6 ºF	6.6 ºF	11.7 ºF
Water Deficit	5%	10%	6%	10%	12%	22%
Groundwater Recharge	25%	29%	4%	6%	-20%	-17%
Runoff	61%	90%	-1%	22%	-32%	-34%

Source: California Landscape Conservation Partnership. 2021

Sea Level Rise

Sea levels have been rising over the past several decades and are expected to continue to rise. Sea level rise is mostly attributed to two factors: the expansion of water as it warms (thermal expansion) and the melting of ice sheets and glaciers. As average ocean temperatures continue to increase, thermal expansion will continue and can be projected with some degree of certainty. Less certain is how quickly ice sheets will melt, accounting for most of the uncertainty in projections.

Sea level rise will cause currently dry areas to be permanently or chronically inundated. Temporary inundation from extreme tide events and storm surge also will change. Unlike many other impacts resulting from climate change, sea level rise will have a defined extent and location. This allows for a more-detailed risk assessment to be conducted for this climate change impact (see Chapter 12). Although the extent and timing of sea level rise is still uncertain, assessing potential areas at risk provides information appropriate for planning purposes.

16.1.5 Responses to Climate Change

Communities and governments worldwide are working to address, evaluate and prepare for climate changes that are likely to impact communities in coming decades. Generally, climate change discussions encompass two separate but inter-related considerations: mitigation and adaptation. The term “mitigation” can be confusing, because it’s meaning changes across disciplines:

- Mitigation in emergency management—as generally addressed in this hazard mitigation plan—is typically defined as the effort to reduce loss of life and property by lessening the impact of disasters.
- Mitigation in climate change discussions is defined as a human intervention to reduce impacts on the climate system. It includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks.

In this chapter, mitigation is used as defined by the climate change community. In the other chapters of this plan, mitigation is primarily used in an emergency management context.

Adaptation refers to adjustments in natural or human systems in response to the actual or anticipated effects of climate change and associated impacts. These adjustments may moderate harm or exploit beneficial opportunities. Mitigation and adaptation are related, as the world’s ability to reduce greenhouse gas emissions will affect the degree of adaptation that will be necessary. Some initiatives and actions can both reduce greenhouse gas emissions and support adaptation to likely future conditions.

Societies across the world are facing the need to adapt to changing conditions associated with natural disasters and climate change. Farmers are altering crops and agricultural methods to deal with changing rainfall and rising temperature; architects and engineers are redesigning buildings; planners are looking at managing water supplies to deal with droughts or flooding.

Adaptive capacity goes beyond human systems, as some ecosystems are able to adapt to change and to buffer surrounding areas from the impacts of change. Forests can bind soils and hold large volumes of water during times of plenty, releasing it through the year; floodplains can absorb vast volumes of water during peak flows; coastal ecosystems can hold out against storms, attenuating waves and reducing erosion. Other ecosystem services—such as food provision, timber, materials, medicines and recreation—can provide a buffer to societies in the face of changing conditions. Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change. This includes the sustainable management, conservation and restoration of specific ecosystems that provide key services.

Assessment of the current efforts and adaptive capacity of the planning partners participating in this hazard mitigation plan are included in the jurisdiction-specific annexes in Volume 2.

16.2 SONOMA COUNTY EFFORTS TO ADDRESS CLIMATE CHANGE

16.2.1 A Roadmap for Climate Resilience in Sonoma County

In April 2016, the North Bay Climate Adaptation Initiative released *A Roadmap for Climate Resilience in Sonoma County*. The roadmap provides a framework and recommendations for how Sonoma County should approach climate resilience. It defines nine climate resilience goals to address extreme heat, drought, wildfires, fewer freezing nights, extreme floods, higher sea level, and high storm surges. Each goal has a set of priority actions to address the climate hazards related to the goal.

Since the roadmap was published, Sonoma County has experienced more frequent and severe climate hazards, including devastating Russian River floods in 2019 and extreme wildfires in 2017, 2019, and 2020. Given current and forecasted climate conditions, each of these hazards will continue to be a significant risk for Sonoma County.

16.2.2 Sonoma County Regional Climate Protection Authority

The Sonoma County Regional Climate Protection Authority (RCPA) leads a local government coalition to mobilize regional climate action in Sonoma County. RCPA is a special district governed by a Board of Directors comprising representatives from the Sonoma County Board of Supervisors and council members from each of the county's cities. The RCPA provides a forum for local elected officials to engage in dialogue on a wide range of topics related to decarbonization, carbon sequestration, and community resilience.

The RCPA developed *Climate Action 2020 Plan*: *A Regional Program for Sonoma County Communities*, but it was challenged in court and its environmental impact report was ruled to be inadequate. Unable to adopt the Climate Action 2020 Plan, the Sonoma County Board of Supervisors adopted the Climate Change Action Resolution to help create countywide consistency and clear guidance about coordinated implementation of greenhouse gas reduction measures. Under the resolution, Sonoma County agrees to work toward the RCPA's countywide target to reduce greenhouse gas emissions to 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050. Sonoma County adopts the following goals to reduce greenhouse gas emissions, and will pursue local actions that support these goals:

- Increase building energy efficiency
- Increase renewable energy use
- Switch equipment from fossil fuel to electricity
- Reduce travel demand through focused growth
- Encourage a shift toward low-carbon transportation options
- Increase vehicle and equipment fuel efficiency
- Encourage a shift toward low-carbon fuels in vehicles and equipment
- Reduce idling
- Increase solid waste diversion
- Increase capture and use of methane from landfills
- Reduce water consumption
- Increase recycled water and graywater use
- Increase water and waste-water infrastructure efficiency
- Increase use of renewable energy in water and wastewater systems
- Reduce emissions from livestock operations
- Reduce emissions from fertilizer use
- Protect and enhance the value of open and working lands

- Promote sustainable agriculture
- Increase carbon sequestration
- Reduce emissions from the consumption of goods and services; and

The County will continue to work to increase the health and resilience of social, natural, and built resources to withstand the impacts of climate change by pursuing local actions that support the following goals:

- Promote healthy, safe communities
- Protect water resources
- Promote as sustainable, climate-resilient economy
- Mainstream the use of climate projections

Potential objectives would address the economic, social, and environmental impacts of future wildfires, floods, extreme heat, drought, sea level rise, and other climate change risks.

16.3 VULNERABILITY ASSESSMENT— HAZARDS OF CONCERN

The following sections provide information on how each identified hazard of concern for this planning process may be impacted by climate change and how these impacts may alter current exposure and vulnerability to these hazards for the people, property, critical facilities, and environment in the planning area.

16.3.1 Dam Failure

Climate Change Impacts on the Hazard

The *California Fourth Climate Change Assessment* identifies expected changes to rainfall and winter storm patterns. On average, changes in California's annual precipitation levels are not expected to be dramatic; however, the increase in frequency and intensity for the largest storms (sometimes referred to as atmospheric rivers) may pose increasing risks to the Sonoma County's critical infrastructure, including dams. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard.

If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. According to the California Department of Water Resources, flood flows on many California rivers have been record-setting since the 1950s. This means that water infrastructure, such as dams, have been forced to manage flows for which they were not designed. The California Division of Safety of Dams has indicated that climate change may result in the need for increased safety precautions to address higher winter runoff, frequent fluctuations of water levels, and increased potential for sedimentation and debris accumulation from changing erosion patterns and increases in wildfires. According to the Division, climate change also will impact the ability of dam operators to estimate extreme flood events (California Department of Water Resources, 2008).

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Exposure, Sensitivity and Vulnerability

The following summarizes changes in exposure and vulnerability to the dam failure hazard resulting from climate change:

- **Population**—Population exposure and vulnerability to the dam failure hazard could change as the demand on aging infrastructure increases due to a changing hydrograph.
- **Property**—Property exposure and vulnerability to the dam failure hazard could change as the demand on aging infrastructure increases due to a changing hydrograph.
- **Critical facilities**—The exposure and vulnerability of critical facilities could change as the demand on aging infrastructure increases due to a changing hydrograph. Dam owners and operators are sensitive to the risk and may need to alter maintenance and operations to account for changes in the hydrograph and increased sedimentation. Critical facility owners and operators in levee failure inundation areas should always be aware of residual risk from flood events that may overtop the levee system.
- **Environment**—The exposure and vulnerability of the environment to dam failure could change for the same reasons cited above. Ecosystem services may be used to mitigate some factors that could increase the risk of design failures, such as increasing the natural water storage capacity in watersheds above dams.
- **Economy**—Dams in California are highly regulated and monitored. While the threat of dam failure could increase due to the impacts from climate change, it is assumed that dam owner/operators will be aware of potential deficiencies due to state regulation and oversight. The largest economic impacts will be costs associated with retrofits to these facilities so that they have the strength and integrity to withstand increased demand associated with a changing hydrograph.

16.3.2 Drought

Climate Change Impacts on the Hazard

Global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure.

With a warmer climate, droughts are projected to become more frequent, more severe, and longer lasting. According to California's *Fourth Climate Assessment*, future increases in temperature, regardless of whether total precipitation goes up or down, will likely cause longer and deeper California droughts, posing major problems for water supplies, natural ecosystems, and agriculture (Ackerly et al., 2018).

Because changes in precipitation patterns are still uncertain, the potential impacts and likelihood of drought are also uncertain, however climatic water deficits are projected to increase across most climate scenarios. The California Department of Water Resources (DWR) has noted impacts of climate change on statewide water resources by charting changes in snowpack, sea level, and river flow. As temperatures rise and more precipitation comes in the form of rain instead of snow, these changes will likely continue or grow even more significant. DWR estimates that the Sierra Nevada snowpack, which provides a large amount of the water supply for other parts of the state, will experience a 48- to 65-percent loss by the end of the century compared to historical averages. Projections for the planning area show a significant decline in projected snow water equivalent in April snowpack. Increasing temperatures may also increase net evaporation from reservoirs by 15 to 37 percent.

As a result of climate change, Sonoma County can expect to experience hotter, drier weather with longer summers causing more frequent and more severe droughts. *Climate Ready Sonoma County: Climate Hazards and Vulnerabilities by the North Bay Climate Adaptation Initiative* looks at the risks and uncertainties involved with climate readiness. Although models disagree about whether Sonoma County precipitation levels will decrease or increase as a result of climate change, projected warmer temperatures are expected to increase the rate of evaporation from bodies of water, further decreasing the amount of available water. However, all scenario models indicate more variable precipitation, with unusual amounts of rain at unusual times, contributing to increased drought. With longer periods when soils are drier and less runoff into reservoirs, drought conditions reduce local water supply, stress regional supplies, and limit the availability of statewide water sources (County of Sonoma 2017).

Exposure, Sensitivity and Vulnerability

The following summarizes changes in exposure and vulnerability to the drought hazard resulting from climate change:

- **Population**—Since droughts typically do not directly kill, injure or displace people, population exposure and vulnerability to drought are unlikely to increase as a result of climate change, in the context for hazard mitigation planning. However, greater numbers of people may need to engage in behavior change, such as water saving efforts to mitigate the economic impacts discussed below.
- **Property**—Property exposure and vulnerability may increase as a result of increased drought resulting from climate change, although this would most likely occur in non-structural property such as crops and landscaping. It is unlikely that structure exposure and vulnerability would increase as a direct result of drought, although secondary hazards associated with drought, such as wildfire, may increase and threaten structures (see wildfire section below).
- **Critical facilities**—Critical facility exposure and vulnerability are unlikely to increase as a result of increased drought resulting from climate change, with the exception of water and wastewater critical infrastructure. The demand for water storage is likely to increase as water tables are depleted from the extraction of groundwater.
- **Environment**—The vulnerability of the environment may increase as a result of increased drought resulting from climate change. Prolonged or more frequent drought resulting from climate change may stress ecosystems in the region, which include many special-status species.
- **Economy**—The largest measurable impacts of drought tend to be economic. Increased incidence of drought could increase the potential for impacts on the local economy.

16.3.3 Earthquake

Climate Change Impacts on the Hazard

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity as ice melts and water runs off, shifting tremendous amounts of weight on the earth's crust. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes there (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms or heavy precipitation could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events.

Exposure, Sensitivity and Vulnerability

Because impacts on the earthquake hazard are not well understood, increases in exposure and vulnerability of local resources are not able to be determined.

16.3.4 Flood

Climate Change Impacts on the Hazard

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Scientists project greater storm intensity with climate change, resulting in more direct runoff and flooding. High frequency flood events in particular will likely increase with a changing climate. What is currently considered a 1-percent-annual-chance also may strike more often, leaving many communities at greater risk. Going forward, model calibration must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted.

Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain areas to contribute to peak storm runoff. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

Exposure, Sensitivity and Vulnerability

The following summarizes changes in exposure and vulnerability to the flood hazard resulting from climate change:

- **Population and Property**—Population and property exposure and vulnerability may increase as a result of climate change impacts on the flood hazard. Runoff patterns may change, resulting in flooding in areas where it has not previously occurred.
- **Critical facilities**—Critical facility exposure and vulnerability may increase as a result of climate change impacts on the flood hazard. Runoff patterns may change, resulting in risk to facilities that have not historically been at risk from flooding. Changes in the management and design of flood protection critical facilities may be needed as additional stress is placed on these systems. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, bypass channels and levees, as well as the design of local sewers and storm drains.
- **Environment**—The exposure and vulnerability of the environment may increase as a result of climate change impacts on the flood hazard. Changes in the timing and frequency of flood events may have broader ecosystem impacts that alter the ability of already stressed species to survive.
- **Economy**—If flooding becomes more frequent, there may be impacts on the local economy. More resources may need to be directed to response and recovery efforts, and businesses may need to close more frequently due to loss of service or access during flood events.

16.3.5 Landslide/Mass Movements

Climate Change Impacts on the Hazard

Climate change may impact the variability of storm patterns, potentially increasing the probability of more intense storms with varying duration. Increase in global temperature is likely to affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. Each these factors would increase the probability of mass movements occurring.

Exposure, Sensitivity and Vulnerability

The following summarizes changes in exposure and vulnerability to the mass movement hazard resulting from climate change:

- **Population and Property**—Increased frequency and severity of rainfall and wildfire events are likely to increase the frequency and severity of landslide events in the planning area. Climate change is unlikely to impact slopes or soil types, but it could impact vegetation type and coverage, which would make some areas more vulnerable to soil saturation from increased rainfall. Steep slopes (10 percent grades or higher) in WUI (wildland urban interface) areas are likely to see increases in vulnerability.
- **Critical facilities**—Critical facility exposure and vulnerability would be unlikely to increase due to climate change impacts on the mass movement hazard, except for those in areas as noted above. However, critical facility owners and operators may experience more frequent disruption to service provision resulting from mass movement hazards. For example, transportation systems may experience

more frequent delays if movements blocking these systems occur more frequently. In addition, increased sedimentation resulting from mass movements may negatively impact flood control facilities, such as dams.

- **Environment**—Except for areas noted above, exposure and vulnerability of the environment would be unlikely to increase because of climate change. Landslide impacts on vegetation and wildlife are mostly negative, but are generally local, which allows species to recover with time. In the long term, landslides may even have positive effects on the habitats of flora and fauna (Schuster and Highland, 2003).
- **Economy**—Changes to the mass movement hazard resulting from climate change are unlikely to result in impacts on the local economy; but impacts may be felt if the limited major highways in the planning area are repeatedly impacted.

16.3.6 Sea Level Rise

The sea-level rise hazard is associated almost entirely with climate change. Therefore, the sea-level rise risk assessment presented in Chapter 12 addresses the impacts of climate change on this hazard.

16.3.7 Severe Weather

Climate Change Impacts on the Hazard

Climate change presents a challenge for risk management associated with severe weather. The frequency of weather-related disasters is increasing, leading to increased economic losses. The science for linking the severity of specific severe weather events to climate change is still evolving; however, a number or trends provide some indication of how climate change may be impacting these events. According to the *U.S. National Climate Change Assessment* (2014), there were more than twice as many high temperature records as low temperature records broken between 2001 and 2012, and heavy rainfall events are becoming more frequent and more severe.

The increase in average surface temperatures can also lead to more intense heat waves. Evidence suggests that heat waves are already increasing, especially in western states. Extreme heat days in the planning area are likely to increase.

Climate change impacts on other severe weather events such as thunderstorms and high winds are still not well understood.

Exposure, Sensitivity and Vulnerability

The following summarizes changes in exposure and vulnerability to the severe weather hazard resulting from climate change:

- **Population and Property**—Population and property exposure and vulnerability are likely to increase as a direct result of climate change impacts on the severe weather hazard in term of summer extreme heat events and potentially winter storm events. Secondary impacts, such as the risk of fire or extent of localized flooding, may increase, impacting greater numbers of people and structures.
- **Critical facilities**—Critical facility exposure and vulnerability may increase as a result of climate change impacts on the severe weather hazard. Critical facility owners and operators may experience more frequent disruption to service provision. For example, more frequent and intense heat waves or storms may cause more frequent disruptions in power service.

- **Environment**—More frequent storms and heat events and more intense rainfall may place additional stress on already stressed ecosystems.
- **Economy**—Climate change impacts on the severe weather hazard may impact the local economy through more frequent disruption to services, such as power outages.

16.3.8 Tsunami

Climate Change Impacts on the Hazard

The impacts of global climate change on tsunami probability are unknown. Some scientists say that melting glaciers could induce tectonic activity, inducing earthquakes. Other scientists have indicated that underwater avalanches (also caused by melting glaciers), may also result in tsunamis. Even if climate change does not increase the frequency with which tsunamis occur, it may result in more destructive waves. As sea levels continue to rise, tsunami inundation areas would likely reach further into communities than current mapping indicates.

Exposure, Sensitivity and Vulnerability

As land area likely to be inundated by tsunami waves increases, exposure and vulnerability to the tsunami hazard may increase for population, property, critical facilities, and the environment. Changes to the tsunami hazard from climate change may result in more direct economic impacts on a greater number of businesses and economic centers, as well as the infrastructure systems that support those businesses.

16.3.9 Wildfire

Climate Change Impacts on the Hazard

Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation, which can increase flammability.

Changes in climate patterns may impact the distribution and perseverance of insect outbreaks that create dead trees (increase fuel). When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Exposure, Sensitivity and Vulnerability

The following summarizes changes in exposure and vulnerability to the wildfire hazard resulting from climate change:

- **Population**—*California's Fourth Climate Change Assessment - Bay Regional Report* states that "wildfires will continue to be a major disturbance in the region. Future wildfire projections suggest a longer fire season, an increase in wildfire frequency, and an expansion of the area susceptible to fire."
- **Property and Critical facilities**—The exposure and vulnerability of property and infrastructure is anticipated to increase based on projections from California's *Fourth Climate Change Assessment*. The application and enforcement of codes and standards to mitigate the risk from wildfire hazards could help to decrease this risk as development moves into wildfire hazard areas.

- **Environment**— It is possible that the exposure and vulnerability of the environment will be impacted by changes in wildfire risk due to climate change. Natural fire regimes may change, resulting in more or less frequent or higher intensity burns. These impacts may alter the composition of the ecosystems in areas in and surrounding planning area. If more acres are burned every year, wildlife may be more stressed as the suitable habitat is lost.
- **Economy**— Recent wildfire activity in California has shown that economic impacts include the value of destroyed and damaged capital, the health costs related to air pollution exposure, and indirect losses due to broader economic disruption cascading along with regional and national supply chains. Indirect economic impacts can cascade outside of the impacted areas. These impacts can be expected to increase if the frequency and severity of wildfires increase as projected. Preventative power outages and direct loss of property due to wildfires also cause significant economic impacts.

16.4 ISSUES

Major gaps in current knowledge and understanding about how climate change will impact Sonoma County's hazards are as follows:

- Planning for climate change related impacts can be difficult due to inherent uncertainties in projection methodologies (although there are confirmed trends in terms of increasing temperatures, increasing water deficits, and increasing wildfire hazards).
- Average temperatures are expected to continue to increase in the planning area, which may lead to a host of primary and secondary impacts, such as an increased incidence of heat waves.
- Expected changes in precipitation patterns are still poorly understood and could have significant impacts on the water supply and flooding in the planning area since all future scenarios project greater rainfall variability from year to year..
- Some impacts of climate change are poorly understood such as potential impacts on the frequency and severity of earthquakes, thunderstorms, and tsunamis.
- Potentially heavy rain events may result in inland stormwater flooding after stormwater management systems are overwhelmed.
- Permanent and temporary inundation resulting from sea level rise has the potential to impact portions of the population and assets in the planning area.
- There are still many unknowns regarding relationships between wildfire and a changing climate. However, current models project increasing wildfire probability and risks of structure loss based on impacts of climate change and projected development. Continued research and modeling are necessary to better understand the impacts of climate change on the fire environment throughout the planning area and to inform adaptation strategies
- Climate change has the potential to impact the following:
  - The vulnerability of municipal and on-site water supplies
  - Forest structure, composition, and flammability
  - The severity of wildfires and acres burned
  - The adequacy of access and evacuation routes
  - Response times for limited fire suppression resources
  - Heat wave duration coupled with wildfire smoke, especially as they affect disadvantaged populations unlikely to have air conditioning.

17. HAZARDS OF INTEREST

The hazards of concern assessed in Chapters 7 through 15 and rated and rated in Chapter 18 are those that present significant risks in the planning area. Additional hazards, both natural and human-caused, were identified by the Steering Committee as having some potential to impact the planning area, but at a much lower risk level than the hazards of concern. These other hazards are identified as hazards of interest.

The sections below provide short profiles of each hazard of interest, including qualitative discussion of their potential to impact in Sonoma County. No formal risk assessment of these hazards was performed, and no mitigation initiatives have been developed to address them. However, all planning partners for this plan should be aware of these hazards and should take steps to reduce the risks they present whenever it is practical to do so.

17.1 PUBLIC HEALTH EMERGENCY

According to the World Health Organization, a pandemic involves the worldwide spread of a new disease. While an epidemic remains limited to one city, region, or country, a pandemic will spread beyond national borders and possibly worldwide. Authorities consider a disease to be an epidemic when the number of people with the infection is higher than the forecast number within a specific region. If an infection becomes widespread in several countries at the same time, it may turn into a pandemic. A new virus strain or subtype that easily transmits between humans can cause a pandemic. Bacteria that become resistant to antibiotic treatment may also be behind the rapid spread (Felman 2020).

Sometimes, pandemics occur when new diseases develop the ability to spread rapidly. Often, a new virus cannot spread between animals and people, but after it changes or mutates, it may start to spread easily, and a pandemic may result. Seasonal flu epidemics generally occur because of a viral subtype that is already circulating among people. Novel subtypes, on the other hand, generally cause pandemics. These subtypes will not previously have circulated among humans. A pandemic can lead to social disruption, economic loss, and general hardship on a wide scale (Felman 2020).

In March 2020, Sonoma County was included in the FEMA Major Disaster Declaration for the COVID-19 coronavirus pandemic. As of January 2021, about 23,000 people, or 4.57 percent of the Sonoma County population, had contracted the coronavirus and 234 people, 1.01 percent of the population, had died from it (Sonoma County Emergency 2021). As of January 2021, over 18,000 people in Sonoma County had received the COVID-19 vaccine (Sonoma County Emergency 2021).

17.2 TERRORISM

17.2.1 Defining Terrorism

Acts of terrorism are intentional, criminal, malicious acts with the following characteristics:

- They involve the use of illegal force.
- They are intended to intimidate or coerce.
- They are committed in support of political or social objectives.

The Federal Bureau of Investigation (FBI) categorizes two types of terrorism in the United States:

- **Domestic terrorism** involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. The bombing of the Alfred P. Murrah federal building in Oklahoma City is an example of domestic terrorism. The FBI is the primary response agency for domestic terrorism. The FBI coordinates domestic preparedness programs and activities of the United States to limit acts posed by terrorists, including the use of weapons of mass destruction.
- **International terrorism** involves groups or individuals whose terrorist activities are foreign-based or directed by countries or groups outside the United States, or whose activities transcend national boundaries. Examples include the 1993 bombing of the World Trade Center and the attacks of September 11, 2001 at the World Trade Center and the Pentagon.

Three factors distinguish terrorism hazards from other types of hazards:

- In the case of chemical, biological, and radioactive agents, their presence may not be immediately obvious, making it difficult to determine when and where they may have been released, who has been exposed, and what danger is present for first responders and emergency medical technicians.
- There is limited scientific understanding of how these agents affect the population at large.
- Terrorism evokes strong emotional reactions, ranging from anxiety to fear to anger to despair to depression.

Most terrorist events in the United States have been bombing attacks, involving detonated or undetonated explosive devices, tear gas, pipe bombs, or firebombs. The effects of terrorism can vary from loss of life and injuries to property damage and disruptions in services such as electricity, water supplies, transportation, or communications. The event may have an immediate effect or a delayed effect. Terrorists often choose targets that offer limited danger to themselves and areas with relatively easy public access. Foreign terrorists look for visible targets where they can avoid detection before and after an attack such as international airports, large cities, major special events, and high-profile landmarks.

17.2.2 Cyberterrorism

Cyberterrorism is the use of computers and information, particularly over the Internet, to recruit others to a cause, cause physical or financial harm, or cause a severe disruption of service. It can be driven by religious, political, or other motives. Like traditional terrorism tactics, cyberterrorism seeks to evoke strong emotional reactions, but it does so through information technology rather than a physically violent or disruptive action.

Cyberterrorism has three main types of objectives (Kostadinov 2012):

- **Organizational**—Cyberterrorism with an organizational objective includes functions other than cyber-attacks. Terrorist groups today use the internet every day for recruitment, training, fundraising, communication, or planning. Organizational cyberterrorism can use platforms such as social media as a tool to spread a message beyond country borders and instigate physical forms of terrorism. Organizational efforts may include system attacks as a tool for training new members of a faction in cyber warfare.
- **Undermining**—Cyberterrorism with undermining as an objective seeks to hinder the normal functioning of computer systems, services, or websites. Such methods include defacing, denying, and exposing information. These attacks aim to undermine the victim's high dependence on online structures to support vital operational functions. They typically do not result in grave consequences unless undertaken as part of a larger attack. Undermining attacks on computers include the following:
  - Physical attack against computer equipment, a computer facility, or transmission lines to disrupt the reliability of equipment.
  - Using electromagnetic energy, usually in the form of an electromagnetic pulse, to attack computer equipment or data transmissions. By overheating circuitry or jamming communications, an electronic attack disrupts the reliability of equipment and the integrity of data.
  - Using malicious code directed against computer processing code, instruction logic, or data. The code can generate malicious network packets that disrupt data or logic. This type of cyber-attack can disrupt the reliability of equipment, the integrity of data, and the confidentiality of communications.
- **Destructive**—The destructive objective for cyberterrorism is what organizations fear most. Through the use of computer technology and the Internet, the terrorists seek to inflict destruction or damage on tangible property or assets, and even death or injury to individuals. There are no cases of pure cyberterrorism as of the date of this plan.

17.2.3 Addressing Terrorism

While education, heightened awareness, and early warning of unusual circumstances may deter crime and terrorism, intentional acts that harm people and property are possible at any time. Public safety entities react to the threat, locating, isolating and neutralizing further damage, and investigating potential scenes and suspects to bring criminals to justice. Those involved with terrorism response, including public health and public information staff, are trained to deal swiftly with the public's emotional reaction. The area of the event must be clearly identified in all emergency alert messages to prevent those not affected by the incident from overwhelming local emergency rooms and response resources, which would reduce service to those actually affected. The public must be informed clearly and frequently about what government agencies are doing to mitigate the impacts of the event. The public will also be given clear directions on how to protect the health of individuals and families.

In dealing with terrorism, the unpredictability of human beings must be considered. People with a desire to perform criminal acts may seek out targets of opportunity that may not fall into established lists of critical areas or facilities. First responders train not only to respond to organized terrorism events, but also to respond to random acts by individuals who, for a variety of reasons ranging from fear to emotional trauma to mental instability, may choose to harm others and destroy property.

The Sonoma County Department of Emergency Management is responsible for the mitigation, preparedness, planning, coordination of response, and recovery activities related to county emergencies and disasters, including terrorism. The department serves as the primary coordination point for emergency management's activities affecting more than one jurisdiction, and the unincorporated areas of the county. The Department of Emergency Management became an independent County department in July 2019.

In January 2019, the County adopted a resolution authorizing the County Administrator and the Director of Emergency Management to seek state and federal financial funding assistance through the State of California or the federal Department of Homeland Security related to homeland security, emergency management, hazard mitigation, preparedness and disaster response programs, which could include counterterrorism initiatives (County of Sonoma 2019).

17.3 CYBER-ATTACK

A cyber threat is an intentional and malicious crime that compromises the digital infrastructure of a person or organization, often for financial or terror-related reasons. Such attacks vary in nature and are perpetrated using digital mediums or sometimes social engineering to target human operators. Generally, attacks last minutes to days, but large-scale events and their impacts can last much longer. As information technology continues to grow in capability and interconnectivity, cyber threats become increasingly frequent and destructive. In 2014, internet security teams at Symantec and Verizon indicated that nearly 1 million new pieces of malware—malicious code designed to steal or destroy information—were created every day (Harrison and Pagliery 2015).

Cyber threats differ by motive, attack type and perpetrator profile. Motives range from the pursuit of financial gain to political or social aims. Cyber threats are difficult to identify and comprehend. Types of threats include using viruses to erase entire systems, breaking into systems and altering files, using someone's personal computer to attack others, or stealing confidential information. The spectrum of cyber risks is limitless, with threats having a wide-range of effects on the individual, community, organizational, or nation. The following sections describe cyber-attacks in general and, more specifically, cyberterrorism.

Public and private computer systems are subject to a variety of cyber-attacks, from blanket malware infection to targeted attacks on system capabilities. Cyber-attacks seek to breach IT security measures designed to protect an individual or organization. The initial attack is followed by more severe attacks for the purpose of causing harm, stealing data, or financial gain. Organizations are prone to attacks that can be either automated or targeted. Table 17-1 describes the most common cyber-attack mechanisms faced by organizations today.

Since 2013, a type of cyber-attack called cyber ransom has become increasingly common against individuals and small- and medium-sized organizations. Cyber ransom occurs when an individual downloads ransom malware, or ransomware, often through phishing or drive-by download, and the subsequent execution of code results in encryption of all data and personal files stored on the system. The victim then receives a message that demands a fee in the form of electronic currency or cryptocurrency, such as Bitcoin, for the decryption code. In October 2015, the FBI said that commonly used ransomware is so difficult to override, that victims should pay the ransom to retrieve their data (Danielson 2015).

With millions of threats created each day, the importance of protection against cyber-attacks becomes a necessary function of everyday operations for individuals, government facilities, and businesses. The increasing dependency on technology for vital information storage and the often automated method of infection means higher stakes for the success of measurable protection and education.

Table 17-1. Common Mechanisms for Cyber Attacks

Type	Description
Socially Engineered Trojans	Programs designed to mimic legitimate processes (e.g. updating software, running fake antivirus software) with the end goal of human-interaction caused infection. When the victim runs the fake process, the Trojan is installed on the system.
Unpatched Software	Nearly all software has weak points that may be exploited by malware. Most common software exploitations occur with Java, Adobe Reader, and Adobe Flash. These vulnerabilities are often exploited as small amounts of malicious code are often downloaded via drive-by download.
Phishing	Malicious email messages that ask users to click a link or download a program. Phishing attacks may appear as legitimate emails from trusted third parties.
Password Attacks	Third party attempts to crack a user's password and subsequently gain access to a system. Password attacks do not typically require malware, but rather stem from software applications on the attacker's system. These applications may use a variety of methods to gain access, including generating large numbers of generated guesses, or dictionary attacks, in which passwords are systematically tested against all of the words in a dictionary.
Drive-by Downloads	Malware is downloaded unknowingly by the victims when they visit an infected site.
Denial of Service Attacks	Attacks that focus on disrupting service to a network in which attackers send high volumes of data until the network becomes overloaded and can no longer function.
Man in the Middle	Man-in-the-Middle attacks mirror victims and endpoints for online information exchange. In this type of attack, the attacker communicates with the victims, who believe they are interacting with a legitimate endpoint website. The attacker is also communicating with the actual endpoint website by impersonating the victim. As the process goes through, the attacker obtains entered and received information from both the victim and endpoint.
Malvertising	Malware downloaded to a system when the victim clicks on an affected ad.
Advanced Persistent Threat	An attack in which the attacker gains access to a network and remains undetected. Advanced persistent threat attacks are designed to steal data instead of cause damage.

18. RISK RATING

FEMA requires all hazard mitigation planning partners to have jurisdiction-specific mitigation actions based on local risk, vulnerability, and community priorities. This plan included a risk rating protocol for each planning partner, in which "risk" was calculated by multiplying probability by impact on people, property and the economy. The risk estimates were generated using methodologies promoted by FEMA. The Steering Committee reviewed, discussed and approved the methodology and results. All planning partners rated risk for their own jurisdictions following the same methodology.

Numerical ratings of probability and impact were based on the hazard profiles and exposure and vulnerability evaluations presented in Chapters 7 through 16. Using that data, each planning partner rated the risk of all the natural hazards of concern described in this plan. When available, estimates of risk were generated with data from Hazus or GIS. For hazards of concern with less specific data available, qualitative assessments were used. As appropriate, results were adjusted based on local knowledge and other information not captured in the quantitative assessments. The hazards of interest described in Chapter 17 were not rated for the following reasons:

- A key component of risk as defined for the planning effort is probability of occurrence. While it is possible to assign a recurrence interval for natural hazards because of historical occurrence, it is not feasible to assign recurrence intervals for the other hazards of interest, which lack such historical precedent.
- Federal hazard mitigation planning regulations do not require the assessment of non-natural hazards (44 CFR, 201.6). It is FEMA's position that this is a local decision.

Risk rating results are used to help establish mitigation priorities. Each partner used its risk rating to inform the development of its action plan. Planning partners were directed to identify mitigation actions, at a minimum, to address each hazard with a "high" or "medium" risk rating. Actions that address hazards with a low or no hazard rating are optional.

Volume 2 presents the risk ratings for each planning partner. The following planning-area-wide risk rating was prepared by the planning team.

18.1 PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- Medium—Hazard event is likely to occur within 100 years (Probability Factor =2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor =1)
- No exposure—There is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is based on past hazard events in the area and the potential for changes in the frequency of these events resulting from climate change. Table 18-1 summarizes the probability assessment for each natural hazard of concern for this plan.

Table 18-1. Probability of Hazards

Hazard Event	Probability (high, medium, low)	Probability Factor
Dam Failure	Medium	2
Drought	High	3
Earthquake (Hayward Scenario)	Medium	2
Flooding (1% annual chance)	High	3
Landslide/Mass Movement (very high/high risk areas)	High	3
Sea Level Rise (200-cm + 100-yr)	High	3
Severe Weather	High	3
Tsunami	Low	1
Wildfire (very high/high risk areas)	High	3

18.2 IMPACT

Hazard impacts were assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High—25 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—10 percent to 25 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—10 percent or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the population is exposed to a hazard (Impact Factor = 0)
- **Property**—Values were assigned based on the percentage of the total ***property value exposed*** to the hazard event:
  - High—25 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium—10 percent to 25 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low—10 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0)
- **Economy**—Values were assigned based on the percentage of the total ***property value vulnerable*** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total replacement value of the property exposed to the hazard. Loss estimates separate from the exposure estimates were generated for the earthquake, flooding, and tsunami hazards using Hazus. For other hazards, such as dam failure, landslide/mass movement and wildfire, vulnerability was estimated as a percentage of exposure, due to the lack of loss estimation tools specific to those hazards.

- High—Estimated loss from the hazard is 10 percent or more of the total exposed property value (Impact Factor = 3)
- Medium—Estimated loss from the hazard is 5 percent to 10 percent of the total exposed property value (Impact Factor = 2)
- Low—Estimated loss from the hazard is 5 percent or less of the total exposed property value (Impact Factor = 1)
- No impact—No loss is estimated from the hazard (Impact Factor = 0)

The impacts of each risk category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1. Table 18-2 summarizes the impacts for each hazard.

Table 18-2. Impact on People, Property and the Economy from Hazards

	People (Weighting Factor 3)		Property (Weighting Factor 2)		Economy (Weighting Factor 1)	
Hazard Event	Impact / Score	Weighted Score	Impact / Score	Weighted Score	Impact / Score	Weighted Score
Dam Failure	Medium / 2	6	Medium / 2	4	Medium / 2	2
Drought	None / 0	0	Low / 1	2	Medium / 2	2
Earthquake (Hayward Scenario)	High / 3	9	High / 3	6	High / 3	3
Flooding (1% annual chance)	Low / 1	3	Low / 1	2	Low / 1	1
Landslide/Mass Movement (very high/high risk areas)	Medium / 2	6	High / 3	6	Medium / 2	2
Sea Level Rise (200-cm + 100-yr)	Low / 1	3	Low / 1	2	Low / 1	1
Severe Weather	Medium / 2	6	Low / 1	2	Low / 1	1
Tsunami	Low / 1	3	Low / 1	2	None / 0	0
Wildfire (very high/high risk areas)	Low / 1	3	Medium / 2	4	Medium / 2	2

18.3 RISK RATING

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors, as summarized in Table 18-3. Based on these ratings, each hazard was identified as being in the highest, medium, or lowest risk category. Figure 18-1 shows the hazard risk rating for the planning area. Hazard risk rating for each participating planning partner can be found in Volume 2 of this plan.

Table 18-3. Hazard Risk Rating

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Dam Failure	2	6 + 4 + 2 = 12	24
Drought	3	0 + 2 + 2 = 4	12
Earthquake (Hayward Scenario)	2	9 + 6 + 3 = 18	36
Flooding (1% annual chance)	3	3 + 2 + 1 = 6	18
Landslide/Mass Movement (very high/high risk areas)	3	6 + 6 + 2 = 14	42
Sea Level Rise (200-cm + 100-yr)	3	3 + 2 + 1 = 6	18
Severe Weather	3	6 + 2 + 1 = 9	18
Tsunami	1	3 + 2 + 0 = 5	5
Wildfire (very high/high risk areas)	3	3 + 4 + 2 = 9	27/36[a]

a. The quantitative score for wildfire (27) was adjusted base on the judgment of County staff to a score equivalent to earthquake.

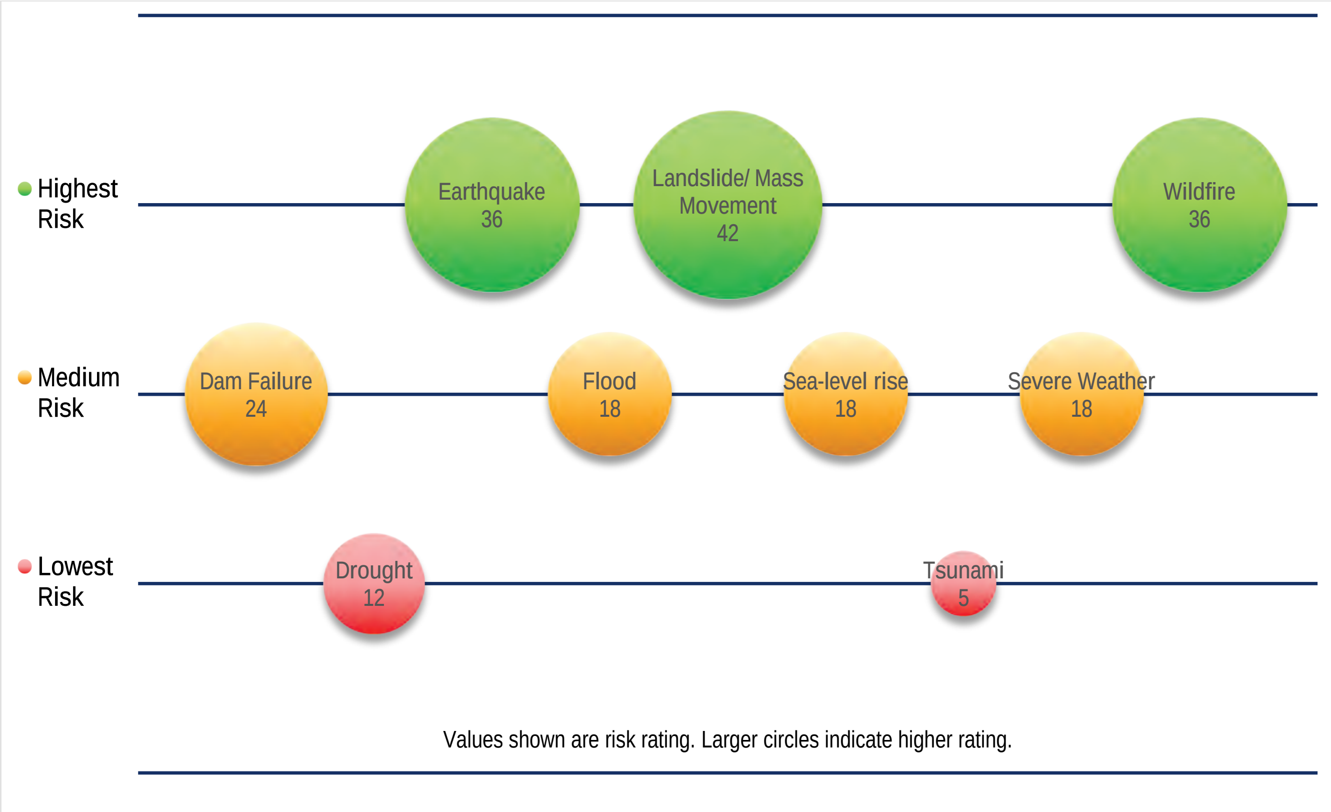


Figure 18-1. Hazard Risk Rating

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

PART 3—MITIGATION STRATEGY

19. MISSION STATEMENT, GOALS, AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Steering Committee reviewed the guiding principle, goals and objectives from the 2010 Hazard Mitigation Plan. It was determined that the 2010 plan's guiding principle, goals, and objectives still reflect community priorities and the results of the risk assessment. Therefore, only minor changes were made, to clarify intent and meaning. The guiding principle, goals, objectives and actions in this plan all support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Actions (presented in Chapter 19) were prioritized based on their ability to meet multiple objectives.

19.1 MISSION STATEMENT

A mission statement focuses the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The mission statement for this hazard mitigation plan is as follows:

> Create a resilient Sonoma County for the whole community.

19.2 GOALS

The following are the mitigation goals for this plan:

1. Protect people and minimize loss of life, injury, and social impacts.
2. Minimize potential for loss of property, economic and social impacts, and displacement due to hazards.
3. Minimize potential for environmental impacts and consider a broad-range of mitigation solutions, including nature-based solutions where feasible.
4. Communicate natural hazard risk to the whole community within Sonoma County.
5. Support and inform the development of relevant mitigation policies and programs.
6. Promote an adaptive and resilient Sonoma County that proactively anticipates the future impacts from hazards within the county.
7. Pursue the development and implementation of long-term, cost-effective, and environmentally sound mitigation projects.
8. Enhance the capability/capacity of the Sonoma County planning area to prepare, respond, and recover from the impact of natural hazards.

The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

19.3 OBJECTIVES

The selected objectives meet multiple goals, as listed in Table 19-1. Therefore, the objectives serve as a stand-alone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives also are used to help establish priorities.

Table 19-1. Objectives for the Hazard Mitigation Plan

Objective Number	Objective Statement
O-1	Incorporate mitigation best management measures into plans, codes, and other regulatory standards for the private sector, nonprofit agencies, and community-based organizations within the planning area.
O-2	Maintain established partnerships in the identification and implementation of mitigation measures in the Sonoma County Planning area.
O-3	Retrofit, purchase, mitigate or relocate structures in high hazard areas, with an emphasis on those subject to repetitive damages.
O-4	Promote and implement hazard mitigation plans and projects that are consistent with state, regional, and local climate action and adaptation goals, policies, and programs.
O-5	Improve and expand systems that provide warning and emergency communications to the whole community.
O-6	Increase resilience and capabilities of community lifelines.
O-7	Prevent (or discourage) new development in hazardous areas to ensure that if building occurs in high-risk areas that it is done in such a way as to minimize risk.
O-8	At the local government level, continually improve understanding of the location and potential impacts of natural hazards in all planning mechanisms that address current and future land uses within the planning area.
O-9	Consider the impacts of natural hazards in all planning mechanisms that address current and future land uses within the planning area
O-10	Minimize adverse impacts from flood risk on vulnerable communities.
O-11	Through the enforcement of relevant federal, state, and local regulations, sustain life and property protection measures for all communities and structures located in the Sonoma County planning area.
O-12	All cities, the County, special districts, and tribal organizations will develop, adopt, and implement local hazard mitigation principles that may be integrated with local comprehensive plan safety elements, Community Wildfire Protection Plans, floodplain management plans, facilities master plans, and other local planning initiatives.

20. MITIGATION BEST PRACTICES AND ADAPTIVE CAPACITY

20.1 MITIGATION BEST PRACTICES

Catalogs of hazard mitigation best practices were provided to the planning partnership that present a broad range of alternatives to be considered for use in Sonoma County, in compliance with 44 CFR (Section 201.6(c)(3)(ii)). One catalog was developed for each hazard of concern evaluated in this plan. These catalogs are based on practical experience from around the country as well as FEMA guidance on mitigation best-management practices. The catalogs present alternatives that are categorized in two ways:

- By who would have responsibility for implementation:
  - Individuals (personal scale)
  - Businesses (corporate scale)
  - Government (government scale).
- By what the alternative would do:
  - Manipulate the hazard
  - Reduce exposure to the hazard
  - Reduce vulnerability to the hazard
  - Build local capacity to respond to or prepare for the hazard.

The catalogs were provided to each planning partner in a “toolkit” prepared by the core planning team to support the development of the action plans identified in this plan. The alternatives presented include actions to mitigate current risk from hazards and actions to reduce risk from changes in hazard impacts resulting from climate change. Hazard mitigation actions recommended in this plan were selected from an analysis of the alternatives in the catalogs. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the established goals and objectives, and are generally within the capabilities of the planning partners to implement. The catalogs provide a list of what could be considered to reduce risk from natural hazards within the planning area. Recommended actions were selected based on an analysis of each partner’s ability to implement the action. Actions may not have been selected for one or more of the following reasons:

- The action is not feasible.
- The action is already being implemented.
- The planning partner does not have the capability to implement the action.
- There is an apparently more cost-effective alternative.
- The action does not have public or political support.

The catalogs for each hazard are presented in Table 20-1 through Table-20-8.

Table 20-1. Alternatives to Mitigate the Dam Failure Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Relocate out of dam failure inundation areas • Reduce vulnerability to the hazard: ❖ Elevate home to appropriate levels • Build local capacity to respond to or prepare for the hazard: ❖ Learn about risk reduction for the dam failure hazard ❖ Learn the evacuation routes for a dam failure event ❖ Educate yourself on early warning systems and the dissemination of warnings	• Manipulate the hazard: ❖ Remove dams ❖ Harden dams • Reduce exposure to the hazard: ❖ Replace earthen dams with hardened structures • Reduce vulnerability to the hazard: ❖ Flood-proof facilities within dam failure inundation areas • Build local capacity to respond to or prepare for the hazard: ❖ Educate employees on the probable impacts of a dam failure ❖ Develop a continuity of operations plan	• Manipulate the hazard: ❖ Remove dams ❖ Harden dams • Reduce exposure to the hazard: ❖ Replace earthen dams with hardened structures ❖ Relocate critical facilities out of dam failure inundation areas ❖ Consider open space land use in designated dam failure inundation areas • Reduce vulnerability to the hazard: ❖ Adopt higher floodplain standards in mapped dam failure inundation areas ❖ Retrofit critical facilities within dam failure inundation areas • Build local capacity to respond to or prepare for the hazard: ❖ Map dam failure inundation areas ❖ Enhance emergency operations plan to include a dam failure component ❖ Institute monthly communications checks with dam operators ❖ Inform the public on risk reduction techniques ❖ Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas ❖ Consider the probable impacts of climate change in assessing the risk associated with the dam failure hazard ❖ Establish early warning capability downstream of listed high hazard dams ❖ Consider the residual risk associated with protection provided by dams in future land use decisions

Table-20-2. Alternatives to Mitigate the Drought Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ None • Reduce vulnerability to the hazard: ❖ Drought-resistant landscapes ❖ Reduce water system losses ❖ Modify plumbing systems (through water saving kits) ❖ For homes with on-site water systems: increase storage, utilize rainwater catchment • Build local capacity to respond to or prepare for the hazard: ❖ Practice active water conservation	• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ None • Reduce vulnerability to the hazard: ❖ Drought-resistant landscapes ❖ Reduce private water system losses ❖ Support alternative irrigation techniques to reduce water use and encourage use of climate-sensitive water supplies ❖ For businesses with on-site water systems: increase storage, utilize rainwater catchment • Build local capacity to respond to or prepare for the hazard: ❖ Practice active water conservation	• Manipulate the hazard: ❖ Groundwater recharge through stormwater management ❖ Develop a water recycling program ❖ Increase "above-the-dam" regional natural water storage systems • Reduce exposure to the hazard: ❖ Identify and create groundwater backup sources • Reduce vulnerability to the hazard: ❖ Water use conflict regulations ❖ Reduce water system losses ❖ Distribute water saving kits ❖ increase conventional storage that is filled during high-flow periods • Build local capacity to respond to or prepare for the hazard: ❖ Public education on drought resistance ❖ Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers ❖ Develop drought contingency plan ❖ Develop criteria "triggers" for drought-related actions ❖ Improve accuracy of water supply forecasts ❖ Modify rate structure to influence active water conservation techniques ❖ Consider the probable impacts of climate change on the risk associated with the drought hazard

Table-20-3. Alternatives to Mitigate the Earthquake Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Locate outside of hazard area (off soft soils) • Reduce vulnerability to the hazard: ❖ Retrofit structure (anchor house structure to foundation) ❖ Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) ❖ Build to higher design • Build local capacity to respond to or prepare for the hazard: ❖ Practice "drop, cover, and hold" ❖ Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event ❖ Keep cash reserves for reconstruction ❖ Become informed on the hazard and risk reduction alternatives available. ❖ Develop a post-disaster action plan for your household	• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Locate or relocate mission-critical functions outside hazard area where possible • Reduce vulnerability to the hazard: ❖ Build redundancy for critical functions and facilities ❖ Retrofit critical buildings and areas housing mission-critical functions • Build local capacity to respond to or prepare for the hazard: ❖ Adopt higher standard for new construction; consider "performance-based design" when building new structures ❖ Keep cash reserves for reconstruction ❖ Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. ❖ Develop a continuity of operations plan	• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Locate critical facilities or functions outside hazard area where possible • Reduce vulnerability to the hazard: ❖ Harden infrastructure ❖ Provide redundancy for critical functions ❖ Adopt higher regulatory standards • Build local capacity to respond to or prepare for the hazard: ❖ Provide better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (e.g., tax incentives, information) ❖ Include retrofitting and replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components such as pipe, power line, and road repair materials ❖ Develop and adopt a continuity of operations plan ❖ Initiate triggers guiding improvements (such as <50% substantial damage or improvements) ❖ Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. ❖ Develop a post-disaster action plan that includes grant funding and debris removal components.

Table-20-4. Alternatives to Mitigate the Flooding Hazard

Personal Scale	Corporate Scale	Government Scale	
• Manipulate the hazard: ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • Reduce exposure to the hazard: ❖ Locate outside of hazard area ❖ Elevate utilities above base flood elevation ❖ Use low-impact development techniques • Reduce vulnerability to the hazard: ❖ Raise structures above base flood elevation ❖ Elevate items within house above base flood elevation ❖ Build new homes above base flood elevation ❖ Flood-proof structures • Build local capacity to respond to or prepare for the hazard: ❖ Buy flood insurance ❖ Develop household plan, such as retrofit savings, communication with outside, 72-hour self-sufficiency during and after an event	• Manipulate the hazard: ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • Reduce exposure to the hazard: ❖ Locate critical facilities or functions outside hazard area ❖ Use low-impact development techniques • Reduce vulnerability to the hazard: ❖ Build redundancy for critical functions or retrofit critical buildings ❖ Provide flood-proofing when new critical infrastructure must be located in floodplains • Build local capacity to respond to or prepare for the hazard: ❖ Keep cash reserves for reconstruction ❖ Support and implement hazard disclosure for sale of property in risk zones. ❖ Solicit cost-sharing through partnerships with others on projects with multiple benefits.	• Manipulate the hazard: ❖ Maintain drainage system ❖ Institute low-impact development techniques on property ❖ Dredging, levee construction, and providing regional retention areas ❖ Structural flood control, levees, channelization, or revetments. ❖ Stormwater management regulations and master planning ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • Reduce exposure to the hazard: ❖ Locate or relocate critical facilities outside of hazard area ❖ Acquire or relocate identified repetitive loss properties ❖ Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. ❖ Adopt land development criteria such as planned unit developments, density transfers, clustering ❖ Institute low impact development techniques on property ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff ❖ Preserve undeveloped vulnerable shoreline ❖ Restore existing flood control and riparian corridors • Reduce vulnerability to the hazard: ❖ Harden infrastructure, bridge replacement program ❖ Raise structures above base flood level ❖ Provide redundancy for critical functions and infrastructure ❖ Adopt regulatory standards such as freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. ❖ Stormwater management regulations and master planning. ❖ Adopt "no-adverse impact" floodplain management policies that strive to not increase the flood risk on downstream communities	❖ Facilitate managed retreat from, or upgrade of, the most at-risk areas ❖ Require accounting of sea level rise in all applications for new development in shoreline areas ❖ Implement Assembly Bill 162 (2007) requiring flood hazard information in local general plans • Build local capacity to respond to or prepare for the hazard: ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) ❖ Incorporate retrofitting or replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Consider participation in the Community Rating System ❖ Maintain and collect data to define risks and vulnerability ❖ Train emergency responders ❖ Create an elevation inventory of structures in the floodplain ❖ Develop and implement a public information strategy ❖ Charge a hazard mitigation fee ❖ Integrate floodplain management policies into other planning mechanisms within the planning area. ❖ Consider the probable impacts of climate change on the risk associated with the flood hazard ❖ Consider the residual risk associated with structural flood control in future land use decisions ❖ Enforce National Flood Insurance Program requirements ❖ Adopt a Stormwater Management Master Plan ❖ Develop an adaptive management plan to address the long-term impacts of sea level rise

Table-20-5. Alternatives to Mitigate the Landslide/Mass Movement Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope ❖ Minimize vegetation removal and the addition of impervious surfaces. • Reduce exposure to the hazard: ❖ Locate structures outside of hazard area (off unstable land and away from slide-run out area) • Reduce vulnerability to the hazard: ❖ Retrofit home • Build local capacity to respond to or prepare for the hazard: ❖ Institute warning system, and develop evacuation plan ❖ Keep cash reserves for reconstruction ❖ Educate yourself on risk reduction techniques for landslide hazards	• Manipulate the hazard: ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope • Reduce exposure to the hazard: ❖ Locate structures outside of hazard area (off unstable land and away from slide-run out area) • Reduce vulnerability to the hazard: ❖ Retrofit at-risk facilities • Build local capacity to respond to or prepare for the hazard: ❖ Institute warning system, and develop evacuation plan ❖ Keep cash reserves for reconstruction ❖ Develop a continuity of operations plan ❖ Educate employees on the potential exposure to landslide hazards and emergency response protocol.	• Manipulate the hazard: ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope • Reduce exposure to the hazard: ❖ Acquire properties in high-risk landslide areas. ❖ Adopt land use policies that prohibit the placement of habitable structures in high-risk landslide areas. • Reduce vulnerability to the hazard: ❖ Adopt higher regulatory standards for new development within unstable slope areas. ❖ Armor/retrofit critical infrastructure against the impact of landslides. • Build local capacity to respond to or prepare for the hazard: ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas: better land controls, tax incentives, information ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Educate the public on the landslide hazard and appropriate risk reduction alternatives. ❖ Consider the probable impacts of climate change on the risk associated with the landslide hazard

Table-20-6. Alternatives to Mitigate the Severe Weather Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ None • Reduce vulnerability to the hazard: ❖ Insulate house ❖ Provide redundant heat and power ❖ Insulate structure ❖ Plant appropriate trees near home and power lines ("Right tree, right place" National Arbor Day Foundation Program) • Build local capacity to respond to or prepare for the hazard: ❖ Trim or remove trees that could affect power lines ❖ Promote 72-hour self-sufficiency ❖ Obtain a NOAA weather radio. ❖ Obtain an emergency generator.	• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ None • Reduce vulnerability to the hazard: ❖ Relocate critical infrastructure (such as power lines) underground ❖ Reinforce or relocate critical infrastructure such as power lines to meet performance expectations ❖ Install tree wire • Build local capacity to respond to or prepare for the hazard: ❖ Trim or remove trees that could affect power lines ❖ Create redundancy ❖ Equip facilities with a NOAA weather radio ❖ Equip vital facilities with emergency power sources.	• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Develop an urban heat island reduction program that includes an urban forest program or plan • Reduce vulnerability to the hazard: ❖ Harden infrastructure such as locating utilities underground ❖ Trim trees back from power lines ❖ Designate snow routes and strengthen critical road sections and bridges • Build local capacity to respond to or prepare for the hazard: ❖ Support programs such as "Tree Watch" that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. ❖ Establish and enforce building codes that require all roofs to withstand snow loads ❖ Increase communication alternatives ❖ Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors. ❖ Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines ❖ Provide NOAA weather radios to the public ❖ Consider the probable impacts of climate change on the risk associated with the severe weather hazard ❖ Review and update heat response plan in light of climate change (heat events) projections

Table 20-7. Alternatives to Mitigate the Tsunami Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Locate outside of hazard area • Reduce vulnerability to the hazard: ❖ Apply personal property mitigation techniques to your home such as anchoring your foundation and foundation openings to allow flow though. • Build local capacity to respond to or prepare for the hazard: ❖ Develop and practice a household evacuation plan ❖ Educate yourself on the risk exposure from the tsunami hazard and ways to minimize that risk ❖ Understand tsunami warning signs and signals	• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Locate structure or mission critical functions outside of hazard area whenever possible • Reduce vulnerability to the hazard: ❖ Mitigate personal property for the impacts of tsunami • Build local capacity to respond to or prepare for the hazard: ❖ Develop and practice a corporate evacuation plan ❖ Educate employees on the risk exposure from the tsunami hazard and ways to minimize that risk	• Manipulate the hazard: ❖ Build wave abatement structures (e.g. the “Jacks” looking structure designed by the Japanese) • Reduce exposure to the hazard: ❖ Locate structure or functions outside of hazard area whenever possible ❖ Harden infrastructure for tsunami impacts ❖ Relocate identified critical facilities located in tsunami high hazard areas • Reduce vulnerability to the hazard: ❖ Adopt higher regulatory standards that will provide higher levels of protection to structures built in a tsunami inundation area ❖ Utilize tsunami mapping to guide development away from high risk areas through land use planning • Build local capacity to respond to or prepare for the hazard: ❖ Use probabilistic tsunami mapping and land use guidance from the state when published ❖ Provide incentives to guide development away from hazard areas ❖ Improve the tsunami warning and response system ❖ Provide residents with tsunami inundation maps ❖ Join NOAA’s Tsunami Ready program ❖ Develop and communicate evacuation routes ❖ Enhance the public information program to include risk reduction options for the tsunami hazard

Table-20-8. Alternatives to Mitigate the Wildfire Hazard

Personal Scale	Corporate Scale	Government Scale
• Manipulate the hazard: ❖ Clear potential fuels on property such as dry overgrown underbrush and diseased trees • Reduce exposure to the hazard: ❖ Create and maintain defensible space around structures ❖ Locate outside of hazard area ❖ Mow regularly • Reduce vulnerability to the hazard: ❖ Create and maintain defensible space around structures and provide water on site ❖ Use fire-resistant building materials ❖ Create defensible spaces around home • Build local capacity to respond to or prepare for the hazard: ❖ Employ techniques from the National Fire Protection Association's Firewise USA program to safeguard home ❖ Identify alternative water supplies for fire fighting ❖ Install/replace roofing material with non-combustible roofing materials and implement other strategies to harden homes from embers and flame impingement	• Manipulate the hazard: ❖ Clear potential fuels on property such as dry underbrush and diseased trees • Reduce exposure to the hazard: ❖ Create and maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area • Reduce vulnerability to the hazard: ❖ Create and maintain defensible space around structures and infrastructure and provide water on site ❖ Use fire-resistant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. • Build local capacity to respond to or prepare for the hazard: ❖ Support Firewise USA community initiatives. ❖ Create /establish stored water supplies to be utilized for firefighting.	• Manipulate the hazard: ❖ Clear potential fuels on property such as dry underbrush and diseased trees ❖ Implement best management practices on public lands • Reduce exposure to the hazard: ❖ Create and maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area ❖ Enhance building code to include use of fire resistant materials in high hazard area. • Reduce vulnerability to the hazard: ❖ Create and maintain defensible space around structures and infrastructure ❖ Use fire-resistant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. ❖ Consider higher regulatory standards (such as Class A roofing) ❖ Establish biomass reclamation initiatives ❖ Reintroduce fire (controlled or prescribed burns) to fire-prone ecosystems ❖ Manage fuel load through thinning and brush removal ❖ Establish integrated performance standards for new development to harden homes. • Build local capacity to respond to or prepare for the hazard: ❖ More public outreach and education efforts, including an active Firewise USA program ❖ Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas ❖ Identify fire response and alternative evacuation routes and establish where needed ❖ Seek alternative water supplies ❖ Become a Firewise USA community ❖ Use academia to study impacts/solutions to wildfire risk ❖ Establish/maintain mutual aid agreements between fire service agencies ❖ Develop, adopt, and implement integrated plans for mitigating wildfire impacts in wildland areas bordering on development ❖ Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land use decisions ❖ Establish a management program to track forest and rangeland health ❖ Provide incentives to for existing structures to be hardened against wildfire.

20.2 ADAPTIVE CAPACITY

Adaptive capacity is defined as the ability to adjust to potential damage, take advantage of opportunities, or respond to consequences (IPCC, 2014). This term is typically used while discussing climate change adaptation; however, it is similar to the alternatives presented in the tables for building local capacity. In addition to hazard-specific capacity building, the following list provides general alternatives that planning partners considered to build capacity for adapting to both current and future risks (Cal EMA, et al., 2012):

- Incorporate climate change adaptation into relevant local and regional plans and projects.
- Establish a climate change adaptation and hazard mitigation public outreach and education program.
- Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation and mitigation strategy development and regional approaches.
- Establish an ongoing monitoring program to track local and regional climate impacts and adaptation strategy effectiveness.
- Increase participation of low-income, immigrant, non-English-speaking, racially and ethnically diverse, and special-needs residents in planning and implementation.
- Ask local employers and business associations to participate in local efforts to address climate change and natural hazard risk reduction.
- Conduct a communitywide assessment and develop a program to address health, socioeconomic, and equity vulnerabilities.
- Focus planning and intervention programs on neighborhoods that currently experience social or environmental injustice or bear a disproportionate burden of potential public health impacts.
- Use performance metrics and data to evaluate and monitor the impacts of climate change and natural hazard risk reduction strategies on public health and social equity.
- Develop coordinated plans for mitigating future flood, landslide/mass movement, and related impacts through concurrent adoption of updated general plan safety elements and local hazard mitigation plans.
- Update safety elements to reflect existing hazards and projected climate change impacts on hazards.
- Implement general plan safety elements through zoning and subdivision practices that restrict development in floodplains, landslide/mass movement, and other natural hazard areas.
- Identify and protect locations where native species may shift or lose habitat due to climate change impacts (sea level rise, loss of wetlands, warmer temperatures, drought).
- Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.
- Promote economic diversity.
- Incorporate consideration of climate change impacts as part of infrastructure planning and operations.
- Conduct a climate impact assessment on community infrastructure.
- Identify gaps in legal and regulatory capabilities and develop ordinances or guidelines to address them.
- Identify and pursue new sources of funding for mitigation and adaptation activities.
- Hire new staff or provide training to current staff to ensure an adequate level of administrative and technical capability to pursue mitigation and adaptation activities.

21. AREA-WIDE ACTION PLAN

21.1 RECOMMENDED MITIGATION ACTIONS

The Steering Committee reviewed the catalogs of hazard mitigation alternatives and selected area-wide actions to be included in a hazard mitigation action plan. The selection of area-wide actions was based on the risk assessment of identified hazards of concern and the defined hazard mitigation goals and objectives. Table-21-1 lists the recommended hazard mitigation actions that make up the action plan. The timeframe indicated in the table is defined as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

21.2 ACTION PLAN PRIORITIZATION

The actions recommended in the action plan were prioritized based on the following factors:

- Cost and availability of funding
- Benefit, based on likely risk reduction to be achieved
- Number of plan objectives achieved
- Timeframe for project implementation
- Eligibility for grand funding programs

Two priorities were assigned for each action:

- A high, medium or low priority for implementing the action
- A high, medium or low priority for pursuing grant funding for the action.

The sections below describe the analysis of benefits and costs and the assignment of the two priority ratings.

Table-21-1. Action Plan—Countywide Mitigation Initiatives

Hazards Addressed	Lead Agency	Possible Funding Sources or Resources	Cost	Time Line	Objectives
CW-1—The County will pursue an "Information Sharing Access Agreement" with FEMA allowing the County to readily access FEMA repetitive loss data for the entire county as needed at a level of detail to study and analyze repetitive flood loss problems in the county					
Flood	Permit Sonoma	County General Fund	Low	Short-term	2, 7, 8, 10
CW-2—Continue to maintain a county-wide hazard mitigation website and the associated Story-Map that will store the hazard mitigation plan and provide the public an opportunity to monitor plan implementation progress. Each planning partner can support this initiative by					
All Hazards	Permit Sonoma with support from County DEM	County General Fund	Low	Ongoing	2, 8, 12
CW-3—Leverage public outreach partnering capabilities in the planning area (such as CERT) to promote a uniform and consistent					
All Hazards	County DEM	County General Fund	Low	Ongoing	2, 8, 12
CW-4—Continue to update hazard mapping with best available data and science as it evolves, within the capabilities of the planning partnership. Support FEMA's RiskMAP initiative.					
All Hazards	Permit Sonoma with support from all planning partners and FEMA Region IX	FEMA mitigation grant funding, FEMA's Cooperating Technical Partners program, County capital improvement program funding	Medium	Long-term, depending upon funding	2, 7, 8, 10
CW-5—Retain a steering committee as a working body over time to monitor progress of the hazard mitigation plan, provide technical assistance to planning partners, manage data, and oversee the update of the plan according to schedule. This body will continue to operate under the ground rules established at its inception.					
All Hazards	Permit Sonoma with support from County DEM	County General Fund	Low	Ongoing	2, 8, 12
CW-6—Strive to capture time-sensitive, perishable data—such as high-water marks, extent and location of hazard, and loss information—following hazard events to support future updates to the risk assessment as well as other plans and programs that utilize hazard extent and location data					
All Hazards	County DEM	County General Fund and FEMA Public Assistance following declared disaster events	Low	Ongoing	2, 8, 12
CW-7—Utilize viable and relevant information, data and tools (Hazus models) developed as part of the update to the risk assessment of this plan update to support training and exercise of the County's preparedness, response and recovery programs					
All Hazards	County DEM	County General Fund, Emergency Management Program Development, Homeland Security Grant Program	Low	Ongoing	2, 5, 8, 10, 12

21.2.1 Benefit/Cost Review

The action plan must be prioritized according to a benefit/cost analysis of the proposed actions (44 CFR, Section 201.6(c)(3)(iii)). For this hazard mitigation plan, a qualitative benefit-cost review was performed for each action by assigning ratings for benefit and cost as follows:

- Cost:
  - **High**—Existing funding will not cover the cost of the action; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
  - **Medium**—The action could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the action would have to be spread over multiple years.
  - **Low**—The action could be funded under the existing budget. The action is part of or can be part of an ongoing existing program.
- Benefit:

- **High—**Action will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Action will have a long-term impact on the reduction of risk exposure for life and property, or action will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the action are difficult to quantify in the short term.

To assign priorities, each action with a benefit rating equal to or higher than its cost rating (such as high benefit/medium cost, medium benefit/medium cost, medium benefit/low cost, etc.) was considered to be cost-beneficial. This is not the detailed level of benefit/cost analysis required for some FEMA hazard-related grant programs. Such analysis would be performed at the time a given action is being submitted for grant funding.

21.2.2 Implementation Priority

Implementation priority ratings were assigned as follows:

- **High Priority**—An action that meets multiple objectives, has benefits that exceed costs, and has a secured source of funding. Action can be completed in the short term (1 to 5 years).
- **Medium Priority**—An action that meets multiple objectives, has benefits that exceed costs, and is eligible for funding though no funding has yet been secured for it. Action can be completed in the short term (1 to 5 years), once funding is secured. Medium-priority actions become high-priority actions once funding is secured.
- **Low Priority**—An action that will mitigate the risk of a hazard, has benefits that do not exceed the costs or are difficult to quantify, has no secured source of funding, and is not eligible for any known grant funding. Action can be completed in the long term (1 to 10 years). Low-priority actions may be eligible for grant funding from programs that have not yet been identified.

21.2.3 Grant Pursuit Priority

Grant pursuit priority ratings were assigned as follows:

- **High Priority**—An action that meets identified grant eligibility requirements, has high benefits, and is listed as high or medium implementation priority; local funding options are unavailable or available local funds could be used instead for actions that are not eligible for grant funding.
- **Medium Priority**—An action that meets identified grant eligibility requirements, has medium or low benefits, and is listed as medium or low implementation priority; local funding options are unavailable.
- **Low Priority**—An action that has not been identified as meeting any grant eligibility requirements.

21.2.4 Prioritization Summary for Mitigation Actions

Table 21-2 lists the priority of each area-wide action.

Table 21-2. Prioritization of Area-Wide Mitigation Actions

Action #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Action Grant Eligible?	Can Action be Funded under Existing Programs/ Budgets?	Implementation Priority	Grant Pursuit Priority
CW-1	4	Medium	Low	Yes	No	Yes	High	N/A
CW-2	3	Medium	Low	Yes	No	Yes	High	N/A
CW-3	3	Medium	Low	Yes	No	Yes	High	N/A

Action #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Action Grant Eligible?	Can Action be Funded under Existing Programs/ Budgets?	Implementation Priority	Grant Pursuit Priority
CW-4	4	Medium	Medium	Yes	Yes	Yes	High	Medium
CW-5	3	Medium	Low	Yes	No	Yes	High	N/A
CW-6	3	Medium	Low	Yes	No	Yes	High	N/A
CW-7	5	Medium	Low	Yes	No	Yes	High	N/A

21.3 CLASSIFICATION OF MITIGATION ACTIONS

Each recommended action was classified based on the hazard it addresses and the type of mitigation it involves. Mitigation types used for this categorization are as follows:

- **Prevention**—Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. Includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**—Modification of buildings or structures to protect them from a hazard or removal of structures from a hazard area. Includes acquisition, elevation, relocation, structural retrofit, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness**—Actions to inform residents and elected officials about hazards and ways to mitigate them. Includes outreach projects, real estate disclosure, hazard information centers, and school-age and adult education.
- **Natural Resource Protection**—Actions that minimize hazard loss and preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, wetland restoration and preservation, and green infrastructure.
- **Emergency Services**—Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities.
- **Structural Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Includes dams, setback levees, floodwalls, retaining walls, and safe rooms.
- **Climate Resilience**—Actions that incorporate methods to mitigate and/or adapt to the impacts of climate change. Includes aquifer storage and recovery activities, incorporating future conditions projections in project design or planning, or actions that specifically address jurisdiction-specific climate change risks, such as sea level rise or urban heat island effect.
- **Community Capacity Building**—Actions that increase or enhance local capabilities to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Includes staff training, memorandums of understanding, development of plans and studies, and monitoring programs.

Table 21-3 shows the classification based on this analysis.

Table 21-3. Analysis of Mitigation Actions

Hazard	Actions That Address the Hazard, by Mitigation Type							
	Prevention	Property Protection	Public Education & Awareness	Natural Resource Protection	Emergency Services	Structural Projects	Climate Resilience	Community Capacity Building
Dam Failure	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5

Hazard	Actions That Address the Hazard, by Mitigation Type							
	Prevention	Property Protection	Public Education & Awareness	Natural Resource Protection	Emergency Services	Structural Projects	Climate Resilience	Community Capacity Building
Drought	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5
Earthquake	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5
Flooding	CW-1, CW-4, CW-6	CW-1	CW-1, CW-2		CW-3, CW-7	CW-1		CW-1, CW-2, CW-3, CW-5
Landslide/ Mass Movement	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5
Sea-Level Rise	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5
Severe Weather	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5
Tsunami	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5
Wildfire	CW-4, CW-6		CW-2, CW-3		CW-3, CW-7			CW-2, CW-3, CW-5

22. PLAN ADOPTION AND MAINTENANCE

22.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing bodies of the jurisdictions requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. This plan will be submitted for a pre-adoption review to Cal OES and FEMA Region IX prior to adoption. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix F of this volume.

22.2 ACTION PLAN IMPLEMENTATION

The area-wide action plan in Chapter 21 and jurisdiction-specific action plans in Volume 2 present a range of action items for reducing loss from hazard events. The planning partners have prioritized actions and can begin to implement the highest-priority actions over the next five years. The effectiveness of the hazard mitigation plan depends on its effective implementation and incorporation of the outlined action items into all partners' existing plans, policies, and programs. Some action items do not need to be implemented through regulation but can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. Sonoma County will have lead responsibility for overseeing the plan implementation. Plan implementation will be a shared responsibility among all planning partners and agencies identified as lead agencies in the action plans.

22.3 PLAN MAINTENANCE STRATEGY

Plan maintenance is the formal process for achieving the following:

- Ensuring that the hazard mitigation plan remains an active and relevant document and that the planning partnership maintains its eligibility for applicable funding sources
- Monitoring and evaluating the plan annually and producing an updated plan every five years
- Continuing public participation throughout the plan maintenance and implementation process
- Incorporating the mitigation strategies outlined in this plan into existing planning mechanisms and programs, such as any relevant comprehensive land-use planning process, capital improvement planning process, and building code enforcement and implementation.

A steering committee will be maintained to participate in the plan maintenance strategy, which is summarized in Table 22-1. The sections below further describe each element.

Table 22-1. Plan Maintenance Matrix

Approach	Timeline	Lead Responsibility[a]
Plan Monitoring		
Track the implementation of actions over the performance period of the plan	Continuous over the 5-year performance period of the plan	Permit Sonoma will be the lead agency responsible for the plan monitoring. All planning partners will monitor themselves and report to Permit Sonoma. Monitoring contacts will be the primary point of contacts listed in the jurisdictional annexes.
Progress Reporting		
Track actions over the performance period of the plan; assemble an annual report outlining the status of planning partners' projects	Continuous during the 5-year performance period of the plan	Permit Sonoma will be responsible for progress reporting. Participating planning partners are responsible for maintaining the status of and reporting on their respective projects in accordance with the identified timeline. Permit Sonoma will then assemble and maintain the annual report.
Plan Evaluation		
Review the status of previous actions; assess changes in risk; evaluate success of integration	Upon initiation of hazard mitigation plan update, comprehensive general plan update, or major disaster	All planning partners
Incorporation into Other Planning Mechanisms		
Create a linkage between the hazard mitigation plan and individual jurisdictions' general plans or similar plans identified in the core capability assessments	Ongoing during the performance period of this plan as opportunities for integration become available, or according to timelines identified in the action plans for each planning partner	All planning partners
Grant Monitoring and Coordination		
As grant opportunities present themselves, consider options to pursue grants to fund actions identified in this plan	As grants become available	Permit Sonoma and Sonoma County DEM provide notification to planning partners and convene grant funding meeting as needed.
Plan Update		
The planning partnership will reconvene, at a minimum, every 5 years to guide a comprehensive update of the plan.	Funding and organizing to begin in FY 2024/2025 or upon comprehensive update to General Plan or major disaster	All planning partners
Continuing Public Participation		
Maintain the website, bring the plan to the Board of Supervisors meeting for annual review, and receive comments through the website.	Continuous over the 5-year performance period of the plan	Permit Sonoma will be the lead agency responsible. Planning partner points of contact identified in Volume 2 annexes will help support.

a. Responsible lead party may designate an alternate. Jurisdictional points of contact identified in Volume 2 have support responsibility.

22.3.1 Plan Monitoring

Sonoma County Permit and Resource Department (Permit Sonoma) will be the lead agency with Sonoma County Department of Emergency Management (DEM) as the alternate agency responsible for monitoring the plan, and each partner will have monitor plan implementation by tracking the status of all recommended mitigation actions in its action plan. Staff or departments with primary responsibility are identified in each jurisdictional annex (see Volume 2) and summarized in Table 22-1.

22.3.2 Progress Reporting

The steering committee will convene an annual meeting to evaluate the progress on the action plan during a 12-month performance period. This review will include such items as the following:

- Summary of any hazard events that occurred during the performance period and impact of these events on the planning area
- Review of mitigation success stories
- Review of continued public involvement
- Brief discussions about why targeted strategies were not completed
- Reevaluation of the action plan to establish if the timeline for projects needs identified to be amended
- Recommendations for new projects
- Changes in or potential for new funding options
- The impact of any other planning programs or initiatives that involves hazard mitigations

Based on the review, participating partners will complete a progress report template (see Appendix G) and forward it Permit Sonoma to prepare a formal annual report on plan progress. This report will be retained by the County, with copies forwarded to planning partners and Cal OES. This report should be used as follows:

- The reporting period will cover a 12-month period starting from the date of plan approval by FEMA Region IX
- Permit Sonoma will send out reminder emails to all planning partners no later than three months before the due date
- Planning partners will submit status updates and sections of the annual report no later than two weeks prior to the due date
- Permit Sonoma will prepare the annual report including planning partner information no later than one month following the progress reporting due date
- Permit Sonoma will be responsible for ensuring the report is posted to the County's website that is dedicated to hazard mitigation
- The report will also contain public outreach and engagement made during the reporting period
- The steering committee will use the information in the annual report to identify projects of interest for the following year and to apply for respective mitigation and/or resiliency grants
- All partners will present the report findings to their governing bodies to inform them of the progress of mitigation and resiliency efforts implemented during the reporting period

An annual progress is not a requirement under 44 CFR, but it is recommended since it may enhance the planning partnership's opportunity for grand funding. Failure to prepare annual progress reporting will not jeopardize a planning partner's compliance under the DMA; it may jeopardize its opportunity to leverage funding opportunities with other planning partners. Permit Sonoma will follow up with planning partners that do not participate in the annual reporting as deemed necessary.

22.3.3 Plan Evaluation

The plan will be evaluated by how successfully the implementation of identified actions has helped to achieve the goals and objectives identified in this plan. This will be assessed by a review of the changes in risk that occur over the performance period and by the degree to which mitigation goals and objectives are incorporated into existing plans, policies and programs. Plan evaluation will be a shared responsibility among all planning partnership members and agencies identified as lead agencies in the area-wide and jurisdiction-specific action plans.

22.3.4 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The general plans of the planning partners are considered to be integral parts of this plan. The planning partners, through adoption of general plans and zoning ordinances, have planned for the impact of natural hazards. The hazard mitigation plan development process provided them with an opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their general plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the planning area. An update to a general plan may trigger an update to the hazard mitigation plan.

All municipal planning partners are committed to creating a linkage between the hazard mitigation plan and their individual general plans by identifying a mitigation action to do so and giving that action a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Emergency response plans
- Training and exercise of emergency response plans
- Debris management plans
- Recovery plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans
- Comprehensive flood hazard management plans
- Resiliency plans
- Community Development Block Grant-Disaster Recovery action plans
- Public information/education plans.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

For the special purpose district planning partners to this plan, identified planning capabilities include capital facility plans, emergency operations plan, continuity of operations plans and community wildfire protection plans. Special purpose districts do not have land use authority, so integration with land use plans is not a capability for districts. However, for the planning capabilities that the districts do possess, they will integrate where appropriate relevant sections of this plan when those plans are scheduled for updates. This has already occurred for most of the district planning partners as indicated in Volume 2 of this plan.

22.3.5 Grant Monitoring and Coordination

Permit Sonoma and Sonoma County DEM will identify grant funding opportunities and send notifications to participating partner jurisdictions. Once these opportunities are identified, planning partners interested in pursuing a grant opportunity will convene in a short meeting to review the hazard mitigation plan and pursue a strategy to capture that grant funding. Permit Sonoma will assume lead responsibility for planning and facilitating grant opportunity meetings. Review of the hazard mitigation plan at these meetings can include the following:

- Discussion of any hazard events that occurred during the prior year and their impact on the planning area
- Impact of potential grant opportunities on the implementation of mitigation actions
- Re-evaluation of the action plans to determine if the timeline for identified actions need to be amended (such as changing a long-term action to a short-term action because of funding availability)
- Recommendations for new actions
- Impact of any other planning programs or initiatives that involve hazard mitigation.

If multiple planning partners decide to pursue the same grant funding opportunity, partnerships can be formed to utilize the hazard mitigation plan in the grant application.

22.3.6 Plan Update

Federal regulations require that local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under the Disaster Mitigation Act (44 CFR Section 201.6.d(3)). This plan’s format allows the planning partnership to review and update sections when new data become available. New data can be easily incorporated, resulting in a plan that will remain current and relevant. The planning partnership intends to update the plan on a five-year cycle from the date of plan approval. This cycle may be accelerated to less than 5 years based on the following triggers:

- A presidential disaster declaration that impacts the planning area
- A hazard event that causes loss of life
- A 20-year plan update of a participating jurisdiction’s general plan

It will not be the intent of the update process to develop a complete new hazard mitigation plan. Based on needs identified by the planning team, the update will, at a minimum, include the following elements:

- The update process will be convened through a new steering committee.

- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- Action plans will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or planning partnership policies identified under other planning mechanisms (such as the general plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- Partners’ governing bodies will adopt their respective portions of the updated plan.

Because plan updates can require a year or more to complete, Permit Sonoma will initiate efforts to update the plan before it expires. Permit Sonoma will consider applying for funding to update the plan in Fiscal Year 2024/2025 grant cycle or will identify an alternate source of funding for the plan update in order to begin the update process in the spring of 2025.

22.3.7 Continuing Public Participation

The public outreach strategy used during development of the current update will provide a framework for public engagement through the plan maintenance process. It can be adapted for ongoing public outreach as determined to be feasible by the planning partnership. A steering committee similar to the one involved in developing this hazard mitigation plan update will be put in place to provide stakeholder input on plan maintenance activities.

The public will continue to be apprised of hazard mitigation activities through the website and reports on successful hazard mitigation actions provided to the media. Permit Sonoma will keep the website maintained, including monitoring the email address where members of the public can submit comments to the steering committee. This site will house the final plan and will be a one-stop shop for information regarding the plan, the partnership and plan implementation. Copies of the plan also will be distributed to the Sonoma County library system.

Once a year, Permit Sonoma will bring the plan to a Board of Supervisors meeting for review. These meetings are also televised and on public notices in community newspaper.

Upon initiation of the next plan update process, a new public involvement strategy will be initiated, with guidance from the new steering committee. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. At a minimum, it will include the use of local media outlets.

REFERENCES

Ackerly, David, Andrew Jones, Mark Stacey, Bruce Riordan. (University of California, Berkeley). 2018. *San Francisco Bay Area Summary Report. California's Fourth Climate Change Assessment*. Publication number: CCCA4-SUM-2018-005. Accessed at https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-005_SanFranciscoBayArea_ADA.pdf

Association of State Dam Safety Officials (ASDSO). 2013. "Introduction to Dams." Dam Safety 101. Accessed 2017. http://www.damsafety.org/news/?p=e4cda171-b510-4a91-aa30-067140346bb2.

Berkeley Seismology Lab. 2018. California Faults. Accessed 2021. https://seismo.berkeley.edu/hayward/index.html.

Brown, William M. III, David M. Perkins, Edgar V. Leyendecker, Arthur D. Frankel, James W. Hendley II, and Peter H. Stauffer. 2001. U.S. Geological Survey (USGS). "Hazard Maps Help Save Lives and Property." 2001. Accessed 2017. http://pubs.usgs.gov/fs/1996/fs183-96/fs183-96.pdf.

Cal FIRE. 2012. "Fire Hazard Severity Zone Re-Mapping Project." The website of Cal FIRE. Accessed 2018. http://frap.fire.ca.gov/projects/hazard/fhz

Cal FIRE. 2012a. "Fire Hazard Severity Zone Development." The website of Cal FIRE. Accessed 2018. http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_development

California Coastal Commission. 2019. Climate Change; Sea Level Rise. Accessed 2021. https://www.coastal.ca.gov/climate/slr/.

California Department of Conservation. 2003. "Faults and Earthquakes in California; Note 31." Accessed online: http://www.conservation.ca.gov/cgs/Documents/Note_31.pdf

California Department of Finance. 2020. "E-4 Population Estimates for Cities, Counties, and the States, 2001-2010, with 2000 and 2010 Census Counts." Website of the State of California Department of Finance. Accessed 2020. http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-4/2001-10/

California Department of Finance. 2020a. "E-4 Population Estimates for Cities, Counties, and the State, 2011-2021 with 2010 Census Benchmark." Website of the State of California Department of Finance. Accessed 2021. https://www.dof.ca.gov/forecasting/demographics/Estimates/e-4/2010-21/

California Department of Water Resources. 2008. *Managing an Uncertain Future: Climate Change Adaptation for California's Water.* Accessed 2018. https://www.water.ca.gov/LegacyFiles/climatechange/docs/ClimateChangeWhitePaper.pdf

California Division of Safety of Dams. 2017. Criteria for DSOD's Downstream Hazard Potential Classification. Accessed 2018. https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/All-Programs/Division-of-safety-of-dams/Emergency-Action-Planning/Files/Publications/Criteria-for-DSODs-Downstream-Hazard-Potential-Classification.pdf

California Division of Safety of Dams. 2021. *Dams within Jurisdiction of the State of California*. Accessed 2021. https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/All-Programs/Division-of-safety-of-dams/Files/Publications/Dams-Within-Jurisdiction-of-the-State-of-California-Alphabetically-by-County.pdf

California Emergency Management Agency (Cal EMA) et al. 2012. "California Adaptation Planning Guide." Accessed 2017. http://resources.ca.gov/docs/climate/APG_Understanding_Regional_Characteristics.pdf.

California Employment Development Department. 2021. Major Employers in Sonoma County. Accessed 2021. https://www.labormarketinfo.edd.ca.gov/majorer/countymajorer.asp?CountyCode=000097.

California Governor's Office of Emergency Services (Cal OES). 2018. "Dam Emergency Action Planning." Website of Cal OES. Accessed 2018. http://www.caloes.ca.gov/for-individuals-families/hazard-mitigation-planning/dam-emergency-action-planning

California Landscape Conservation Partnership. 2021. "The Climate Commons." Webpage accessed at http://climate.calcommons.org/basic/welcome-climate-commons

California Office of Environmental Health Hazard Assessment. 2018. 2018 Indicators of Climate Change in California. Accessed 2021. https://oehha.ca.gov/climate-change/2018-indicators-climate-change-california.

California Office of the Attorney General. 2021. Climate Change Impacts in California. Accessed February 2021. https://oag.ca.gov/environment/impact#:~:text=Sea%20level%20rise%2C%20coastal%20flooding,and%20work%20in%20coastal%20counties.&text=As%20sea%20levels%20rise%2C%20saltwater,and%20levee%20systems%20will%20increase.

California Public Utilities Commission. 2021. Public Safety Power Shutoff (PSPS) / De-Energization. Accessed 2021. https://www.cpuc.ca.gov/psps/.

Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh. 2012: Determinants of risk: exposure and vulnerability. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA. Accessed 2021. https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

Centers for Disease Control and Prevention (CDC). 2012. "Drought and Health." Accessed February 2017. http://www.cdc.gov/nceh/drought/.

Climate Central. 2021. "Surging Seas Risk Finder; Sonoma County, California, USA." Page on Climate Central website. Accessed at https://riskfinder.climatecentral.org/county/sonoma-county.ca.us?comparisonType=postal-code&forecastName=Basic&forecastType=NOAA2017_int_p50&level=3&unit=ft

Climate Connections. 2021. "Silent calamity: The health impacts of wildfire smoke." YaleClimateConnections.org website page, accessed at: https://yaleclimateconnections.org/2021/05/silent-calamity-the-health-impacts-of-wildfire-smoke/

City of Sonoma. 2017. History of Sonoma. September 1. Accessed 2021. https://www.sonomacity.org/history-of-sonoma/#:~:text=Native%20American%20Period%20%5BBefore%201823,the%20arrival%20of%20the%20Europeans.

County of Sonoma. 2013. "Sonoma County General Plan 2020; Open Space and Resource Conservation Element." Permit and Resource Management Department. Accessed 2021. https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/General-Plan/Open-Space-and-Resource-Conservation/.

County of Sonoma. 2016. "Groundwater Availability." Map, Permit Sonoma. Accessed 2021. https://sonomacounty.ca.gov/WorkArea/DownloadAsset.aspx?id=2147553775.

County of Sonoma. 2017. "2016 Sonoma County Operational Area Hazard Mitigation Plan." Permit Sonoma; Fire & Emergency Services Department.

County of Sonoma. 2019. "Department of Homeland Security Authorized Agent Signature Authority." Board of Supervisors Agenda Item Summary Report, Department of Emergency Management. Accessed 2021. https://sonoma-county.granicus.com/MetaViewer.php?view_id=2&clip_id=872&meta_id=257688.

County of Sonoma. 2019. "Sonoma County Local Coastal Plan (Public Review Draft)." Accessed 2021. https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/Local-Coastal-Program/Public-Review-Draft/#separateSections.

County of Sonoma. 2021. "Sonoma at a Glance." Economic Development Board. Accessed 2021. http://sonomaedb.org/Why-Sonoma-County/Sonoma-at-a-Glance/.

County of Sonoma. 2021. *Income and Rent Limits.* June 1. Accessed June 8, 2021. https://sonomacounty.ca.gov/CDC/Housing-and-Neighborhood-Investment/Income-and-Rent-Limits/#local.

County of Sonoma. n.d. Sonoma County Historic Overview. Accessed 2021. https://sonomacounty.ca.gov/PRMD/Planning/Historic-Resources/Sonoma-County-Historic-Overview/.

Danielson, Tess. 2015. The FBI says you may need to pay up if hackers infect your computer with ransomware. October 26. Accessed 2019. https://www.yahoo.com/entertainment/s/fbi-recommends-pay-hackers-infect-185625373.html?guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAN6lJrIEj712_hGe9UjyaOIOjOxzrdJn3Tzvsdr6gHgqemY3TjtfJTV6pAtkkzRQFbPMrcdZubyMrZV_XemNdCIy_nIg1HFTFbN3.

Drought Impact Reporter. 2021. The website of the National Drought Mitigation Center. Accessed 2021. http://drought.unl.edu/monitoringtools/droughtimpactreporter.aspx

Dunbar, Paula K, and Craig S Weaver. 2015. U.S. States and Territories National Tsunami Hazard Assessment: Historical record and sources for waves – Update. Boulder, CO: National Oceanic and Atmospheric Administration (NOAA). Accessed 2021. https://nws.weather.gov/nthmp/documents/Tsunami_Assessment_2016Update.pdf.

Dunbar, Paula K. and Craig S. Weaver. 2015. *United States and Territories National Tsunami Hazard Assessment: Historical record and Sources for Waves-Update.* http://www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf

Federal Emergency Management Agency (FEMA). 2015. “Why Dams Fail.” Webpage of the Federal Emergency Management Agency Website. Last updated April 7, 2015. Available online at: https://www.fema.gov/why-dams-fail

Federal Reserve Bank of St. Louis. 2021. Unemployment Rate in Sonoma County, CA. Accessed 2021. https://fred.stlouisfed.org/data/CASONO6URN.txt.

Felman, Adam. 2020. What to know about pandemics. March 30. Accessed 2021. https://www.medicalnewstoday.com/articles/148945.

Fire Safe Sonoma. 2016. “Sonoma County Community Wildfire Protection Plan.” Accessed 2021. https://www.firesafesonoma.org/wp-content/uploads/cwpp-final.pdf.

FireDepartment.net. 2021. “Sonoma County, CA Fire Departments.” Page of the FireDepartment.net website accessed at https://www.firedepartment.net/directory/california/sonoma-county

Hansen, E. M., Schreiner L. C. , and Miller J. F. 1982. Application of probable maximum precipitation estimates, United States east of the 105th meridian. Hydrometeorological Rep. 52, Silver Spring, MD: National Weather Service.

Harrison, Virginia, and Jose Pagliery. 2015. Nearly 1 million new malware threats released every day. April 14. Accessed 2019. https://money.cnn.com/2015/04/14/technology/security/cyber-attack-hacks-security/index.html.

Heady, W. N., B. S. Cohen, M. G. Gleason, J. N. Morris, S. G. Newkirk, K. R. Klausmeyer, H. Walecka, E. Gagneron, M. Small. 2018. Conserving California’s Coastal Habitats: A Legacy and a Future with Sea Level Rise. The Nature Conservancy, San Francisco, CA; California State Coastal Conservancy, Oakland, CA. Accessed at https://www.conservationgateway.org/ConservationPractices/Marine/crr/library/Documents/TNC_SCC_CoastalAssessment_lo.pdf

Howell, Junia, and James R. Elliott. 2018. “Damages Done: The Longitudinal Impacts of Natural Hazards on Wealth Inequality in the United States.” Social Problems (Oxford Academic) 66 (3). Accessed 2021. https://academic.oup.com/socpro/article/66/3/448/5074453#137726978.

Intergovernmental Panel on Climate Change (IPCC). 2014. “Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Parts A, B and Annexes.” Accessed January 2017. http://www.ipcc.ch/report/ar5/wg2/.

Intergovernmental Panel on Climate Change (IPCC). n.d. Special Report on the Ocean and Cryosphere in a Changing Climate. Accessed 2021. https://www.ipcc.ch/srocc/.

Kostadinov, Dimitar. 2012. Cyberterrorism Defined (as distinct from “Cybercrime”). December 21. Accessed 2018. https://resources.infosecinstitute.com/topic/cyberterrorism-distinct-from-cybercrime/.

Larsen, Mort, Prentice, Carol S., Kelsey, Harvey M., Zachariasen, Judith, and Rotberg, Gabriel L. 2005. "Paleoseismic Investigation of the Maacama Fault at the Haehl Creek Site, Willits, California." Geological Society of America Cordilleran Section 101st Annual Meeting. San Francisco. Accessed 2021. https://web.archive.org/web/20160814083719/https:/gsa.confex.com/gsa/2005CD/finalprogram/abstract_85295.htm.

Lewis, Michael S. No date. "Beaufort Wind Chart—Estimating Winds Speeds." The website of NOAA. Accessed 2018. http://www.crh.noaa.gov/Image/iwx/publications/Beaufort_Wind_Chart.pdf

Metropolitan Transportation Commission and Association of Bay Area Governments (MTC & ABAG). 2021. "Bay Area Census; Race Ethnicity Percentage by County, 1980 – 2010." Accessed June 28, 2021 at http://www.bayareacensus.ca.gov/historical/shrcorace.htm

National Academies of Sciences, Engineering, and Medicine. 2018. Emergency Alert and Warning Systems: Current Knowledge and Future Research Directions. Washington, DC: The National Academies Press. Accessed at https://doi.org/10.17226/24935

National Aeronautics and Space Administration (NASA). 2004. NASA Earth Observatory News Web Site Item, dated August 2, 2004. http://earthobservatory.nasa.gov/Newsroom/view.php?id=25145

National Aeronautics and Space Administration (NASA). 2020. NASA Global Climate Change web page "The relentless rise of carbon dioxide." Accessed at: https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/

National Aeronautics and Space Administration (NASA). 2020a. NASA Global Climate Change web page "Climate Change: How Do We Know?." Accessed at: https://climate.nasa.gov/evidence/

National Aeronautics and Space Administration (NASA). 2021. *The Effects of Climate Change.* Accessed 2021. https://climate.nasa.gov/effects/.

National Centers for Environmental Information. 2018. "NGDC/WDS Global Historical Tsunami Database." Accessed 2018. https://www.ngdc.noaa.gov/hazard/tsu_db.shtml

National Centers for Environmental Information. 2021a. "Climate Prediction Center, Palmer Z Index." Accessed at http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

National Centers for Environmental Information. 2021b. "Climate Prediction Center, Palmer Drought Severity Index." Accessed at http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

National Centers for Environmental Information. 2021c. "Climate Prediction Center, Palmer Hydrological Drought Index." Accessed at http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

National Centers for Environmental Information. 2021d. "Climate Prediction Center, Standard Precipitation Index." Accessed at http://www.cpc.ncep.noaa.gov/products/Drought/Monitoring/spi.shtml.

National Drought Mitigation Center. 2021. "Types of Drought." Website accessed June 2021 at https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx

National Oceanic and Atmospheric Administration (NOAA). 2017. "Global and Regional Sea Level Rise Scenarios for the United States." Silver Spring, MD. Accessed 2021. https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2018. "Sea Level Rise Viewer." Accessed at https://coast.noaa.gov/digitalcoast/tools/slr.html.

National Oceanic and Atmospheric Administration (NOAA). 2018a. "Enhanced F Scale for Tornado Damage." The website of NOAA. Accessed 2018. http://www.spc.noaa.gov/faq/tornado/ef-scale.html

National Oceanic and Atmospheric Administration and National Weather Service (NOAA and NWS). 2009. "National Weather Service Glossary." Accessed 2018. http://w1.weather.gov/glossary/.

National Research Council. 2011. *Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia*. Washington, DC: The National Academies Press. Accessed at https://doi.org/10.17226/12877

National Severe Storms Laboratory. 2018. "Severe Weather 101." The website of the National Severe Storms Laboratory. Accessed 2018. https://www.nssl.noaa.gov/education/svrwx101/wind/types/

National Tsunami Hazard Mitigation Program. 2001. *Designing for Tsunamis: Seven Principles for Planning and Designing for Tsunami Hazards.* Accessed 2018. https://nws.weather.gov/nthmp/documents/designingfortsunamis.pdf

Nicholls, Ben. 2020. Personal communication with CAL FIRE West Division Chief Ben Nicholls. November 12, 2020.

Pacific Gas & Electric. n.d. Learn about Public Safety Power Shutoff (PSPS) events. Accessed 2021. https://www.pge.com/en_US/residential/outages/public-safety-power-shuttoff/learn-about-psps.page.

Pacific Northwest Seismic Network. 2018. "Cascadia Subduction zone." Website accessed 2018. https://pnsn.org/outreach/earthquakesources/csz

Pan American Health Organization. 2012. "Older people & disasters." Information sheet prepared by the Pan American Health Organization, Regional Office for the Americas of the World Health Organization. Accessed at https://www.paho.org/hq/dmdocuments/2012/Disasters-English.pdf

Permit Sonoma. 2017. "Bodega Bay Focused Sea Level Rise Vulnerability Assessment and Adaptation Strategies." Accessed 2021. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjl58aM7MHwAhXOXc0KHSMmD4IQFjAAegQIAhAD&url=https%3A%2F%2Fsonomacounty.ca.gov%2FWorkArea%2FDownloadAsset.aspx%3Fid%3D2147578801&usg=AOvVaw2KGTMDj6xnuXrYDlvI2SN-.

San Francisco Bay Conversation and Development Commission. 2011. *Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline*. October 6, 2011. Accessed at https://bcdc.ca.gov/BPA/LivingWithRisingBay.pdf

Schuster, Robert L. and Lynn M. Highland. 2003. "Impact of Landslides and Innovative Landslide-Mitigation Measures on the Natural Environment." U.S. Geological Survey, Denver, Colorado. Accessed at https://pubs.usgs.gov/op/HongKongJuly/HongKongJuly21sm.pdf

Society for Research in Child Development. 2020. "Understanding the Impacts of Natural Disasters on Children." Website article posted August 13, 2020. Accessed at https://www.srcd.org/research/understanding-impacts-natural-disasters-children

Sonoma County Emergency. 2021. *COVID-19 Vaccine Update.* Accessed 2021. https://socoemergency.org/emergency/novel-coronavirus/vaccine-information/.

Sonoma County Emergency. 2021. *Sonoma County Coronavirus Data at a Glance.* Accessed 2021. https://socoemergency.org/emergency/novel-coronavirus/.

Sonoma Water. 2018. "2018 Water Supply Strategies Action Plan." Accessed 2021. https://www.sonomawater.org/media/PDF/Water%20Resources/Water%20Supply/Water%20Supply%20Strategies/WSSAP%202018%20FINAL%20v2.pdf.

Sonoma Water. 2021. *Urban Water Management Plan.* March. Accessed 2021. https://www.sonomawater.org/uwmp.

Sonoma Water. 2021a. "Current Water Supply Levels." Website accessed June 2021 at https://www.sonomawater.org/current-water-supply-levels

Sonoma Water. 2021b. "Zoning and Land Use (Staff Version)." Online GIS map. Accessed June 28, 2021 at https://sonomacounty.maps.arcgis.com/apps/webappviewer/index.html?id=6cc8a5f296b8433d96cbd5db528f4d36

Sonoma Water. n.d. Water Supply. Accessed May 6, 2021. https://www.sonomawater.org/water-supply.

Sonomavalley.com. 2021. About Sonoma Valley: The Birthplace of California's Famed Wine Industry. Accessed 2021. https://www.sonomavalley.com/about/history-of-sonoma-valley/.

Southern California Earthquake Center. 2018. "A Site Conditions Map for California Based on Geology and Hear Wave Velocity." The website of the Southern California Earthquake Center. Accessed 2018 at http://scecinfo.usc.edu/phase3/wills.html

State of California. 2018. California Legislative Information website. Accessed 2018. https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=GOV&sectionNum=8589.5.

U.S. Census Bureau. 2021. *Sonoma County, California Profile Page (2019 American Community Survey 5-Year Estimates).* Accessed June 4, 2021. https://data.census.gov/cedsci/profile?g=0500000US06097.

U.S. Census Bureau. 2021a. "Race." U.S. Census Bureau Quickfacts footnote. Accessed at https://www.census.gov/quickfacts/fact/note/US/RHI625219

U.S. Census Bureau. n.d. Physical Housing Characteristics for Occupied Housing Units (Table S2504). Accessed May 17, 2021.

https://data.census.gov/cedsci/table?q=United%20States&t=Year%20Structure%20Built&g=0500000US06097&tid=ACSST1Y2019.S2504.

U.S. Climate Resilience Toolkit. 2018. U.S. Climate Resilience Toolkit web page on drought: https://toolkit.climate.gov/topics/water/drought

U.S. Drought Monitor (USDM). 2020. Tabular Data Archive, data for Sonoma County, California. Accessed at https://droughtmonitor.unl.edu/Data/DataTables.aspx

U.S. Drought Monitor (USDM). 2021. What is the USDM. Accessed at https://droughtmonitor.unl.edu/About/WhatistheUSDM.aspx

U.S. Drought Portal. 2020. National Integrated Drought Information System. Accessed 2020. https://www.drought.gov/drought/data-gallery/crop-moisture-index

U.S. Geological Survey (USGS). 2016. Map of known active geologic faults in the San Francisco Bay region. Accessed May 2021. https://www.usgs.gov/media/images/map-known-active-geologic-faults-san-francisco-bay-region.

U.S. Geological Survey (USGS). 2017. "Measuring Earthquakes FAQs." Accessed February 2017. https://www2.usgs.gov/faq/categories/9828/3357.

U.S. Geological Survey (USGS). 2018. A New Map of Rodgers Creek Fault in Sonoma County, California. July 16. Accessed 2021. https://www.usgs.gov/natural-hazards/earthquake-hazards/science/a-new-map-rodgers-creek-fault-sonoma-county-california?qt-science_center_objects=0#qt-science_center_objects.

U.S. Geological Survey (USGS). 2020. "How many deaths result from landslides each year?" USGS website accessed at: https://www.usgs.gov/faqs/how-many-deaths-result-landslides-each-year?qt-news_science_products=0#qt-news_science_products

U.S. Geological Survey. n.d. Earthquake Hazard and Probability Maps. Accessed May 6, 2021. https://earthquake.usgs.gov/hazards/interactive/.

U.S. Geological Survey. n.d. What is the probability that an earthquake will occur in the Los Angeles Area? In the San Francisco Bay area? Accessed May 6, 2021. https://www.usgs.gov/faqs/what-probability-earthquake-will-occur-los-angeles-area-san-francisco-bay-area?qt-news_science_products=0#qt-news_science_products.

U.S. Global Change Research Program (USGCRP). 2018. "Fourth National Climate Assessment; Chapter 2, Our Changing Climate." Accessed 2021. https://nca2018.globalchange.gov/chapter/2/.

U.S. Soil Conservation Service. 1972. Soil Survey; Sonoma County California. U.S. Department of Agriculture in Cooperation with University of California. Accessed 2021. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/sonomaCA1972/sonomaCA1972.pdf.

USDA Farm Services Agency. 2021. Disaster Designation Information. USDA web page accessed at https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index

Wildfiretoday.com 2018. “One year later, looking at the disastrous Northern California wildfires.” October 9, 2018. Page of the wildfiretoday.com website. Accessed at https://wildfiretoday.com/tag/pocket-fire/

Wikipedia. 2021. “August 2020 California lightning wildfires. Wikipedia website page accessed at https://en.wikipedia.org/wiki/August_2020_California_lightning_wildfires

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix A. Public Involvement Materials

STEERING COMMITTEE MEETING SUMMARIES

MEETING SUMMARY

Date/Time of Meeting:	Thursday – July 23, 2020
Location:	Online Meeting
Subject:	Steering Committee No. 1
Project Name:	Sonoma County Hazard Mitigation Plan-Update
In Attendance	**Attendees: 25**
	Phoned in: All
	Planning Team: Bart Spencer (Lead), Rob Flaner
Not Present:	N/A
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Item	Action

Welcome and Introductions

- Chair, Ms. Lisa Hullete greeted the committee and introduced Tetra Tech, the county's consultant for the MJHMP
- Rob Flaner and Bart Spencer introduced Tetra Tech and the Tetra Tech team
- As the lead planner, Bart walked through the agenda

Project Overview

- While discussing the work plan, Bart explained that the committee will keep any impacts from the ongoing COVID pandemic in mind as meetings and assignments are scheduled
- The planning team will work to keep everyone on-task as this process progresses over the next few months. The homework that will be given by Tetra Tech will be used to provide insight and guidance on where the steering committee wants the HMP to go.

MJHMP Steering Committee Role

- It was explained to the committee that Lisa, who is the Chair, will coordinate with Rob and Bart on all actions
- There was discussion around the role and necessity of a Vice-Chair, who would run meetings in the event of Lisa's absence

Item	Action
o Later in the meeting Shari Meads from the City of Santa Rosa volunteers to be the Vice-Chair and is elected by consensus • Rob explained FEMA requirement that all meetings be advertised to the public once the charter is approved • Bart and Rob explained the attendance policy. All members are asked to email the program manager () if they are unable to attend the meeting; non-participating members will be asked to identify alternates if they miss multiple meetings; to reach quorum, 50% + 1 participation is required • Bart also explained the virtual meeting guidelines. All meetings must be interactive, but are not required to be in real time; the committee must interact with the public at least twice; and when public facing meetings occur, the committee must consider social distancing protocols • Bart and Rob explained that ground rules/charter must be adopted today and sent to FEMA in order to maintain compliance • Participating jurisdictions were asked to identify potential alternates and to send their contact information to Lisa	Motion to adopt the ground rules was made by Shari Meads, seconded by Karen Gaffney and approved by the committee Shari Meads was elected Vice-Chair by committee consensus
<u>MJHMP Plan Review</u> • Bart reminded committee members about the homework assignment mentioned in the agenda • Assignment 1: Review the California State HMP, specifically the hazards of concern for Sonoma County. Committee members should think about if CA HMP goals and objectives are consistent with those identified in the 2016 Sonoma County LHMP. Members should also look for items and think about issues that would be specific to their jurisdictions or municipalities, and they should also think about what kind of projects could be done that would be specific to their respective organizations • Rob asked that organizations/municipalities with their own separate plans also evaluate those to identify alignments between the plans of the county and state. He expressed that it is important that all plans maintain consistency.	
<u>Public Involvement Strategy</u> • Bart and Lisa discussed the press release sent out by Lisa that announced the commencement of the plan update process	

MEETING SUMMARY

Item	Action

- Bart and Rob discussed the importance of keeping the public informed, and state that the HMP website will be updated with the HMP's status (at start and end of process)
- The committee was asked to provide any suggestions on additional outreach capabilities that may be available

<u>Phase 1 – Jurisdictional Annex Process</u>

- Bart discussed the goals and the stages of phase 1 of the jurisdictional annex process. Phase 1 seeks to identify the most relevant hazards to the county and requires the participation of every organization in order to identify Sonoma County's most relevant hazards. Rob added that the annex process is very helpful to organizations that may seek grant funding for improvement projects.
- Bart and Lisa stated that phase 1 will be disseminated by July 31st and that Tetra Tech will assist organizations with completing this process. Once completed, committee members will submit their annexes to Bart and Lisa
- Annexes should be completed within 30 days. Bart and Rob express that the most likely hazards to be identified by all would be fire, flooding, and earthquake. It is mentioned that all critical (i.e. necessary for physical and/or economic function) facilities need to be identified. Rob suggests members look at FEMA's community lifeline definitions to help identify critical facilities

<u>Action Items and Next Steps</u>

- Bart asked the committee to budget about an hour and a half for meetings moving forward. Several committee members ask if meeting time can be adjusted and everyone votes on the new time agreement
- Bart, Rob, and Lisa reiterated the importance of completing homework assignments
- Committee members were asked to submit any questions to Lisa or the Tetra Tech team prior to the meeting. All actions that need to take place will be made clear in the next agenda

Action: Future meeting day/time agreed upon by group: Last Thursday of the Month from 1 pm to 2:30 pm.

<u>Next Meeting</u>: Thursday, August 27, 2020 from 1 pm to 2:30 pm

MEETING SUMMARY

Date/Time of Meeting:	Thursday, September 24, 2020
Location:	Digital
Subject:	Steering Committee Meeting No. 2
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees: 25 (21 SoCo, 4 TT)** **Planning Team:** Lisa Hulette, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander
Not Present:	N/A
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Item	Action
Welcome and Introductions • Lisa Hulette welcomed members of the steering committee to the 2nd meeting for Sonoma County's MJHMP update • Des Alexander did a roll call, where 21 committee members were in attendance, with 4 members of Tetra Tech also on the call. • No members of the public were on the call.	Previous steering committee meeting notes were approved
Planning Process • Motion to approve meeting summary for Steering Committee meeting 1 was made by Shari Meads, seconded by Kim Jordan, and approved • All planning partners who wish to participate in process have been contacted • Lisa and Bart discussed the draft mission/vision statement document that was sent to committee members. The document featured several sample mission and vision statements, as well as several goals and objectives	

Item	Action
• Although several members did not have a comment, most of the comments that were made were focused on using fewer and more general words; making sure equity was factored into mitigation process, actions, and outcome; placing more emphasis on disaster mitigation with green infrastructure; separate natural and man-made hazards in the goals section	
Hazards of Concern	
• The homework from the last meeting was briefly discussed. Considering the rescheduling of everything due to the wildfires, the county and Sonoma County-portion of the state HMPs will be discussed at the next meeting. Participating cities were also asked to review their individual HMPs if they had them.	
• Bart discussed the differences between natural hazards and human-caused hazards, as well as how each will be covered in the HMP. For natural hazards, he discussed the importance of using historical data to track probabilities.	
• It was proposed that severe weather, sea level rise, tsunami, dam failure, drought, and pandemic be added to the current countywide hazards of earthquake, flood, wildland fire, and landslide. Bart and Rob explained the justifications for each hazard, specifically pandemic. Rob stated it would be very difficult for the plan to get public and political support right now without any mention of pandemic mitigation. Pandemic would not get its own section like the other hazards, but would be looped into the "other hazards of concern" section	
• Discussion included information that failure of Warm Springs Dam was analyzed and modeled as part of the NEPA process for constructing the dam; Lisa and TT will connect with Sonoma Water separately to get needed information; most supported listed and suggested hazards	
• Motion to include all listed and suggested hazards made by Lisa Hulette, seconded by Kim Jordan • Approved by committee	All listed and suggested hazards approved by consensus
Phase 1 Annexes	
• The instructions and phase 1 annex forms went to all participating partners. Tetra Tech is still in the process of receiving them, but they are due soon.	
• Bart explains the three phased approach to the annex process. The first phase asks for general hazards throughout the county; the second phase seeks to build an HMP that is specific to its jurisdiction by ranking hazards accordingly; the third phase asks	

Item	Action

municipalities and districts to devise specific action items for them to take to mitigate those habits. Rob explained that there are different processes for municipalities and districts, so it is important that each one get the correct instructions.

Public Involvement Strategy

- Domenica stated that the website is in the process of being updated to better inform the public. She stated that there is room for a sub-committee to be created in the future to discuss strategies for website improvement.
- Bart also discussed surveys that can be sent out to engage the public. He explained that Tetra Tech would create a survey that would ask the public about their current knowledge of and level of preparation for relevant hazards
- Bart also said that committee members can send screenshots and descriptions of their public engagement strategies to Tetra Tech

Closing Comments

- Action Steps: Steering committee members will decide the best goals and objectives are best for the HMP. The goal is to pare the number of goals to 4-6 and the number of objectives to 8-12.

Tetra Tech agreed to create survey to send to committee

- Tetra Tech agreed to set up a poll for everyone to vote for the mission and vision statements, as well as top goals and objectives
- It was suggested that a cloud-based platform be set up to share information, including community outreach strategies and relevant data

Next Meeting Date

- October 22, 2020 from 1pm to 3:30pm

Adjourn

- Motion to close made by Lisa Hulette, seconded by Shari Meads
- Approved at 2:37pm

Sonoma County MJHMP Steering Committee Meeting #3

Date/Time of Meeting:	Thursday, October 22, 2020
Location:	Digital
Subject:	Steering Committee Meeting No. 3
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees:** Primaries – *Gary Helfrich, Shelley Bianchi-Williamson, Richard Diaz, Hunter McLaughlin, Shari Meads, Katherine Duran, Mollie Asay, Marshall Turbeville, Scott Westrope, Ben Nicholls, Lisa Michelli;* Alternates – *Caerleon Safford, Adrianne Garayalde, Mickie Tagle, Mark Chandler, Kate Piontek*; Public/Other – *Amy Lyle, Dave Schiltgen, Eduardo Hernandez* **Planning Team:** Lisa Hulette, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander
Not Present:	*The Nature Conservancy, Western Builders*
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

<u>Welcome and Introductions</u>

- Lisa gave the overview of the agenda and goals of the meeting
- Des completed the roll call
- 20 steering committee members were present, with 4 members from Tetra Tech
- A couple members of the public were on the call, including Dave Schiltgen (contributed on last HMP) and members from Graton Rancheria

<u>Planning Process</u>

- Lisa asked the committee to review the steering committee meeting minutes from the last minute
- When no corrections were offered, **Shari Meads moved to approve the minutes which was seconded by Richard Diaz. The minutes were approved by the committee.**
- Lisa also asked for public comment, but none was offered at the time

<u>Old Business</u>

- Rob and Bart clarified FEMA's position on the term "equity" and why it would not be helpful to include in the HMP. FEMA currently has no official definition for "equity," so they would have no accurate way to gauge whether it is included in the plan or not. However, FEMA has the BRIC (Building Resilient Infrastructure and Communities) program which focuses on funding mitigation actions for the "whole community." Lisa explained that "whole community" would be the term used for the HMP and that the later discussion regarding community lifelines can outline how that is covered.

Meeting Summary

- Lisa went through the SurveyMonkey results regarding the final mission statement and goals. Lisa Micheli moved to accept the mission statement as written, which was seconded by Shari Meads. The committee voted and the mission statement was adopted. Steering committee members and general public members discussed redundancy in the goals as written and retooled the first five goals as a result.
- Those goals are now as follows: (1) **protect people and minimize loss of life, injury and social impacts** (2) **minimize potential for loss of property, economic and social impacts, and displacement due to hazards** (3) **minimize potential for environmental impacts and consider a broad-range of mitigation solutions, including nature-based solutions where feasible** (4) **communicate natural hazard risk to the whole community within Sonoma County** (5) **support and inform the development of relevant mitigation policies and programs**
- The motion to accept the new goals was made by Lisa Micheli and seconded by Mark Chandler. The new goals were then approved by the committee.
- Due to time constraints, the discussion on the remaining goals was postponed until the next meeting

<u>New Business</u>

- Since all the goals had not been finalized, Bart explained that objectives could not be discussed until that time.
- Bart went on to explain critical facilities and how it related to FEMA's community lifelines concept. He and Rob asked members to identify critical structures in their jurisdictions that would be essential before, during, and after a disaster. These could be anything from the community general store or livestock veterinary offices. This list would not be public-facing and would be used by Tetra Tech to evaluate risk and vulnerability.
- **A motion to move forward with the community lifelines construct was made by Richard Diaz and seconded by Mickie Tagle. It was then approved by the committee**.

<u>Jurisdictional Annex Process</u>

- Bart updated committee members with annex participant statistics. As of the meeting time, about 60-70% of participating jurisdictions had turned in their phase 1 annexes. He then reminded people of the deadlines for each of the annexes and that it is important to the process to return the annexes ASAP. He said that the preview of phase 2 will go out in the next few weeks.

<u>Public Involvement Strategy</u>

- Rob and Bart discussed the sample survey that Tetra Tech had created that would be used to engage the public about their perceived hazard risk.

<u>Action Items and Next Steps</u>

- All phase 1 annexes completed and submitted by next meeting
- Survey will be sent out
- Committee members should look ahead to phase 2 timeline

Meeting Summary

Adjourn

- Approved at 2:28pm

Sonoma County MJHMP Steering Committee Meeting #4

Date/Time of Meeting:	Thursday, November 19, 2020
Location:	Digital
Subject:	Steering Committee Meeting No. 4
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees:** *County of Sonoma, Permit Sonoma (Planning), Permit Sonoma (GIS), Sonoma County Fire Prevention, Sonoma County PIO, Town of Windsor, City of Santa Rosa, SC Ag + Open Space, Sonoma Water, Santa Rosa City Fire, Cal Fire, The Nature Conservancy, Community Development Commission, Sonoma County Winegrowers* Public/Other – *Graton Rancheria* **Planning Team:** Lisa Hulette, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander
Not Present:	*City of Cotati, Pepperwood Preserve, Western Builders*
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome and Introductions

- Lisa gave the overview of the agenda and goals of the meeting
- Des completed the roll call
- 14 member organizations were present, along with Tetra Tech team
- Graton Rancheria was also present

Planning Process

- Steering Committee asked to review and confirm minutes from meeting 3
- Moved by Shari Meads and Seconded by Gary Helfrich
- Approved by committee

Old Business

- Finalize the goals as discussed at the previous meeting
- With no further discussion on the remaining goals, Lisa Hulette moved, and Kim Jordan seconded approving all goals as written
- This motion was approved by the committee

New Business

- Objectives
  - Bart and Rob discussed how objectives will provide greater flexibility in the plan so that a greater number of actions can fall under each objective – improves the chance of obtaining mitigation grant funds

- Much of the remaining discussion was around the need to change passive language in a few of the objectives. The word “mitigate” was added to the third objective and “increase resilience and capabilities” was added to the sixth objective
- After discussion was complete, it was moved by Gary Helfrich and seconded by James Williams to approve the objectives as edited
- This was approved by the committee

Public Involvement Strategy

- Survey Review
  - Bart discussed survey that had been developed by Tetra Tech
  - In the discussion, concerns about addressing renters prompted the reworking of questions to ask for more details about residency type, hazard considerations and their effect on choice of residency, and renter’s insurance
- Public Engagement
  - County website for MJHMP is now live. Individual jurisdictions can write descriptions of their involvement with the plan or they can include a link to the county’s website on their site. Lisa or Domenica should be contacted for more information. Since this is part of FEMA’s requirements for public engagement, screenshots of each jurisdiction’s MJHMP description should be sent to Des or Bart.
  - Additional information on public engagement strategies will be sent to the committee by Domenica

Action Items and Next Steps

- Provide feedback on survey
  - Scheduled to be sent out the first week of December
- Phase 2 annexes due by December 18
  - If organizations have any questions, they are asked to contact Tetra Tech for guidance

Adjourn

- Approved at 2:16pm

Sonoma County MJHMP Steering Committee Meeting #5

Date/Time of Meeting:	Thursday, December 17, 2020
Location:	Digital
Subject:	Steering Committee Meeting No. 5
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees:** *County of Sonoma, Permit Sonoma (Planning), Permit Sonoma (GIS), Sonoma County Emergency Management, Sonoma County PIO, Town of Windsor, City of Santa Rosa, City of Cotati, SC Ag + Open Space, Cal Fire, The Nature Conservancy, Pepperwood Preserve, Community Development Commission, Sonoma County Winegrowers* Public/Other – *Graton Rancheria, Greenbelt Alliance* **Planning Team:** Lisa Hulette, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander
Not Present:	*County of Sonoma Fire Prevention, Sonoma Water, Western Builders, Sonoma County Winegrowers*
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome and Introductions

- Lisa gave the overview of the agenda and goals of the meeting
- Des completed the roll call
- 13 member organizations were present, along with Tetra Tech team
- Graton Rancheria and Greenbelt Alliance were also present

Planning Process

- Steering Committee asked to review and confirm minutes from meeting 4
- Moved by Shari Meads and Seconded by Gary Helfrich
- Approved by committee

Old Business

- Discuss confirmation of mission statement, goals, and objectives
    - No commentary by the committee, all accepted as written
- Update on Phase 2 statuses
    - Bart has received all except one, despite several attempts at communication
    - Bart and Lisa will continue to follow up with organization
- Additional committee comments
    - One of the guest organizations asked about the formation of the steering committee and the public outreach strategies used
    - Another asked for clarification on why all the county's cities are not participating in the plan – some have their own LHMPs

- A third question asked about project scope limitations, specifically around natural hazards. Rob explained the difference between threat and risk to clarify.

New Business

- Overview of Phase 3
  - Will involve 3 different workshops
    - Each geared towards fire agents, municipalities, and special districts respectively
    - Will allow for project outlines and contextualization
    - Each group will think about the kinds of mitigation projects they would want to work on over the next five years
  - Bart will set up times in the new year to speed up process

Public Involvement Strategy

- Survey Status
  - Responses as of 12/17/2020 were in 200s
  - Need at least 1000 responses to feel comfortable
  - Domenica sent social media package to committee members
  - Suggestions
    - Reach out to Brant Arthur (SCTA/RCPA) for partner outreach organization list
    - Rob – plan maintenance component can be used for further public engagement after plan approval
- Public Engagement
  - Recommendation – use NextDoor to promote survey

Action Items and Next Steps

- Continue to promote survey link

Adjourn

- Approved at 1:54 PM

Sonoma County MJHMP Steering Committee Meeting #6

Date/Time of Meeting:	Thursday, January 28, 2021
Location:	Digital
Subject:	Steering Committee Meeting No. 6
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees:** *Permit Sonoma, Sonoma County GIS, Sonoma County Fire, Sonoma County Emergency Management (alternate) Sonoma County Public Works, Sonoma County PIO, City of Santa Rosa, City of Cotati, SC Ag + Open Space, Sonoma Water, Geyserville Fire District (alternate), The Nature Conservancy, Pepperwood Preserve, Community Development Commission, Sonoma County Winegrowers* **Planning Team:** Lisa Hulette, Domenica Giovannini, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander **Members of the Public**: Keri Svanstrom (Sebastopol), Teri Shore (Greenbelt Alliance), Amy Lyle (City of Santa Rosa)
Not Present:	*Town of Windsor, Geyserville Fire District, CAL Fire, Western Builders*
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

<u>Welcome and Introductions</u>

- The meeting started at 1:01 PM.
- Lisa Hulette welcomed the committee and Des Alexander took the roll call.

<u>Public Comment</u>

- Lisa opened the meeting up to public comment. She asked that each comment be limited to 2-3 minutes.
- Teri Shore from the Greenbelt Alliance commented about participating in 3-day workshop on climate change with the City of Santa Rosa. While there they went through exercises regarding hazards facing the county hazards and produced solutions and ideas that may be helpful for the plan process. She also stated the steering committee should also consider using this model for public outreach regarding the MJHMP. Amy Lyle from Santa Rosa stated this workshop was related to the Eco-Adapt/Virginia Tech workshop on climate adaption in support of Santa Rosa's Climate Adaptation Plan & General Plan updates. They are coordinating with County staff, but Lyle was willing to provide a broader update at this or a future meeting. The reports will be shared with the group as they are produced.
- Sonia Taylor stated that there needs to be a more robust public engagement process. She asked that the committee remain aware of concurrent county initiatives (strategic plan w/ climate change & resiliency goals). Santa Rosa is currently developing their WUI which has evacuation plans included. She thinks there should be a place in the plan for how to develop evacuation plans for single family communities. In response, Bart explains that CalOES and FEMA asks that

other plans be examined and that the MJHMP meant to complement plans and integrate with them. Tetra Tech is currently working with the county to learn what plans are out there for integration.

- Following the end of the comment period, Lisa commented that public comments could also be submitted through email.

Planning Process

- Lisa Hulette asked the committee to review and accept the minutes from the last steering committee. After hearing no discussion, Shari Meads motioned to accept the minutes which was seconded by Lisa Micheli. The minutes were then approved by the committee.

Old Business

- Bart gave a brief overview of the status of Phase 2 of the plan and the general progress of the plan. He explained that the hazard profiles are still in development, most of the data has been compiled, and that the next steps will involve looking at jurisdiction-specific hazards.

New Business

- Bart and Rob launched into the discussion of Phase 3 of the MJHMP process. The next step of the project will involve three separate workshops. Fire districts, special districts, and municipalities will each have their own workshop, during which each jurisdiction will be shown a breakdown of their own hazard risk and exposure. They will then be asked to develop action plans and projects that address each of those hazards.
- Projects can be as varied as plans, road improvements, grid improvements, and other tasks that would be useful and grant-eligible under BRIC. These annexes will be incorporated into the draft plan, which will then be opened for public comment. After the public comment period, the plan draft will then be sent to CalOES and FEMA for approval. This process averages 45 to 90 days.
- Rob explains the importance of risk ranking to the Phase 3 workshops. FEMA requires that all action items have a quantifiable impact, so each jurisdiction needs to think about what projects and actions they can take on to mitigate hazards.
- Tetra Tech is still finalizing the risk assessments and analysis, and they want to have results to show the public before hosting public meetings. They will be launching the StoryMap with the risk analysis information once analysis is complete.
- In the comment period, it was asked if there are any additional GIS meetings planned to review the risk indices and scenarios. Lisa Hulette explained there are not currently any meetings planned, but she expects technology-related meetings to occur in the future. There were no public comments on this process.

Public Involvement

- Jeana provided an update on the public involvement strategy. She said that the survey is still open and will remain open until 1st public meeting. It has been linked to social media and the steering committee is asked to assist in the final push. There is an email list for this process and updated information will be pushed out through this list; Domenica will load the information once the meeting is complete. Information on the workshop date will be posted on the website once that date is chosen.

- Much of the committee discussion focused on community outreach beyond digital mediums. Amy Lyle asked if it would helpful to have a 3-week lead time to honor current city engagement methodology. She also asked if translation support was needed; Lisa Hulette informed her the county are currently doing Spanish outreach. It was suggested that the County also reach out to each community's Chamber of Commerce, as well as the Spanish community through the Corazon Healdsburg, Hispanic Chamber of Commerce, etc. WhatsApp was also discussed as having been successful for Spanish community; Domenica will reach out to county to see if this app could be used for outreach. She said she will also look into Spanish translation for public meetings.
- Rob said that the continuing public involvement phase occurs after plan is submitted for approval, so this will be an opportunity to engage in greater public outreach. If plan is not approved, then there is no opportunity for grant funding. Since FEMA wants dynamic plans there needs to be development of continuing public involvement strategies (ex. StoryMap). He asked the committee to be mindful of the plan reapproval timeline, while also respecting the desire for greater public outreach. Progress reporting is part of 5-year update process, so building components of continual outreach into the plan will be crucial to its success. This year's BRIC allotment from FEMA is estimated at $3.7 billion, so there is a lot of potential funding on the table.
- Chris Godley also commented that DEM is also going to be actively engaging the community later this year as they develop the county's new Emergency Operations Plan (EOP), which guides emergency response. This will include cultural competence and teaming with the Office of Equity for community engagement.
- The only public comment came from Teri Shore of Greenbelt Alliance. She thanked the committee for discussing public engagement strategies. She also wanted to confirm if comments could be sent to Lisa Hulette, Tetra Tech, the Steering Committee, and/or Domenica. She explained that she has been involved in Napa's LHMP process and wanted to be able to share best practices she gained from those meetings. Lisa said that she can be used as a POC and that she will direct the comments to the appropriate channels.

Adjourn

- Occurred at 1:47 PM

Sonoma County MJHMP Steering Committee Meeting #7

Date/Time of Meeting:	Thursday, February 25, 2021
Location:	Digital
Subject:	Steering Committee Meeting No. 7
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees:** *County of Sonoma, Sonoma County PIO, City of Santa Rosa, City of Cotati, Sonoma Water, Sonoma County Emergency Management (Chris Godley for Ben Nichols), Cal Fire, Geyserville Fire District, CAL FIRE, The Nature Conservancy, Pepperwood Preserve, Community Development Commission, Sonoma County Winegrowers* **Planning Team:** Lisa Hulette, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander **Public/Other**: None
Not Present:	*Permit Sonoma (Planning), Permit Sonoma (GIS), County of Sonoma Fire Prevention, SC Ag + Open Space, Town of Windsor, Santa Rosa City Fire, Western Builders*
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome and Introductions

- Lisa gave the overview of the agenda and goals of the meeting
- Des completed the roll call
- 13 member organizations were present, along with Tetra Tech team
- No members of the public announced themselves during the roll call.

Public Comment

- No comments from the public were made.

Planning Process

- Steering Committee asked to review and confirm minutes from meeting 6
- Moved by Chris Godley and seconded by Shari Meads
- Approved by committee

Old Business

- Bart says the plan progress is currently on track
- Committee Questions and Comments
  - When are we submitting?
    - Targeting June 30th for submission of the plan; everything needs to be done by June 15th. Bart goes through timeline of the plan from now until submittal to CalOES and FEMA. Bart talks to the group briefly about plan maintenance

strategy and how the StoryMap will be a Sonoma County-based tool for them to use on continued public engagement.

- Tetra Tech previews the StoryMap with the Steering Committee. This can be used as a holistic public engagement tool, with links to public meetings, steering committee minutes, FEMA grant information, hazard mitigation in Sonoma County, etc. Hazard tab page describes results of hazard analyses. Tetra Tech is working with Esri to get raster format of wildfire data.
- Rob informed community that we are using the FIRM data, but the PFIRM data can be analyzed by the county at a later day.

New Business

- Overview of Phase 3
  - Workshops
    - Upcoming dates for workshops will be in March and April
    - Working with fire districts, municipalities, and special districts
    - Risk rankings will be completed for each jurisdiction. They will be used to develop specific action items related to the hazards unique to your area
    - FEMA's BRIC funding will be 6% of the total of last year's disasters, presenting lots of opportunity for project funding
    - The goal is for the internal review draft of the plan complete by mid to late May
  - Discussion
    - The committee asks about lengthening the public comment period. Rob says that since this is a categorical exemption project, the public comment period does not need to be longer. He asks the group to investigate if we need to do a CEQA exemption for the plan.
- Plan Maintenance Strategy
  - Rob recommends an annual progress review format to assess progress on the MJHMP.

Public Involvement Strategy

- Lisa says that the public meeting for the plan is today from 3:30 PM – 5:00 PM. The steering committee is encouraged to attend, but there is no opportunity to participate in the presentation.

Other Discussion Items

- Since Tetra Tech will not have data to present to the group, there is no need to have a steering committee meeting in March. The next meeting will be in April.

Adjourn

- Motion to adjourn by Mark Chandler and seconded by Adrianne Garayalde
- Adjourned at 1:55 PM

Sonoma County MJHMP Steering Committee Meeting #8

Date/Time of Meeting:	Thursday, April 22, 2021
Location:	Digital
Subject:	Steering Committee Meeting No. 8
Project Name:	Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update
In Attendance	**Attendees:** *County of Sonoma Fire Prevention, County of Sonoma Public Works, Sonoma County PIO, Town of Windsor, City of Santa Rosa, City of Cotati, Sonoma Water, Sonoma County Ag + Open Space, Geyserville Fire District, Santa Rosa City Fire, The Nature Conservancy, Pepperwood Preserve, Community Development Commission, Sonoma County Winegrowers* **Planning Team:** *Lisa Hulette, Bart Spencer, Rob Flaner, Carol Baumann, Des Alexander* **Public/Other**: *Yanin Kramsky, PhD.*
Not Present:	*Permit Sonoma (Planning), Permit Sonoma (GIS), County of Sonoma Emergency Management, Cal Fire, Western Builders*
Summary Prepared by:	Des Alexander
Quorum – Yes or No	Yes

Welcome and Introductions

- Lisa gave the overview of the agenda and goals of the meeting
- Des completed the roll call. Kent Gylfe was present for Sonoma Water and Steve Suter was present for Santa Rosa City Fire. Karen Gaffney of SC Ag + Open Space and Kirsten Larsen of Community Development Commission have both retired and will be replaced by their alternates.
    - 14 member organizations were present, along with Tetra Tech team.
    - Yanin Kramsky, a PhD and local Bay Area resident, announced himself as a member of the public.
- Steering Committee asked to review and confirm minutes from meeting 7. Hearing no comments or revisions, it was moved by Shari Meads and seconded by Lisa Michelli to accept the minutes as written. This was approved by the steering committee.

Public Comment

- No comments from the public were made.

Planning Process

- Plan Progress
    - Bart stated that the last steps of the plan are in progress. Action items (grant-eligible and actionable) are being developed by each jurisdiction during the Phase 3 meetings. Given the current digital divide, Tetra Tech wants all jurisdictions to get as much assistance as possible. He explained that Tetra Tech is also hosting Q & A sessions to help jurisdictions with completing their annexes.
- Next Steps

- Bart explained that Phase 3 annexes are due on May 12th and will be reviewed by three Tetra Tech staff. Once reviewed, they will be added to the draft plan. The Core Planning Team and the Steering Committee will both review the draft plan internally and the final edit will commence once all comments have been given.
- The public comment period will ideally start in mid-June. A public meeting will be held during this time to provide further opportunity for comments on the plan. The StoryMap will live on the county website and will be a continually changing resource available to the residents of County.
- The plan is scheduled for concurrent review with CalOES/FEMA. This is due to grants pending in certain Sonoma County jurisdictions and will make sure the county is up to speed by the time the BRIC funding series starts in September.
- Once approved by CalOES/FEMA, the plan will need to be adopted by each jurisdiction by resolution. All adoptions should be sent to Lisa who will forward them to FEMA.
- Annual maintenance of the plan will start after the plan is approved. Permit Sonoma will be responsible for maintaining the plan through progress reporting. Every jurisdiction would send an annual progress report on their action items to an online platform set up by Tetra Tech. Lisa will use those reports to generate a county report that will be submitted to CalOES. This is considered a best practice but is not a requirement. The only requirement is continual public outreach, which will be done with the StoryMap, hazard awareness campaigns, etc.

- Committee Comments
  - Kent Gylfe asked for clarification on the draft plan review timeframe. Lisa said that they want to have a draft plan available by June 15th to discuss at the next steering committee. Bart said that was possible if all Phase 3 annexes are submitted by the due date. Bart also advises that if the public comment period produces any substantive criticisms, those edits would need to be made and a second public comment period would need to be scheduled. This would push back the final submittal date.
  - Kim Jordan asked about the length of the public comment period and her goal date for the Town of Windsor's plan approval. Bart said that the Town of Windsor will have the draft plan in early June, but the Board of Supervisors will not be able to make substantive changes until the plan has been officially adopted. If they did, this would result in the earlier mentioned second public comment period.
- Actions
  - A motion to move forward with annual plan maintenance strategy was made by Shari Meads and seconded by Shelly Bianchi-Williamson. The motion was approved by the committee.

Public Outreach

- Public Meeting
  - Primary public outreach will be the scheduled webinar, which will provide public comments. The public comments can also be obtained through the StoryMap and email.
  - This webinar will be held around the public draft upload date; information on the meeting will be shared through County social media channels.
- Committee Comments
  - No comments from the committee

Other Discussion Items/Comments

- None from the committee or the public
- Lisa reminded the committee of the ongoing phase 3 meetings and Q & A forums with Tetra Tech; their purpose is to assist jurisdictions with developing action items.

Final Steering Committee Meeting

- Thursday, June 21, 2021 from 1pm to 2pm.

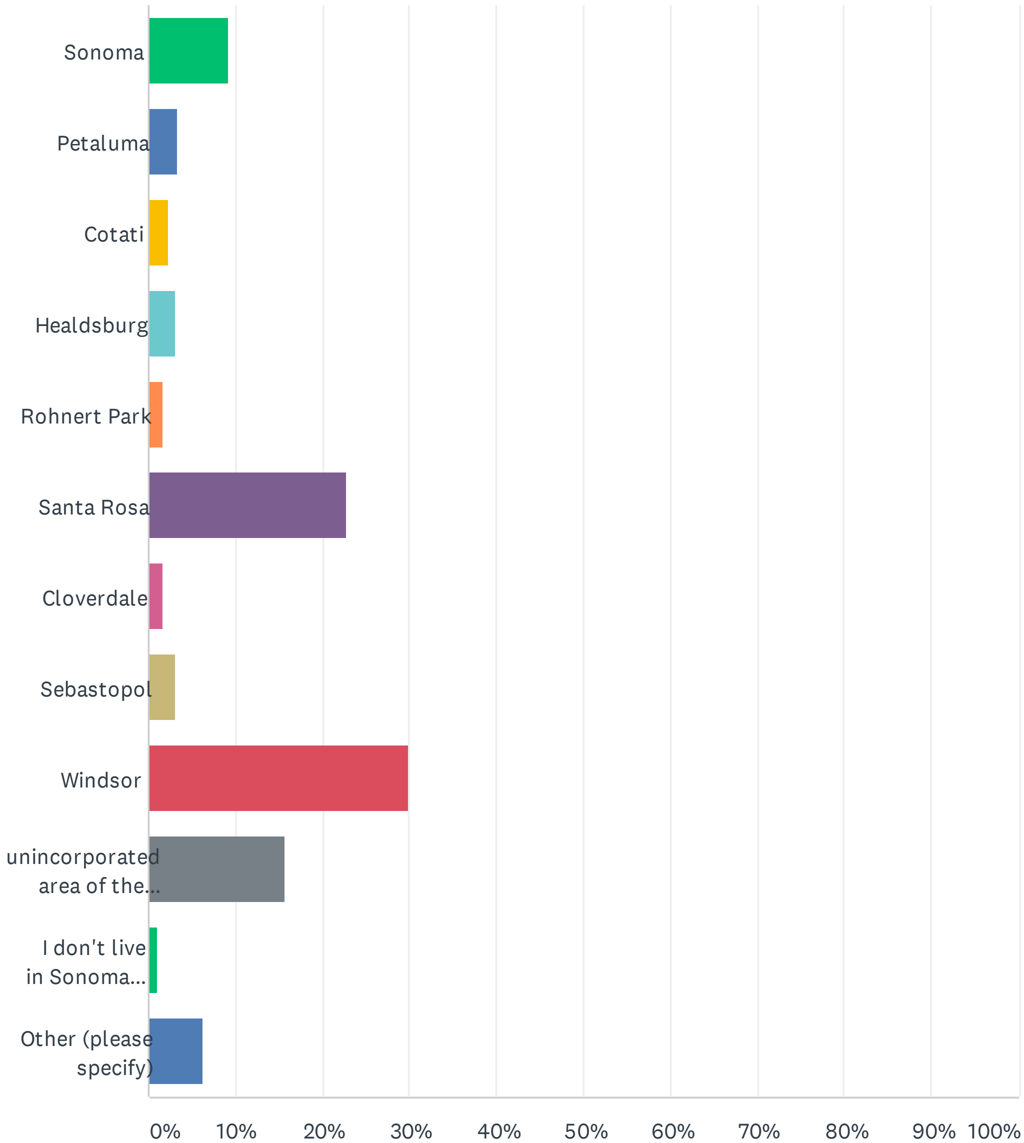
Adjourn

- 1:42 PM

SURVEY RESULTS

Q1 Where in Sonoma County do you live or generally stay?

Answered: 691   Skipped: 0



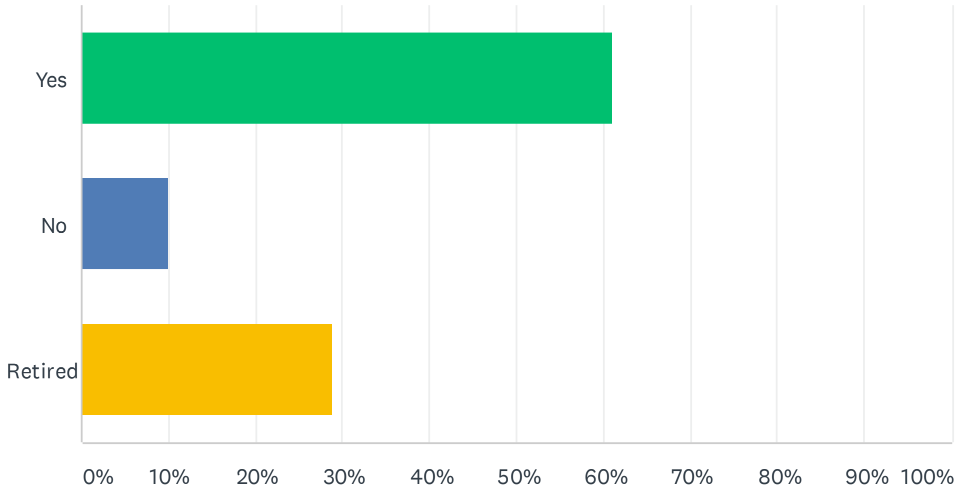
ANSWER CHOICES	RESPONSES	
Sonoma	9.26%	64
Petaluma	3.33%	23
Cotati	2.32%	16
Healdsburg	3.18%	22
Rohnert Park	1.59%	11
Santa Rosa	22.87%	158
Cloverdale	1.59%	11
Sebastopol	3.04%	21
Windsor	29.81%	206
unincorporated area of the County	15.77%	109
I don't live in Sonoma County	1.01%	7
Other (please specify)	6.22%	43
TOTAL		691

#	OTHER (PLEASE SPECIFY)	DATE
1	Cazadero	2/25/2021 8:50 PM
2	Jenner	2/9/2021 6:40 PM
3	Sonoma Coast north of Jenner	2/9/2021 5:40 PM
4	Muniz Ranches	2/9/2021 5:18 PM
5	Jenner	2/9/2021 4:10 PM
6	Jenner	2/9/2021 3:32 PM
7	Jenner	2/9/2021 6:39 AM
8	unincorporated west sebastopol	2/1/2021 3:31 PM
9	Occidental	1/26/2021 10:31 AM
10	Why isn't Guerneville listed separately?	1/8/2021 2:27 PM
11	Geyserville	1/8/2021 12:08 AM
12	Unincorporated area too Close to Santa Rosa & Windsor	1/7/2021 2:43 PM
13	Forestville	1/4/2021 12:09 PM
14	Bodega Bay	1/4/2021 12:06 PM
15	outside of Windsor Town limits	1/4/2021 11:43 AM
16	Glen Ellen	12/30/2020 12:26 PM
17	Glen Ellen	12/30/2020 12:02 PM
18	Glen Ellen	12/30/2020 11:57 AM
19	Glen Ellen	12/30/2020 12:01 AM
20	Boyes Hot Springs	12/29/2020 9:53 PM
21	Springs area of Sonoma Valley	12/29/2020 7:32 PM
22	Oakmont	12/28/2020 9:03 AM
23	Bodega Bay	12/24/2020 6:15 PM
24	Larkfield Wikiup area	12/23/2020 5:34 PM
25	Bodega Bay	12/22/2020 1:02 PM
26	Glen ellen/mayacamas mtns	12/22/2020 10:47 AM
27	Bodega Bay	12/22/2020 2:34 AM
28	Bodega Bay	12/21/2020 8:58 PM
29	Bodega Bay	12/21/2020 8:48 PM
30	Bodega Bay	12/21/2020 8:39 PM
31	Bodega Bay	12/21/2020 12:03 PM
32	Glen Ellen	12/21/2020 10:08 AM
33	Larkfield/Wikiup area	12/18/2020 2:23 PM
34	Sonoma Valley - Boyes Hot Springs (you probably should add that or 1st District supervisor may be peeved.)	12/18/2020 12:36 PM
35	Penngrove	12/18/2020 11:03 AM
36	Bodega Bay	12/18/2020 2:34 AM
37	Bodega Bay	12/17/2020 8:41 AM

38	Bodega Bay	12/16/2020 5:55 PM
39	Bodega Bay	12/16/2020 2:23 PM
40	Bodega Bay	12/16/2020 1:23 PM
41	The Sea Ranch	12/8/2020 5:08 PM
42	Glen Ellen	12/8/2020 5:01 PM
43	asd	11/17/2020 4:00 PM

Q2 Do you work in Sonoma County?

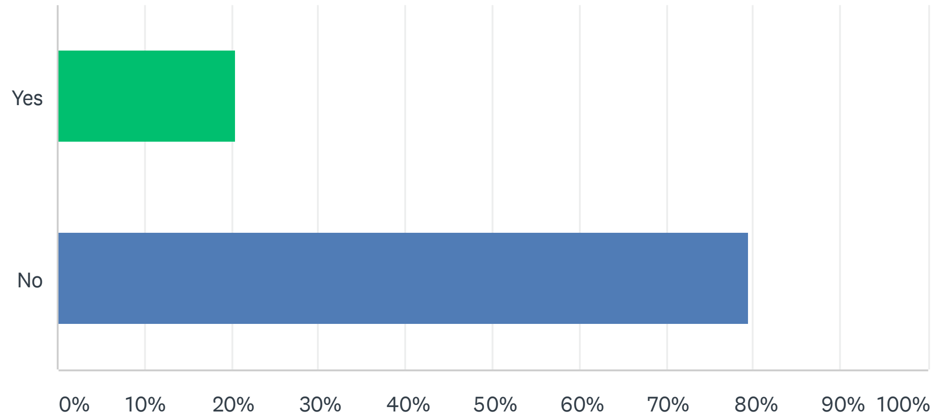
Answered: 688 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	61.19%	421
No	10.03%	69
Retired	28.78%	198
TOTAL		688

Q3 Do you own or operate a business in Sonoma County?

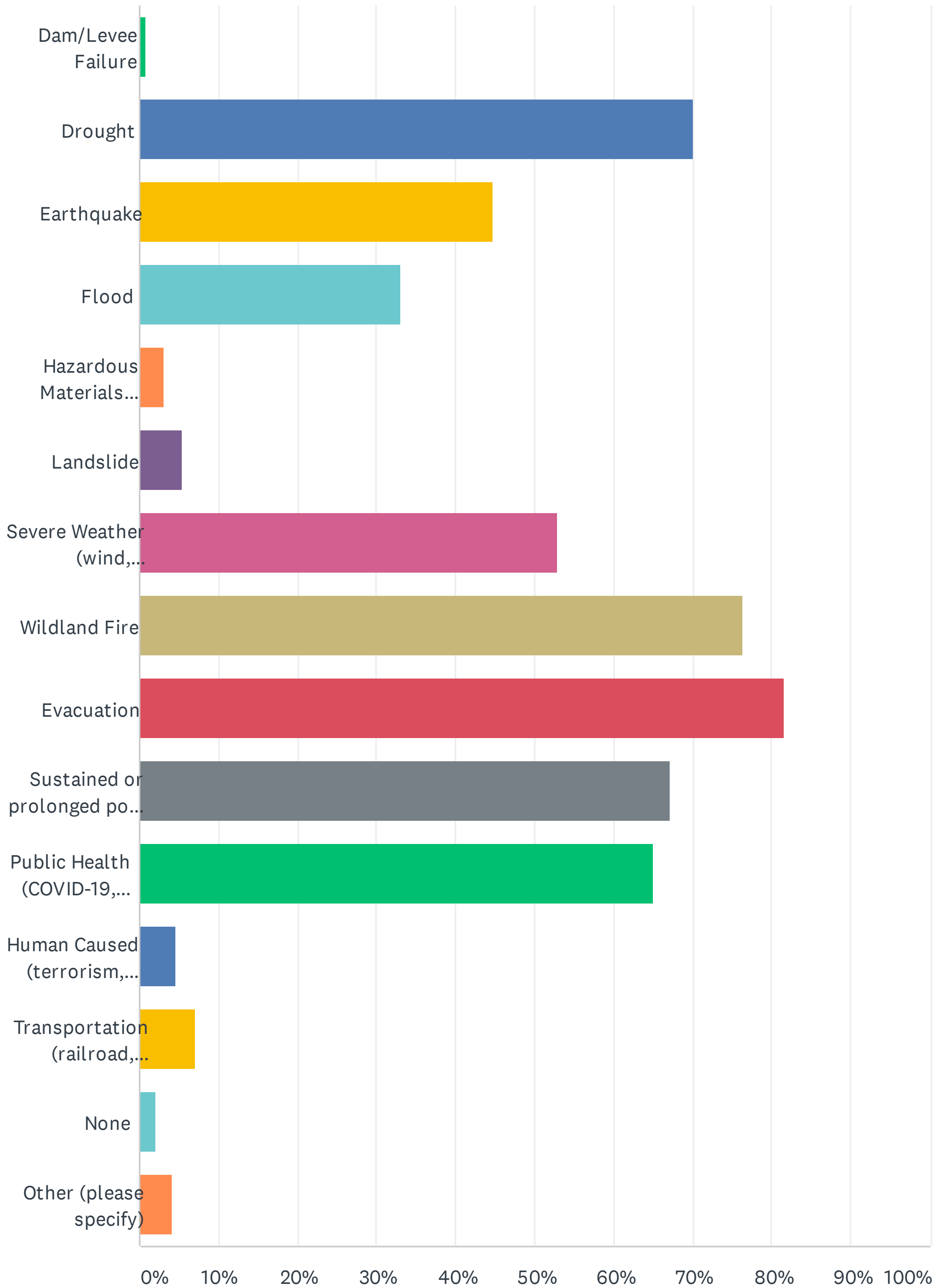
Answered: 683 Skipped: 8



ANSWER CHOICES	RESPONSES	
Yes	20.50%	140
No	79.50%	543
TOTAL		683

Q4 Which of the following hazard events have you or anyone in your household experienced in the past 20 years within Sonoma County? (Check all that apply)

Answered: 682 Skipped: 9

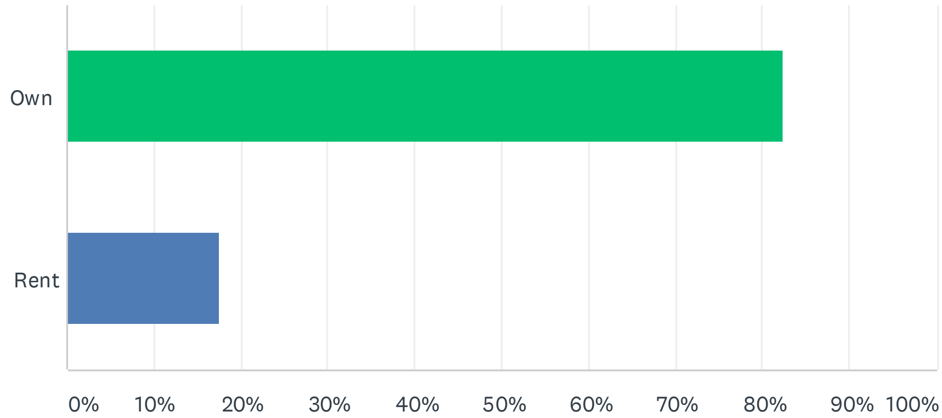


ANSWER CHOICES	RESPONSES	
Dam/Levee Failure	0.73%	5
Drought	70.09%	478
Earthquake	44.87%	306
Flood	32.99%	225
Hazardous Materials Release	3.08%	21
Landslide	5.43%	37
Severe Weather (wind, lightning, snow accumulation, etc.)	52.93%	361
Wildland Fire	76.39%	521
Evacuation	81.52%	556
Sustained or prolonged power outage	67.16%	458
Public Health (COVID-19, West-Nile, SARS, etc)	65.10%	444
Human Caused (terrorism, Active Shooter, etc)	4.55%	31
Transportation (railroad, airport, interstate, etc.)	7.04%	48
None	2.05%	14
Other (please specify)	4.11%	28
Total Respondents: 682		

#	OTHER (PLEASE SPECIFY)	DATE
1	Loma Prieta earthquake prior to 20 years	2/27/2021 5:34 PM
2	Narrow country roads. Can't evacuate and fire trucks coming but can't the	2/25/2021 8:14 PM
3	Neighbors having tree work done but leaving fire fuel on the ground as well as thrown onto my property. Spoke with one tree cutter who felt it was okay to leave large piles of dead branches in the ground to "masticate" at the hight of the 2020 fire season on a steep hillside rural residential area with poor fire service access.	2/21/2021 8:33 AM
4	Fires the past four years	2/19/2021 11:37 AM
5	non-local smoke (air quality issues)	2/9/2021 5:10 PM
6	erosion	2/9/2021 4:10 PM
7	sustained smoke and smoke damage to crops	2/1/2021 3:31 PM
8	Death	1/25/2021 12:33 AM
9	I am not sure what you mean by "experienced": directly or indirectly affected?	1/23/2021 12:35 PM
10	Threat of fire; threat of evacuation; smoke and bad air quality due to smoke from fires	1/12/2021 3:43 PM
11	6 PPL in 2019, several in 2020. No power = no water	1/9/2021 9:38 AM
12	Unhealthy air quality	1/9/2021 9:04 AM
13	sustained natural gas outage, due to wildfires.	1/8/2021 6:07 PM
14	GOVERNMENT STUPIDITY	1/7/2021 2:43 PM
15	Civil unrest, police brutality and militarism	1/5/2021 2:00 PM
16	Tazed by police, malicious counselors at rehab centers, constant exposure to opioid addicts and pushers, biohazard trash left in overflowing garbage cans in front of businesses and wherever the street people have been, dangerous bike lane for bicycle riding and incompetent personnel in the professional field everything from medical to administration. The list goes on and on. There is a level of incompetency and greed in this county that defies definition	12/30/2020 5:51 PM
17	County-sanctioned construction built to flood my home	12/30/2020 12:26 PM
18	propane supplier	12/29/2020 8:02 PM
19	Ineffectual and inept Supervisor representing Sonoma Valley	12/29/2020 3:18 PM
20	Heavy ash and smoke that Acacia apartments still has not cleaned (ashes still collected in the hallways)	12/21/2020 11:22 AM
21	I've been hit by motorists multiple times while I was cycling. I regularly have to take evasive action to avoid being hit by motorists.	12/19/2020 7:58 AM
22	Smoke from Wildlands fire, did not lose home	12/19/2020 6:44 AM
23	Have not had Covid but am experiencing the effects on the community as is everyone else.	12/18/2020 10:47 AM
24	Were in an evacuation zone but did not evacuate as we have a ranch that 1 Has short grass and seems safer than going anywhere and 2. Animals need care and fear if we left we would be stopped from.coming back.for days.	12/17/2020 8:29 PM
25	Neighbors on Shaw Ct setting off aerial fireworks	12/16/2020 5:55 PM
26	Threat of power outage, loss of internet access	12/15/2020 8:15 AM
27	PG&E PSPS; heat events; CAOSI power rolling outages.	11/17/2020 2:46 PM
28	I think extreme heat should be included here	11/12/2020 9:39 PM

Q5 Do you own or rent your place of residence?

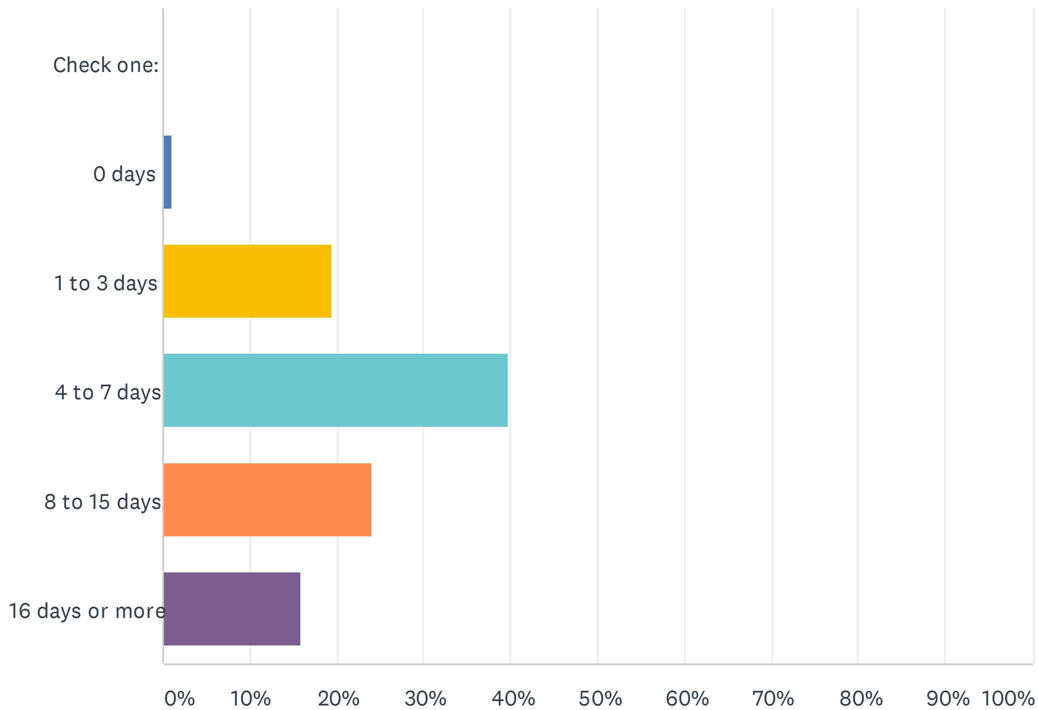
Answered: 684   Skipped: 7



ANSWER CHOICES	RESPONSES	
Own	82.46%	564
Rent	17.54%	120
TOTAL		684

Q6 If your household were impacted/isolated due to a hazard event, how many days could your household survive because of your preparedness?

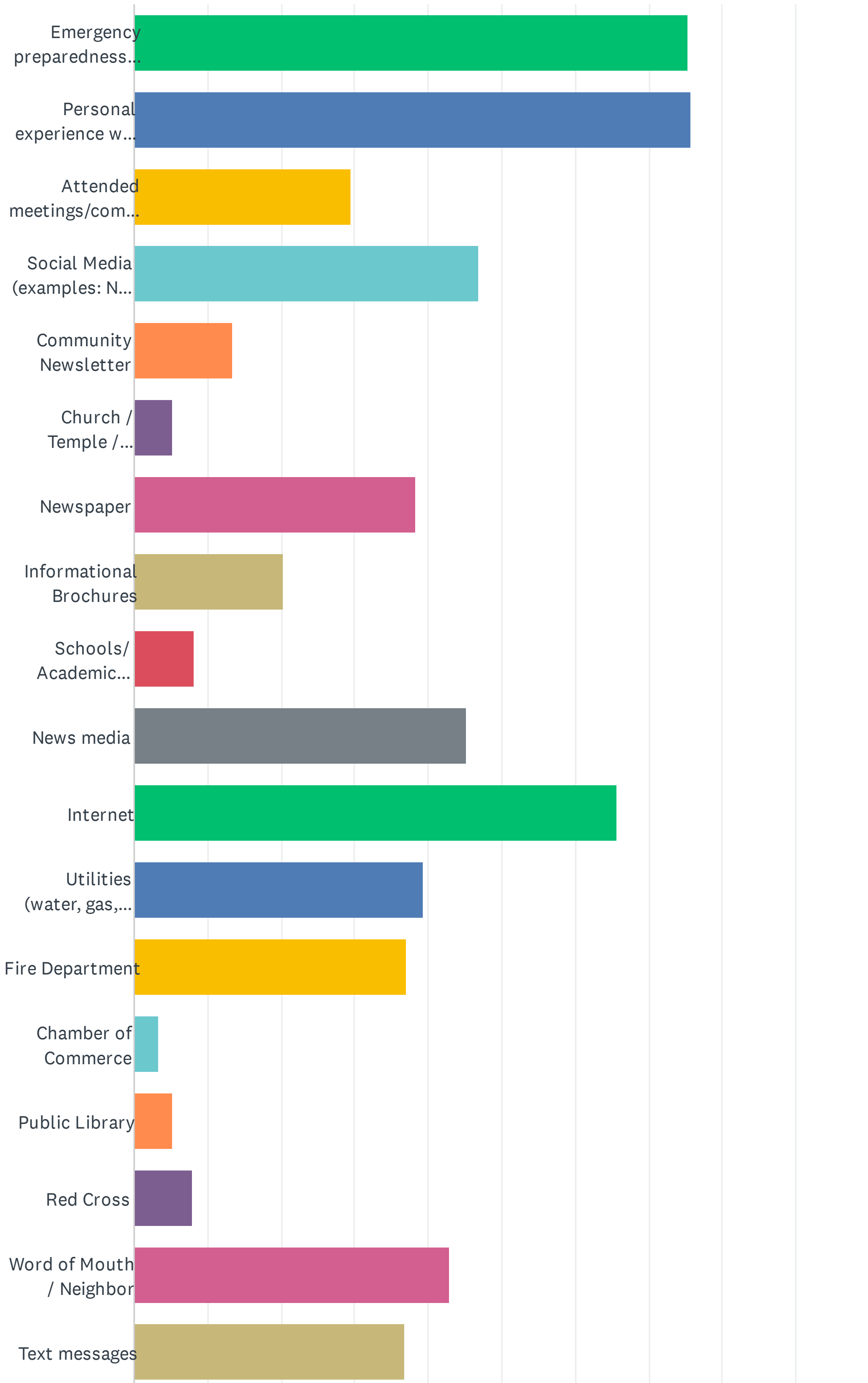
Answered: 633   Skipped: 58

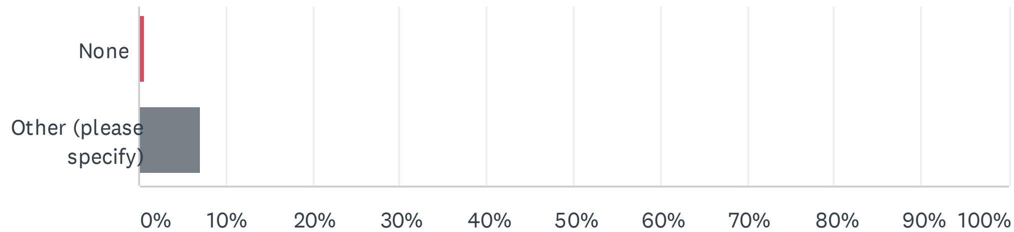


ANSWER CHOICES	RESPONSES	
Check one:	0.00%	0
0 days	0.95%	6
1 to 3 days	19.43%	123
4 to 7 days	39.81%	252
8 to 15 days	24.01%	152
16 days or more	15.80%	100
TOTAL		633

Q7 Which of the following have provided you with useful information to help you be prepared for a hazard event? (Check all that apply)

Answered: 634 Skipped: 57





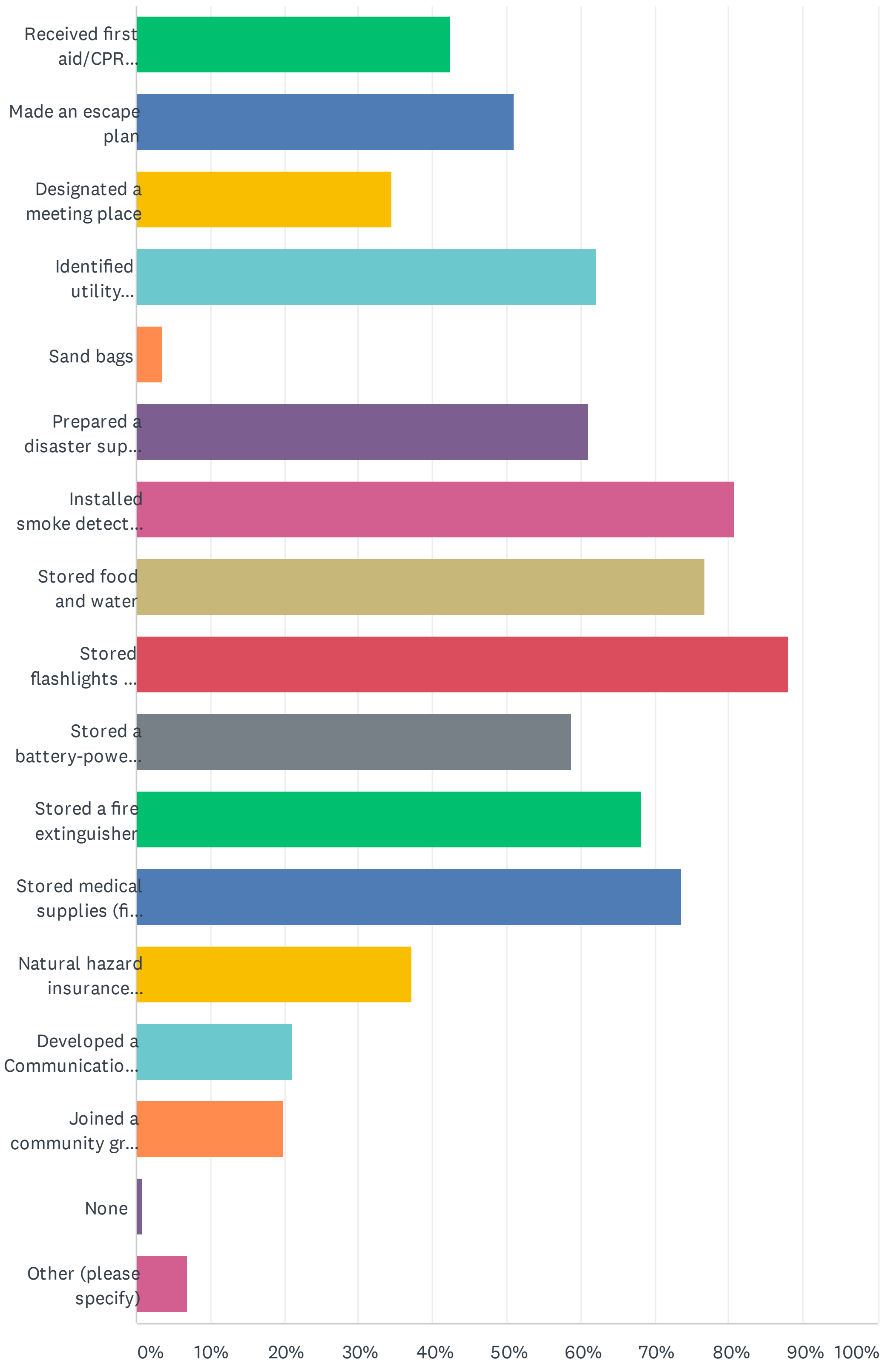
ANSWER CHOICES	RESPONSES	
Emergency preparedness information from a government source (e.g., federal, state, or local emergency management)	75.39%	478
Personal experience with one or more natural hazards/disasters	75.71%	480
Attended meetings/community events or workshops that have dealt with disaster preparedness	29.50%	187
Social Media (examples: Next Door, Facebook, Twitter)	46.85%	297
Community Newsletter	13.41%	85
Church / Temple / Worship Center	5.21%	33
Newspaper	38.33%	243
Informational Brochures	20.19%	128
Schools/ Academic Institutions	8.20%	52
News media	45.11%	286
Internet	65.77%	417
Utilities (water, gas, electric, etc.)	39.27%	249
Fire Department	37.07%	235
Chamber of Commerce	3.31%	21
Public Library	5.21%	33
Red Cross	8.04%	51
Word of Mouth / Neighbor	42.90%	272
Text messages	36.91%	234
None	0.63%	4
Other (please specify)	7.10%	45
Total Respondents: 634		

#	OTHER (PLEASE SPECIFY)	DATE
1	“Sonoma County Fire Updates” and “Caz Hills - Fire/emergency” pages on Facebook	2/25/2021 7:27 PM
2	“Sonoma county Fire Updates” and “Caz Hills - Fire/ emergency” page on Facebook	2/25/2021 7:17 PM
3	COPE and CERT	2/25/2021 4:29 PM
4	professional societies	2/12/2021 12:23 PM
5	local community organizations	2/9/2021 5:15 PM
6	ham radio	2/9/2021 4:14 PM
7	fire alerts on text when power is on	2/9/2021 3:35 PM
8	888-777	1/27/2021 3:05 PM
9	Internet Research	1/27/2021 12:51 PM
10	Self taught.	1/25/2021 12:41 AM
11	Kaiser - employer	1/18/2021 5:05 PM
12	My dad	1/13/2021 7:32 AM
13	workplace trainings	1/12/2021 3:20 PM
14	Senator Mike McGuire	1/8/2021 8:11 PM
15	County of Sonoma leaders	1/8/2021 3:37 PM
16	Boy Scouts	1/8/2021 7:02 AM
17	AARP magazine articles (how to pack a "go bag")	1/7/2021 5:27 PM
18	Nixil local maps & some local government is a Partly helpful	1/7/2021 2:57 PM
19	Common sense	1/6/2021 9:42 AM
20	I am part of the EOC for the City of Santa Rosa	1/5/2021 6:02 PM
21	KSRO	1/5/2021 10:40 AM
22	Active Fire maps and air quality websites	1/5/2021 10:34 AM
23	nixle	1/4/2021 2:03 PM
24	I'm a FEMA trained emergency preparedness educator	1/1/2021 6:31 PM
25	KSRO	12/31/2020 7:49 AM
26	Instinct	12/30/2020 5:54 PM
27	Common sense; figured it out.	12/30/2020 5:54 PM
28	CERT Training	12/24/2020 12:43 PM
29	map your neighborhood	12/23/2020 11:47 PM
30	I am trained in disaster response and volunteer in the SF EOC	12/22/2020 12:12 PM
31	CERT meetings	12/22/2020 2:36 AM
32	Fire Safe Sonoma	12/21/2020 9:44 AM
33	Employer News Letters	12/21/2020 9:18 AM
34	Neighborfest	12/19/2020 4:45 PM
35	Girl Scouts	12/19/2020 2:34 PM
36	newspaper online; academic inst. only because i work at one	12/18/2020 8:52 PM
37	work experience (fire department job)	12/18/2020 10:00 AM

38	Fire Safe Council	12/18/2020 7:45 AM
39	Bodega Bay CERT	12/18/2020 2:37 AM
40	Those in agriculture are used to being prepared, improvising, and running multiple generators.	12/17/2020 8:42 PM
41	local government information releases	12/17/2020 2:14 PM
42	Bodega Bay CERT	12/16/2020 1:31 PM
43	Podcasts	12/16/2020 1:26 PM
44	COPE and CERT	12/16/2020 12:42 PM
45	Neighborhood gang	12/16/2020 11:49 AM

Q8 Which of the following steps has your household taken to prepare for a hazard event? (Check all that apply)

Answered: 636 Skipped: 55


Received first aid/CPR...
Made an escape plan
Designated a meeting place
Identified utility...
Sand bags
Prepared a disaster sup...
Installed smoke detect...
Stored food and water
Stored flashlights ...
Stored a battery-powe...
Stored a fire extinguisher
Stored medical supplies (fi...
Natural hazard insurance...
Developed a Communicatio...
Joined a community gr...
None
Other (please specify)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

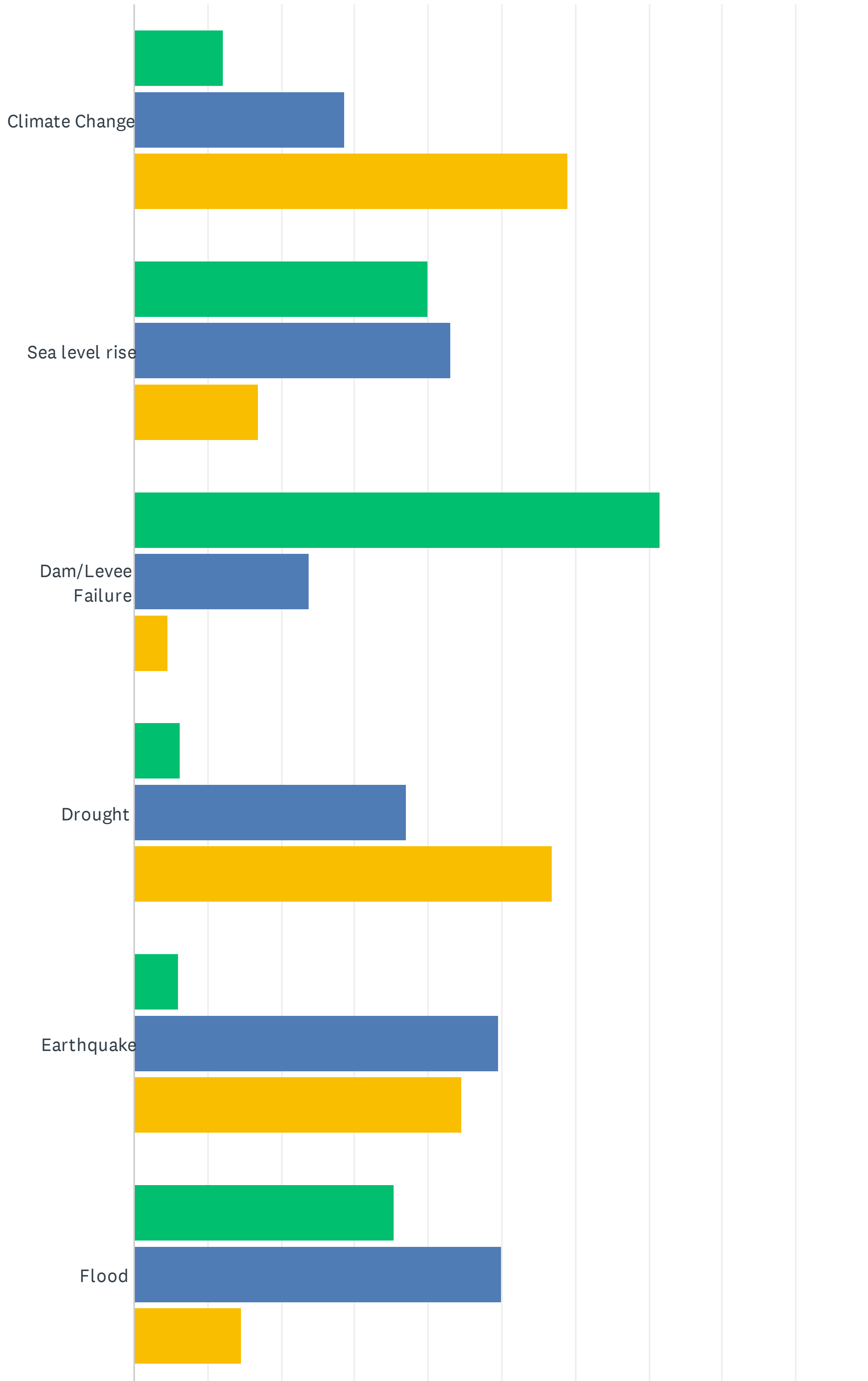
ANSWER CHOICES	RESPONSES	
Received first aid/CPR training	42.45%	270
Made an escape plan	50.94%	324
Designated a meeting place	34.59%	220
Identified utility shutoffs	62.11%	395
Sand bags	3.62%	23
Prepared a disaster supply kit	61.01%	388
Installed smoke detectors on each level of the house	80.82%	514
Stored food and water	76.73%	488
Stored flashlights and batteries	88.05%	560
Stored a battery-powered radio	58.81%	374
Stored a fire extinguisher	68.24%	434
Stored medical supplies (first aid kit, medications)	73.58%	468
Natural hazard insurance (Flood, Earthquake, Wildfire)	37.26%	237
Developed a Communication Plan	21.07%	134
Joined a community group (CERT, Firewise, neighborhood preparedness, etc.)	19.97%	127
None	0.79%	5
Other (please specify)	6.92%	44
Total Respondents: 636		

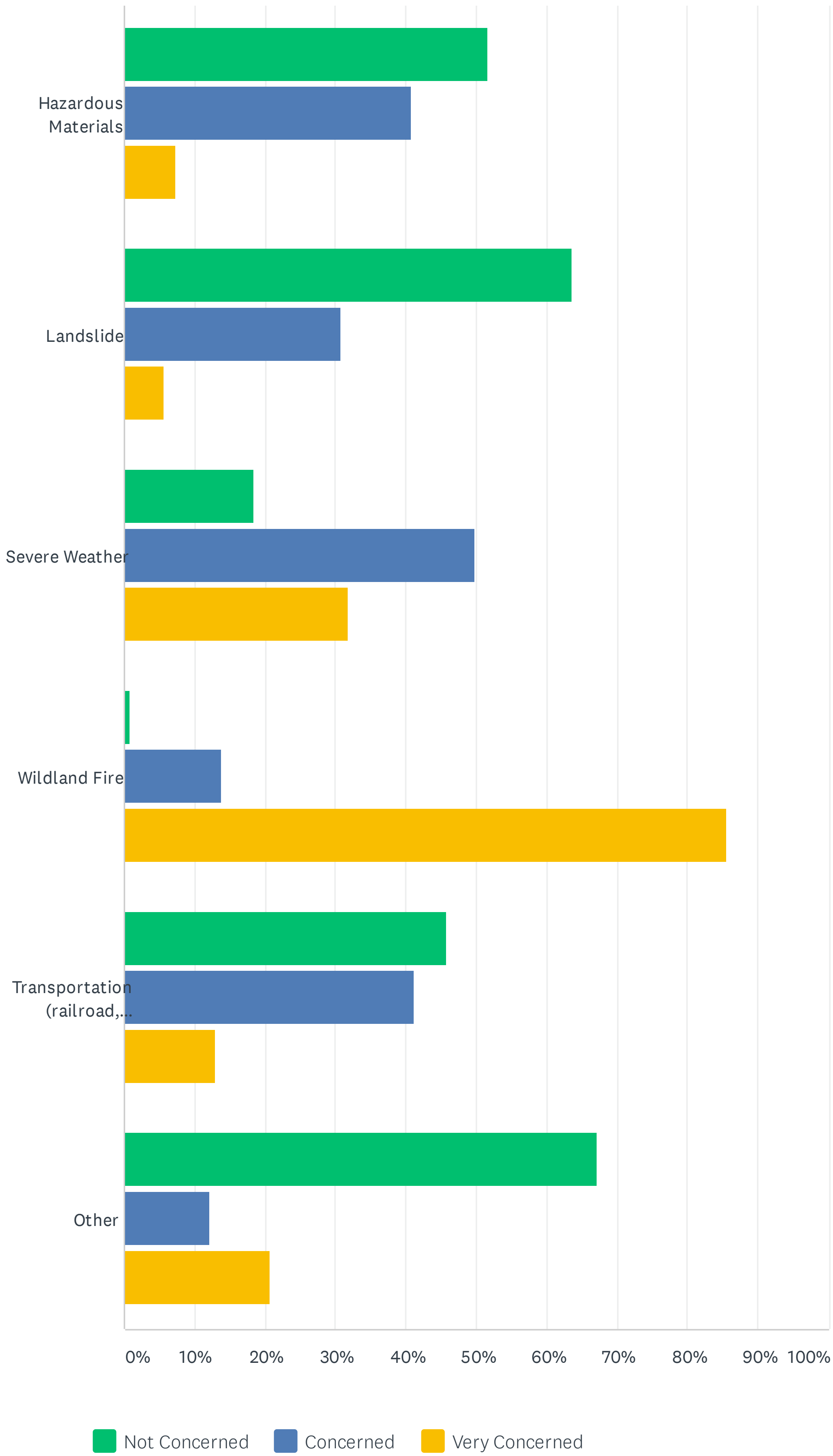
#	OTHER (PLEASE SPECIFY)	DATE
1	Generator, solar powered lights	2/25/2021 7:27 PM
2	Generator, solar lights, propane back up fridge	2/25/2021 7:17 PM
3	joined the fire department	2/25/2021 4:24 PM
4	propane generator with 2 - 5gal backup tanks. On going fire fuel clearance.	2/21/2021 8:42 AM
5	Off-grid cooking. Home food production.	2/11/2021 9:36 AM
6	meeting places and escape plans are extremely situation-specific	2/9/2021 5:15 PM
7	water system for fire	2/9/2021 3:35 PM
8	Alternative Living Place	2/9/2021 9:28 AM
9	battery for charging phones	2/9/2021 8:15 AM
10	Cut back most shrubs and trees around our house	2/8/2021 10:23 PM
11	Fire hardened landscape	1/23/2021 12:39 PM
12	bought a generator	1/23/2021 11:36 AM
13	stored masks for smoke AND covid	1/12/2021 3:20 PM
14	Solar and home battery backups	1/10/2021 12:39 PM
15	Solar and Test Powerwall	1/9/2021 11:19 AM
16	Our Gehricke Road community has developed an emergency phone tree in case of evacuation	1/9/2021 9:45 AM
17	Back up power for house	1/9/2021 9:13 AM
18	Evacuation list posted near door	1/8/2021 2:31 PM
19	back up battery	1/8/2021 10:06 AM
20	Prepared bug-out bags and waterbobs	1/5/2021 2:01 PM
21	Driving partner, because I cant.	1/5/2021 11:37 AM
22	Cleared leaves/brush, fireproofed some outside areas of house, installed filters on windows, bought air purifier	1/5/2021 10:34 AM
23	Completed CERT from Los Angeles Fire Department staff.	1/5/2021 9:40 AM
24	Purchased a generator	1/4/2021 12:48 PM
25	Fear is not an option	12/30/2020 5:54 PM
26	Back up power supply (battery) to last 3 days	12/30/2020 12:19 PM
27	installed battery storage system for solar	12/28/2020 3:58 PM
28	Started the Mayacamas Fire Safe Council, and husband is volunteer Firefighter	12/22/2020 10:50 AM
29	Prepared to abandon the state entirely.	12/21/2020 11:26 AM
30	COAD	12/21/2020 9:28 AM
31	Bought a generator	12/19/2020 4:45 PM
32	Stored food and supplies elsewhere	12/19/2020 12:28 PM
33	Wood fired stove and wood.	12/19/2020 8:04 AM
34	Organized neighborhood COPE	12/19/2020 6:49 AM
35	what does communication plan mean? that's too vague for me	12/18/2020 8:52 PM
36	Created defensible space and hardened buildings	12/18/2020 7:45 AM
37	own a type 2 fire engine with enough hose to reach any home in the neighborhood	12/17/2020 12:25 AM

38	Purchased a gas generator	12/16/2020 1:31 PM
39	PV and battery backup power and generator	12/16/2020 1:16 PM
40	Stored fuel and PV electric charger (1440 wh)	12/16/2020 11:49 AM
41	Always have a 'go bag' even when at work/Never let a vehicle go below 1/2 tank of gas	12/15/2020 2:46 PM
42	Signed up for all the alerts on phone	12/15/2020 2:44 PM
43	Not a formal community group but local family and a few neighbors	12/8/2020 5:44 PM
44	Purchased Two Generators for Home and Water	12/8/2020 5:03 PM

Q9 How concerned are you about the following hazards in Sonoma County? (Check one response for each hazard)

Answered: 641 Skipped: 50




Hazardous Materials
Landslide
Severe Weather
Wildland Fire
Transportation (railroad,...
Other
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Not Concerned
Concerned
Very Concerned

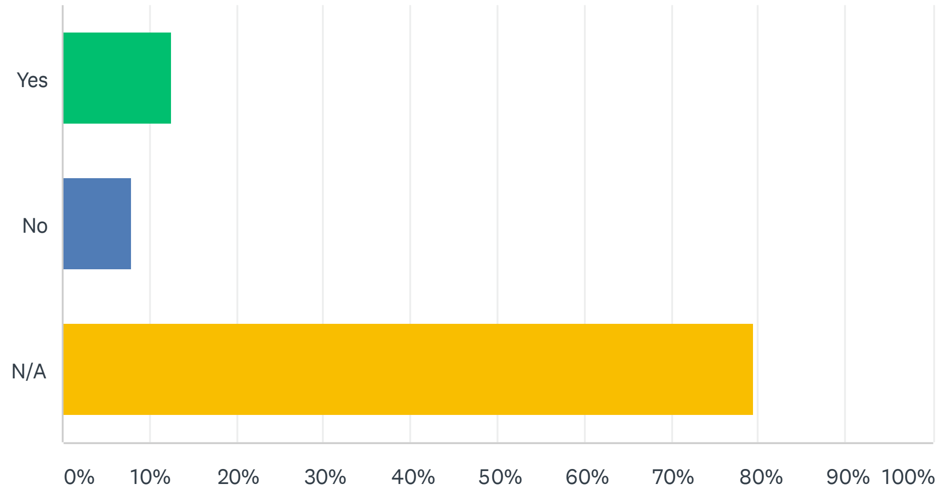
	NOT CONCERNED	CONCERNED	VERY CONCERNED	TOTAL	WEIGHTED AVERAGE
Climate Change	12.16% 77	28.75% 182	59.08% 374	633	2.47
Sea level rise	39.87% 242	43.16% 262	16.97% 103	607	1.77
Dam/Levee Failure	71.65% 422	23.77% 140	4.58% 27	589	1.33
Drought	6.19% 39	36.98% 233	56.83% 358	630	2.51
Earthquake	6.01% 38	49.53% 313	44.46% 281	632	2.38
Flood	35.32% 213	50.08% 302	14.59% 88	603	1.79
Hazardous Materials	51.76% 308	40.84% 243	7.39% 44	595	1.56
Landslide	63.56% 375	30.85% 182	5.59% 33	590	1.42
Severe Weather	18.43% 113	49.76% 305	31.81% 195	613	2.13
Wildland Fire	0.79% 5	13.74% 87	85.47% 541	633	2.85
Transportation (railroad, airport, highway, etc.)	45.87% 272	41.15% 244	12.98% 77	593	1.67
Other	67.11% 100	12.08% 18	20.81% 31	149	1.54

#	(PLEASE SPECIFY OTHER HAZARD)	DATE
1	Bureaucracy	2/25/2021 8:22 PM
2	Landslide after flood has taken out Moscow Road, a critical escape route. Let's get one lane (only) restored, please.	2/25/2021 7:27 PM
3	Our "escape route" in Monte Rio had a slide 2 years ago - Moscow Road needs to return to at least one lane open!	2/25/2021 7:17 PM
4	ininformed community in emergency	2/22/2021 10:52 AM
5	Sheriffs not helping with aggressive, gun totting, neighbors.	2/21/2021 8:42 AM
6	loss of species because of development and vineyard expansions	2/12/2021 12:23 PM
7	Social cohesion / strife	2/11/2021 9:36 AM
8	Deforestation as a response to fires. Reduce fire risk by decentralizing our energy systems using solar-based microgrids and community power. Make homes safe in vulnerable locations with sprinklers (these cost $200) and metal roofs (more expensive so rebates should be offered for that). Create no-build zones in fire prone areas. Live in balance with nature and be smart instead of making fear-based decisions that harm the ecosystem.	2/11/2021 6:08 AM
9	indefinitely extended PG&E planned outages	2/9/2021 5:15 PM
10	Road closures from due to natural disasters including downed trees.	2/9/2021 3:26 PM
11	Land use and other policy that can effect events.	2/9/2021 9:28 AM
12	evacuation routes in case of fire	2/9/2021 8:15 AM
13	hazardous at SDC not cleaned up by stae; hwy 37	2/8/2021 6:05 PM
14	hwy 37. hazardous--everything at SDC that the state has not cleaned up	2/8/2021 6:01 PM
15	Power outages and their disruptions	1/26/2021 3:46 PM
16	One way road leading in and out of property with inadequate pull outs	1/9/2021 11:19 AM
17	Power grid integrity and PG&E's incompetence	1/9/2021 11:17 AM
18	Lack of potable water; our seniors complex depends on well water!	1/9/2021 11:13 AM
19	Terrorism	1/9/2021 9:13 AM
20	Public health hazards, such as COVID	1/8/2021 6:12 PM
21	Asphalt plant proposed in Windsor	1/8/2021 3:37 PM
22	Poor Roads	1/8/2021 2:07 PM
23	Civil unrest, unlawful protesting	1/8/2021 12:20 PM
24	Democrats	1/8/2021 10:19 AM
25	ongoing power outage	1/8/2021 10:06 AM
26	pandemic response	1/8/2021 7:18 AM
27	crime driven by economic circumstances/rioting due to political unrest	1/7/2021 11:06 PM
28	The #1 problem has been the making of proper thinning, cleaning and maintaining of Public land and private property a Crime. has over the last 20 to 30 years built up a Huge Fire & flood hazard and made much of our wild land "forest" diseased, weak & exponentially more susceptible to disease,, pests, and fire & flood! !	1/7/2021 2:57 PM
29	famine due to drought and exploited natural resources	1/7/2021 8:58 AM
30	Worst Roads in the State, possibly the Country	1/6/2021 5:16 PM
31	PG& E-caused fires, primarily due to crumbling infrastructure	1/5/2021 3:40 PM
32	Civil unrest, police brutality and militarism	1/5/2021 2:01 PM

33	Still traffic during evacuations	1/5/2021 12:25 PM
34	Covid and lack of enforcement on your end	1/5/2021 12:03 PM
35	Too many cars trying to evacuate at once, noise and air pollution from overhead jets	1/5/2021 10:34 AM
36	Blocked and limited egress on Hembree in Windsor.	1/5/2021 9:40 AM
37	compromised drinking water (salt water intrusion, pollution, etc)	1/5/2021 8:17 AM
38	Earthquake, Infrastructure Failure, Poorly Trained Responders, Misogyny within Responder Units	1/1/2021 6:31 PM
39	Incompetent management and authority on most levels	12/30/2020 5:54 PM
40	Note traffic concern is relative neighborhood evacuation bottlenecks	12/29/2020 7:36 PM
41	Blocked hwy 12 escape route	12/28/2020 9:07 AM
42	Filthy public water	12/22/2020 8:46 AM
43	Openly racist county officials (Sheriff, ALL supervisors failing to uphold their duties to non-English speaking residents)	12/21/2020 11:26 AM
44	PG&E shutoffs. Home is all electric. No hot water, fridge, heat or fans.	12/20/2020 12:22 PM
45	COVID	12/19/2020 4:45 PM
46	Don't understand how Transportation is a hazard.	12/19/2020 12:28 PM
47	Do you mean those transportation system ARE hazards (that's why I checked it) or that I'm worried I won't be able to use them in an emergency?	12/19/2020 8:04 AM
48	Pandemic, there will be others	12/19/2020 6:49 AM
49	smoke from wildland fires for weeks at a time	12/18/2020 11:04 PM
50	Widespread lack of earthquake insurance	12/18/2020 9:59 PM
51	Climate change/global warming	12/18/2020 9:35 PM
52	what' do you mean transportation related to hazard; Am i afraid the airport won't work? am I worried the train won't work that we can't rely on much anyway? what if hwy 101 is unavailable? someone messed up the SMART train so we don't have that going much anymore. Some wealthy privileged people in the county didn't want it.	12/18/2020 8:52 PM
53	Slightly concerned: civil unrest	12/18/2020 1:42 PM
54	Being regulated in a one size fits all manner that makes my life more hazardous. The rules make it difficult or impossible to keep fire safe by preventing preemptive burning for decades. Construction rules that mean a new house is nearer flammable trees because the road improvements that would be required for a permit are unaffordable for me. Government should stop dictating private road construction, especially when county roads are so poorly maintained.	12/17/2020 8:42 PM
55	Widespread lack of earthquake insurance	12/17/2020 6:20 PM
56	neighbor planting 21 redwood trees 8 ft from property line and 22 ft from our house	12/16/2020 8:30 PM
57	PG&E lack of maintenance causing fires	12/16/2020 1:31 PM
58	food and fuel supply	12/16/2020 12:59 PM
59	Pandemic	12/16/2020 12:42 PM
60	Bio, Chem or Cyber-terrorism (esp. rightwing lone-wolf incels)	12/16/2020 11:49 AM

Q10 If you are a renter, do you have renters insurance?

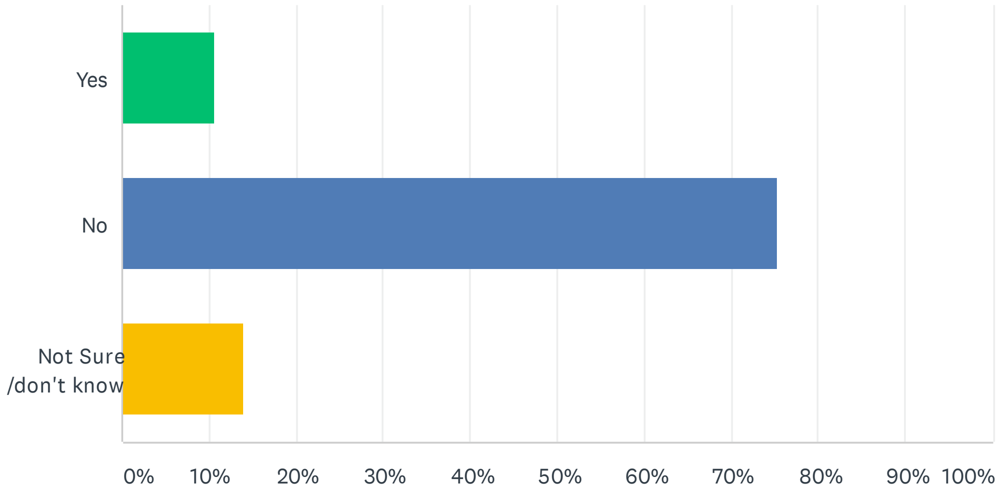
Answered: 514 Skipped: 177



ANSWER CHOICES	RESPONSES	
Yes	12.45%	64
No	7.98%	41
N/A	79.57%	409
TOTAL		514

Q11 Is your property or rental located in or near a designated floodplain?

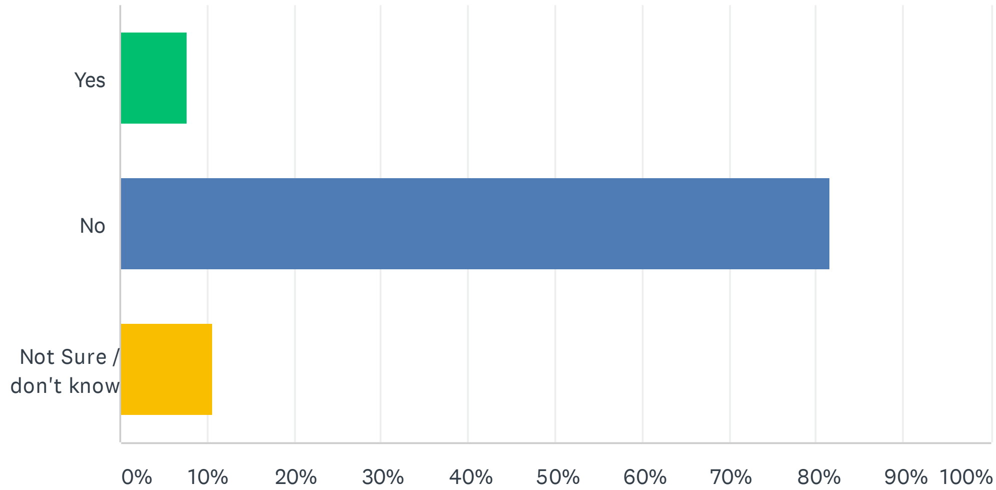
Answered: 627   Skipped: 64



ANSWER CHOICES	RESPONSES	
Yes	10.69%	67
No	75.28%	472
Not Sure /don't know	14.04%	88
TOTAL		627

Q12 Do you have flood insurance?

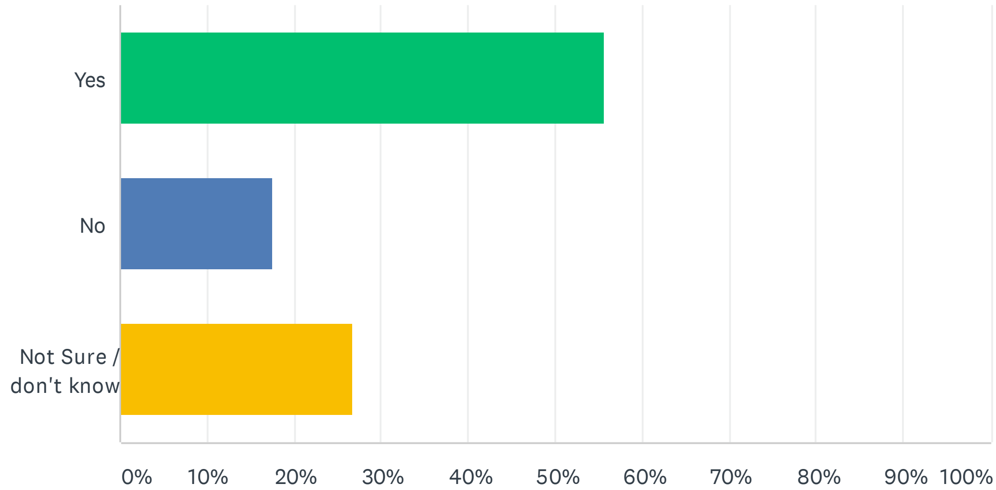
Answered: 634 Skipped: 57



ANSWER CHOICES	RESPONSES	
Yes	7.73%	49
No	81.55%	517
Not Sure / don't know	10.73%	68
TOTAL		634

Q13 Is your property or rental located near an earthquake fault?

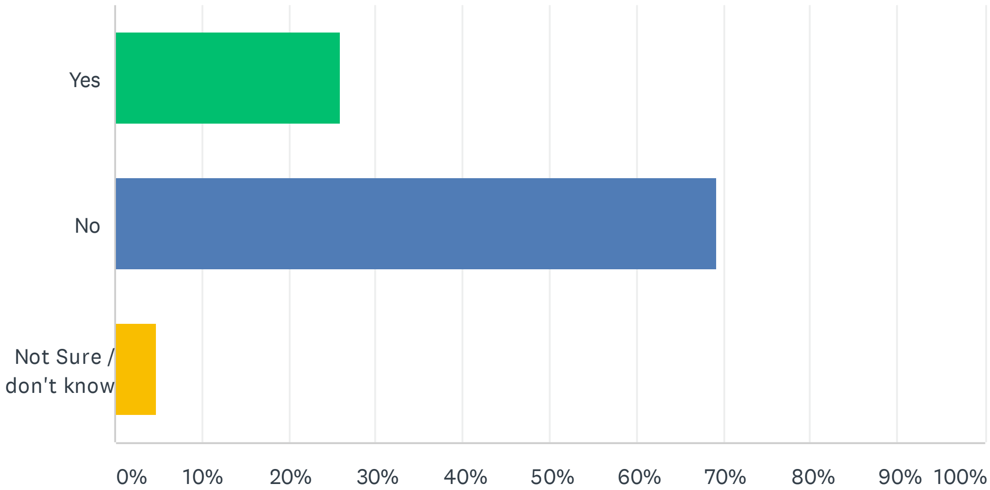
Answered: 636 Skipped: 55



ANSWER CHOICES	RESPONSES	
Yes	55.66%	354
No	17.61%	112
Not Sure / don't know	26.73%	170
TOTAL		636

Q14 Do you have earthquake insurance?

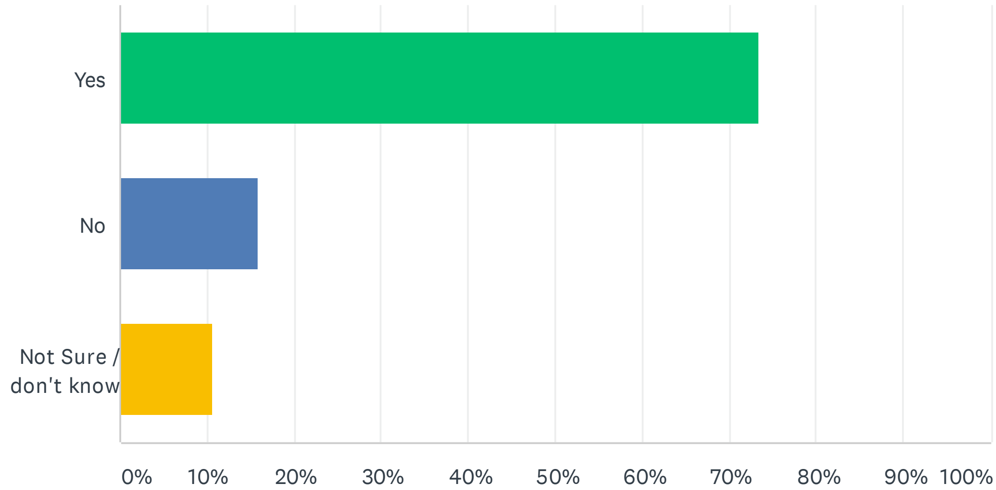
Answered: 632 Skipped: 59



ANSWER CHOICES	RESPONSES	
Yes	25.95%	164
No	69.15%	437
Not Sure / don't know	4.91%	31
TOTAL		632

Q15 Is your property or rental located in an area at risk for wildfires?

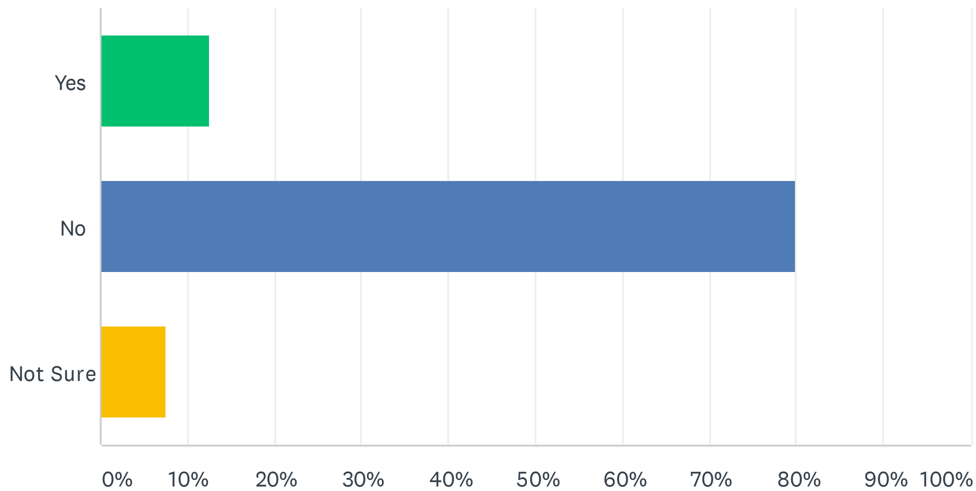
Answered: 634 Skipped: 57



ANSWER CHOICES	RESPONSES	
Yes	73.50%	466
No	15.93%	101
Not Sure / don't know	10.57%	67
TOTAL		634

Q16 Have you ever had problems getting homeowners or renters insurance due to risks from hazards?

Answered: 632 Skipped: 59



ANSWER CHOICES	RESPONSES	
Yes	12.50%	79
No	79.91%	505
Not Sure	7.59%	48
TOTAL		632

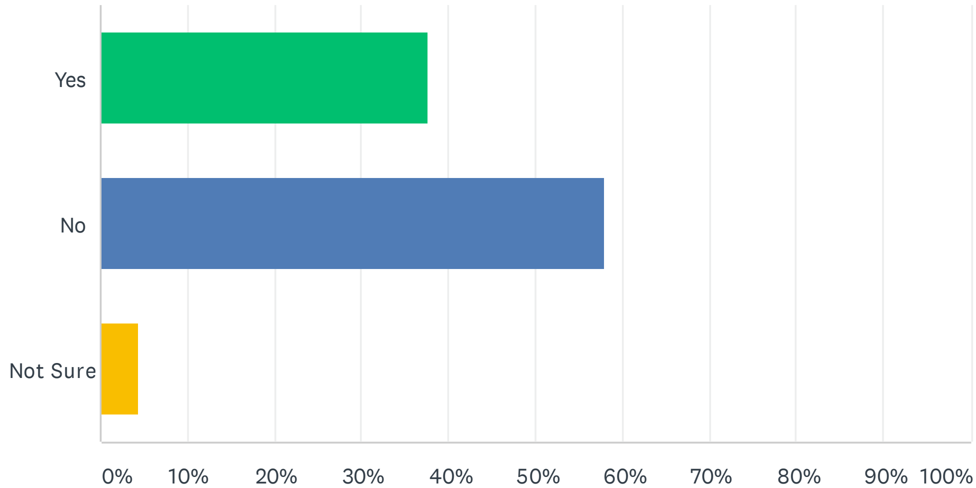
#	IF "YES," WHICH NATURAL HAZARD WAS INVOLVED?	DATE
1	recent wildfires in the county in 2017 and 2020	2/25/2021 8:55 PM
2	Fire	2/25/2021 8:22 PM
3	Fire	2/25/2021 7:27 PM
4	Fire	2/25/2021 7:17 PM
5	Wildfire	2/25/2021 4:29 PM
6	Can't afford more than basic home owner's insurance.	2/21/2021 8:42 AM
7	wildfire	2/16/2021 7:54 AM
8	Wildfires	2/9/2021 7:26 PM
9	fire	2/9/2021 4:14 PM
10	fire	2/9/2021 3:35 PM
11	Fire	2/9/2021 3:26 PM
12	Fire	2/9/2021 2:55 PM
13	Earthquake it is too expensive for us	2/3/2021 12:15 PM
14	Fire	2/1/2021 3:35 PM
15	Since NorthBay Fires, hard to get homeowners insurance and price significantly went up.	1/28/2021 11:39 AM
16	fire	1/23/2021 11:36 AM
17	Wildfires	1/9/2021 12:57 PM
18	Water	1/9/2021 10:20 AM
19	Insurance in the Sonoma hills is definately a concern. We were told by our agency that they would not insure us if they were not already. We are several fire danger levels above what they now accept.	1/9/2021 9:45 AM
20	PG&E caused fire	1/8/2021 7:47 AM
21	Because of government stupidity mentioned before ALL of Sonoma county is now a fire hazard zone!	1/7/2021 2:57 PM
22	kincade, geyserville fires	1/6/2021 1:16 PM
23	Kincade Fire, Walbridge Fire (LNU)	1/6/2021 8:44 AM
24	Earthquake insurance is not affordable.	1/6/2021 7:52 AM
25	Fire	1/6/2021 4:58 AM
26	wild fire	1/5/2021 9:04 PM
27	wildfires	1/5/2021 5:26 PM
28	Wildfire	1/5/2021 4:55 PM
29	Fire	1/5/2021 2:01 PM
30	Fire	1/5/2021 1:30 PM
31	I anticipate the advent of insurance "red lining" due to wildfires.	1/5/2021 9:40 AM
32	Tubbs Fire, Coffey Park. I'm not sure any area is not at risk of wildfre!	1/5/2021 8:17 AM
33	Wildfire	12/31/2020 7:18 AM
34	Wildfire	12/30/2020 11:09 PM
35	2017 wildfire	12/30/2020 6:55 PM

36	wikd fires	12/30/2020 12:39 PM
37	fire	12/30/2020 12:19 PM
38	fire	12/30/2020 10:53 AM
39	wildfire (on another property)	12/29/2020 9:58 PM
40	Fire	12/29/2020 7:48 AM
41	Nuns fire, homeowners insurance canceled at renewal period	12/28/2020 3:58 PM
42	Wildfire, some insurance companies have left this marketplace	12/23/2020 5:41 PM
43	fire, earthquake, flood	12/22/2020 10:50 AM
44	Farmers insurance has been great and hasn’t denied us insurance due to living in the WUI	12/22/2020 10:50 AM
45	Our fire insurance premiums Md homeowners insurance premiums have gone up	12/22/2020 9:34 AM
46	High winds destroyed a fence	12/21/2020 10:42 PM
47	Fire	12/21/2020 2:01 PM
48	Earthquake, Flood, Fire, distance from fire station	12/21/2020 12:05 PM
49	wildfire	12/21/2020 9:28 AM
50	fire	12/21/2020 8:52 AM
51	Eathquake fault 1 mile away, insurance company tried to cancel us last year	12/20/2020 10:25 AM
52	Wildfire	12/19/2020 7:05 PM
53	Did an energy and seismic retrofit 10 yes ago	12/19/2020 6:49 AM
54	Earthquake insurance is expensive and the deductible is insane typically about 10%of property value	12/18/2020 10:51 AM
55	fire	12/18/2020 9:27 AM
56	Fire	12/18/2020 8:12 AM
57	Wildfire	12/18/2020 7:45 AM
58	Fire	12/17/2020 8:42 PM
59	tubbs nunn glass lnu wildfires	12/17/2020 5:09 PM
60	fire insurance	12/17/2020 12:25 AM
61	When located to the North Bay in 2012 from WA State, existing home insurer did not provide homeowner insurance for Marin/Sonoma County.	12/16/2020 5:24 PM
62	Fire insurance difficult in 2017	12/16/2020 1:25 PM
63	Wildfire	12/16/2020 12:42 PM
64	wildfire	12/16/2020 12:29 PM
65	Not us, but nearby neighbors just had policy cancelled for wildfire risk	12/16/2020 11:49 AM
66	fire	12/15/2020 3:07 PM
67	wildfire	12/15/2020 10:47 AM
68	Fire, but we were able to get coverage after cancellation	12/14/2020 3:05 PM
69	wildfires	12/9/2020 8:57 PM
70	Wildfire	12/9/2020 8:35 AM
71	had to cut down trees	12/8/2020 7:55 PM
72	Wildfire	12/8/2020 5:10 PM

73	Wildfire	12/8/2020 5:03 PM
74	You can't get Earthquake Insurance rates are over the top, Fire is becoming a real challenge and expected to become unobtainable	12/8/2020 5:03 PM
75	Fire	11/19/2020 10:19 AM

Q17 When you moved into your residence, did you consider the impact a disaster could have?

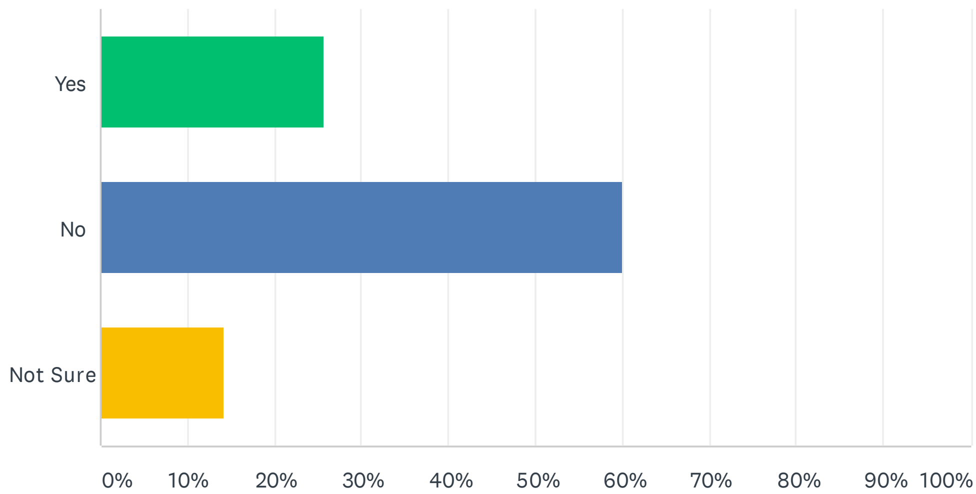
Answered: 616 Skipped: 75



ANSWER CHOICES	RESPONSES	
Yes	37.66%	232
No	57.95%	357
Not Sure	4.38%	27
TOTAL		616

Q18 Was the presence of a hazard risk zone (e.g., dam failure zone, flood zone, landslide hazard area, high fire risk area) disclosed to you by a real estate agent, seller, or landlord before you purchased or moved into your residence?

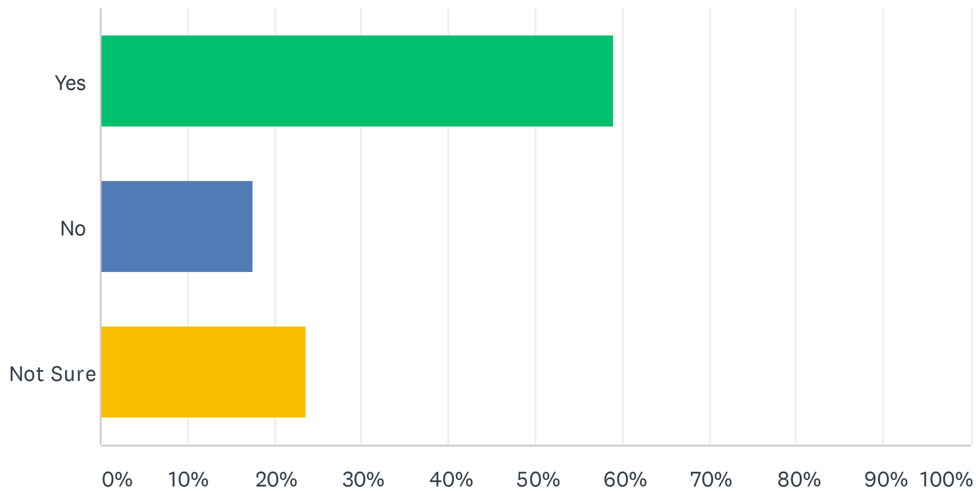
Answered: 617 Skipped: 74



ANSWER CHOICES	RESPONSES	
Yes	25.77%	159
No	59.97%	370
Not Sure	14.26%	88
TOTAL		617

Q19 Would the disclosure of this type of hazard risk information influence your decision to buy or rent a residence?

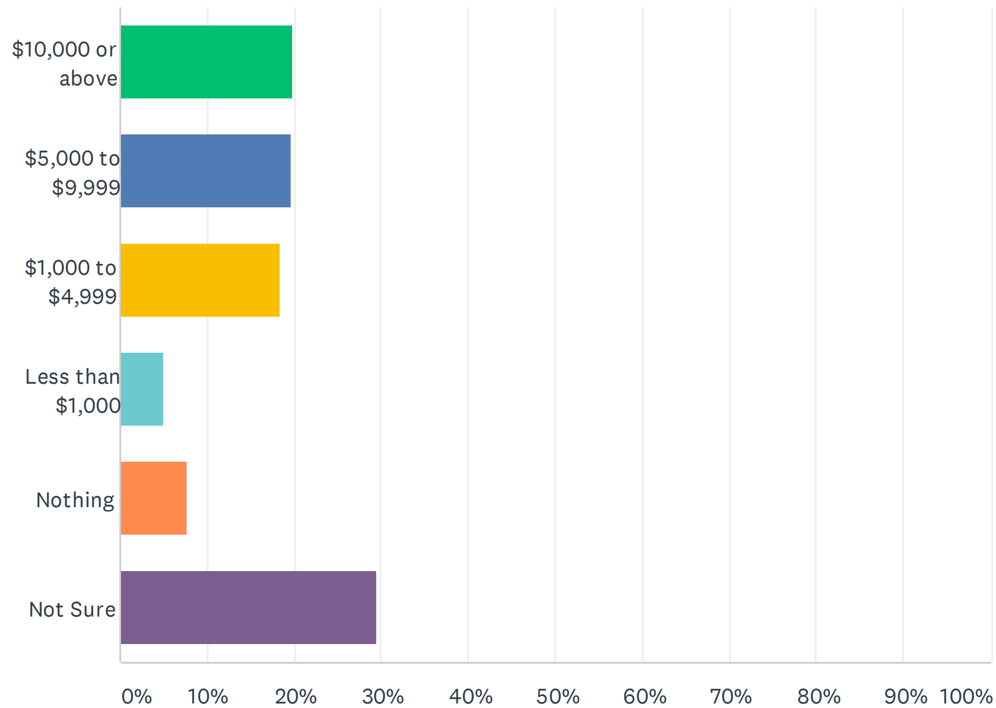
Answered: 616 Skipped: 75



ANSWER CHOICES	RESPONSES	
Yes	58.93%	363
No	17.53%	108
Not Sure	23.54%	145
TOTAL		616

Q20 If you were eligible for funding assistance that required a local contribution, how much money would you be willing to spend to retrofit your home to reduce risks associated with disasters? (for example, by elevating a home above the flood level, performing seismic upgrades, or replacing a combustible roof with non-combustible roofing)

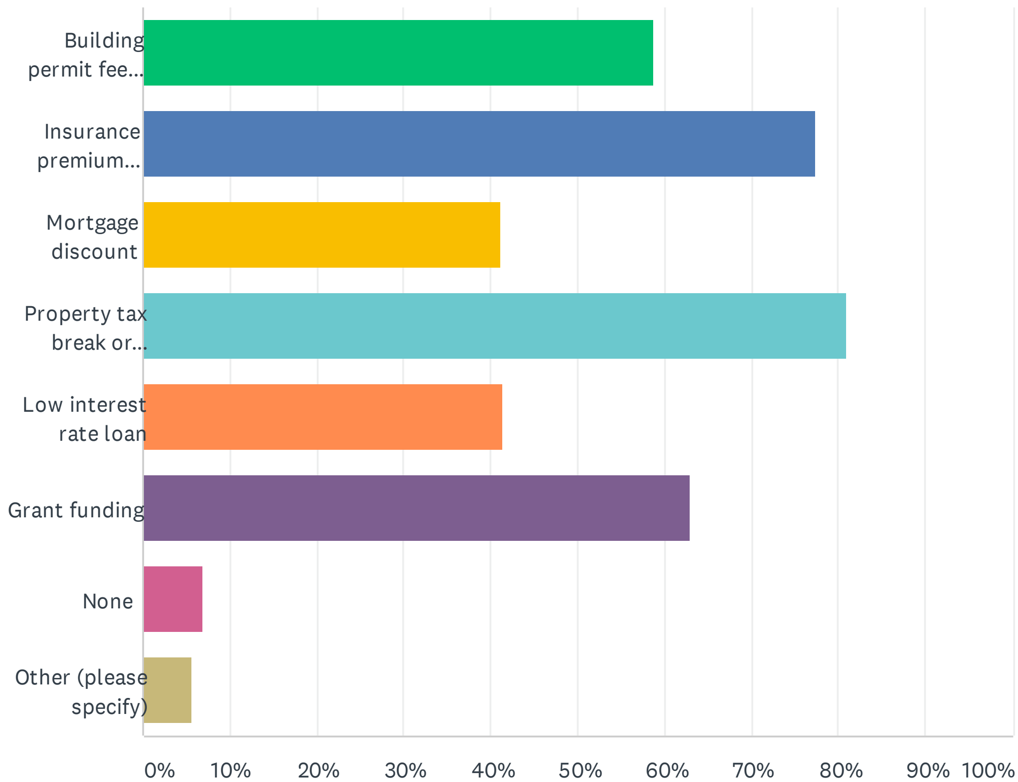
Answered: 611 Skipped: 80



ANSWER CHOICES	RESPONSES	
$10,000 or above	19.80%	121
$5,000 to $9,999	19.64%	120
$1,000 to $4,999	18.33%	112
Less than $1,000	5.07%	31
Nothing	7.69%	47
Not Sure	29.46%	180
TOTAL		611

Q21 Which of the following incentives for property owners would encourage you to spend money to retrofit your home to protect against disasters? (Check all that apply). Please note that your answers to this question does not obligate any of the planning partners to implement the incentives.

Answered: 600 Skipped: 91



ANSWER CHOICES	RESPONSES	
Building permit fee waiver	58.83%	353
Insurance premium discount	77.50%	465
Mortgage discount	41.17%	247
Property tax break or incentive	81.00%	486
Low interest rate loan	41.33%	248
Grant funding	63.00%	378
None	7.00%	42
Other (please specify)	5.67%	34

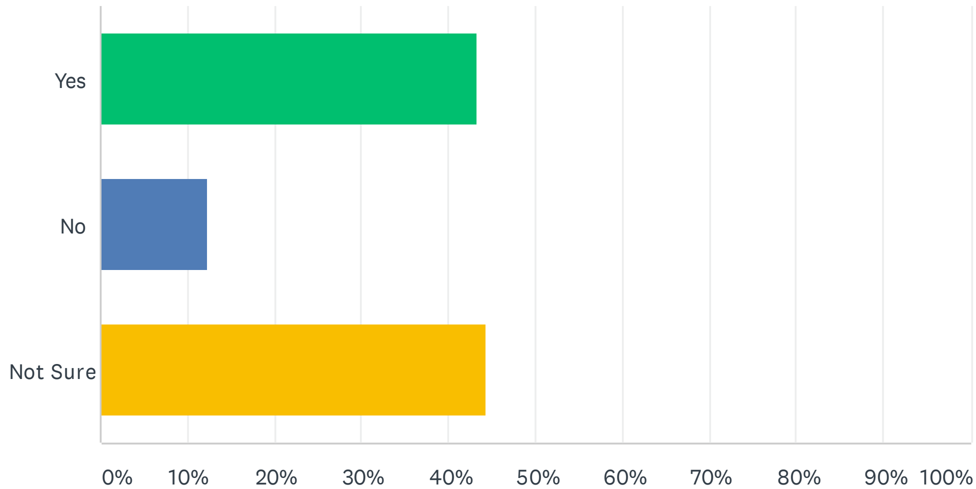
Total Respondents: 600

#	OTHER (PLEASE SPECIFY)	DATE
1	Please!	2/25/2021 7:18 PM
2	Would love to spend money upgrading our home if we weren't far blow the poverty level.	2/21/2021 8:50 AM
3	If there were programs available to my landlord that I would benefit from I would discuss them with her and try to convince her to make these kinds of improvements to the property.	2/11/2021 6:12 AM
4	our home is up to code on all these risks	2/8/2021 9:54 PM
5	I live in a multi-family HOA property. Any assistance would go through them.	1/27/2021 5:37 PM
6	my home is new construction so doesn't need retrofitting	1/12/2021 3:21 PM
7	My modular home is equipped with $5,000 worth of bracing which was provided free for low income people.	1/10/2021 2:57 PM
8	Not sure any retrofit would protect against wildfire	1/9/2021 2:45 PM
9	Help with fire prevention in the way of brush removal on Gehricke Road would be a high priority.	1/9/2021 9:48 AM
10	availability of reliable/unbiased resources to assess specific recommended improvements.	1/8/2021 6:15 PM
11	guarantee that PGE won't turn off my power and gas	1/8/2021 2:43 PM
12	Getting ALL Government out of the way! Eliminate ALL Property Tax for ever!	1/7/2021 3:02 PM
13	My house is relatively new and up to code.	1/5/2021 6:04 PM
14	We're in a condo association so the question doesn't apply	1/5/2021 12:14 PM
15	I am a renter	1/5/2021 9:17 AM
16	Elected	12/30/2020 5:56 PM
17	Insurance coverage	12/23/2020 5:43 PM
18	I'm a renter; I don't care what happens to this building	12/21/2020 11:28 AM
19	N/A	12/19/2020 4:47 PM
20	I don't own.	12/19/2020 8:06 AM
21	If there was financial help available I would encourage my landlord to make use of it and would help make it happen.	12/19/2020 1:28 AM
22	the landlord would probably be interested	12/18/2020 8:33 PM
23	I rent.	12/18/2020 9:53 AM
24	n/a	12/18/2020 8:21 AM
25	Government should not be so involved in trying to be alk things to all people. I is not financially sustainable.. Hazard reduction should be between insurance companies and insurers. Having a program to pay for Vulcan vent materials purchase seems like it would be a goid investment. I feel that some building code regs, such as old venting requirements, were responsible for many ember infiltration fires. M	12/17/2020 8:52 PM
26	income tax break	12/17/2020 5:21 PM
27	Not a property owner	12/16/2020 1:02 PM
28	Technical assistance, bulk procurement, enforcement	12/16/2020 11:53 AM
29	I rent, are you daft?	12/16/2020 8:31 AM
30	Unable to afford to buy home in this county	12/15/2020 3:22 PM
31	I'm a renter, I'm not putting any money into this house	12/15/2020 3:18 PM
32	I rent an apartment, so I'm not in a position to retrofit anything, hence my answers to questions 20 and 21. I don't have earthquake insurance because the premiums would cost me more than	12/15/2020 2:58 PM

	the value of my belongs.	
33	Please expand flood elevation program, grants!	12/10/2020 8:41 PM
34	Assistance with installing rain catchment, rain gardens, soil improvements to keep rain water on the property and out of the Russian River.	12/8/2020 10:43 PM

Q22 If you own/owned property located in a designated “high hazard” area or had received repetitive damages from a hazard event, would you consider a ”buyout” offered by a Federal agency?

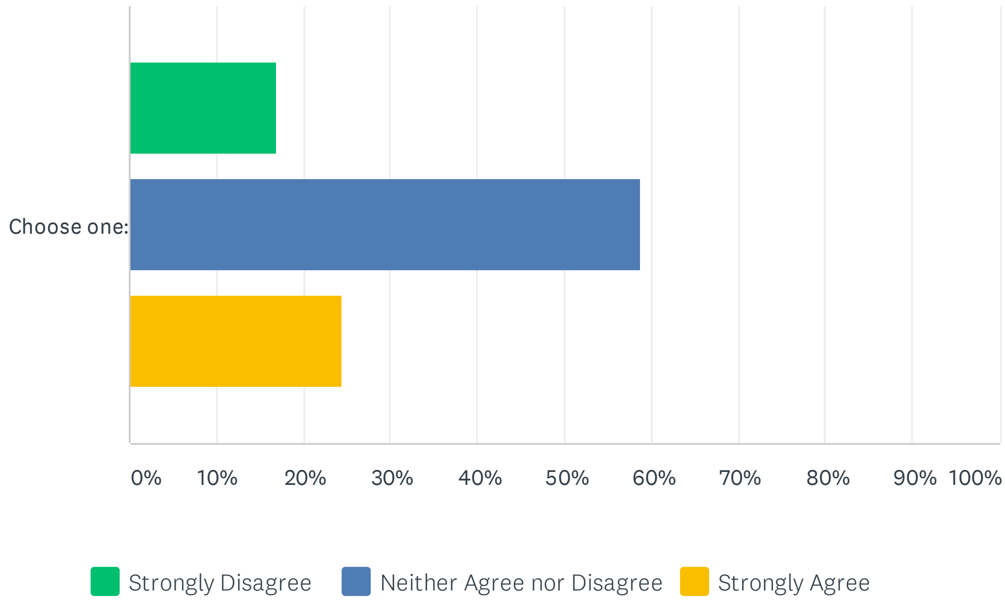
Answered: 598 Skipped: 93



ANSWER CHOICES	RESPONSES	
Yes	43.31%	259
No	12.37%	74
Not Sure	44.31%	265
TOTAL		598

Q23 Please indicate how you feel about the following statement:Information about the risks associated with hazards is readily available and easy to locate.

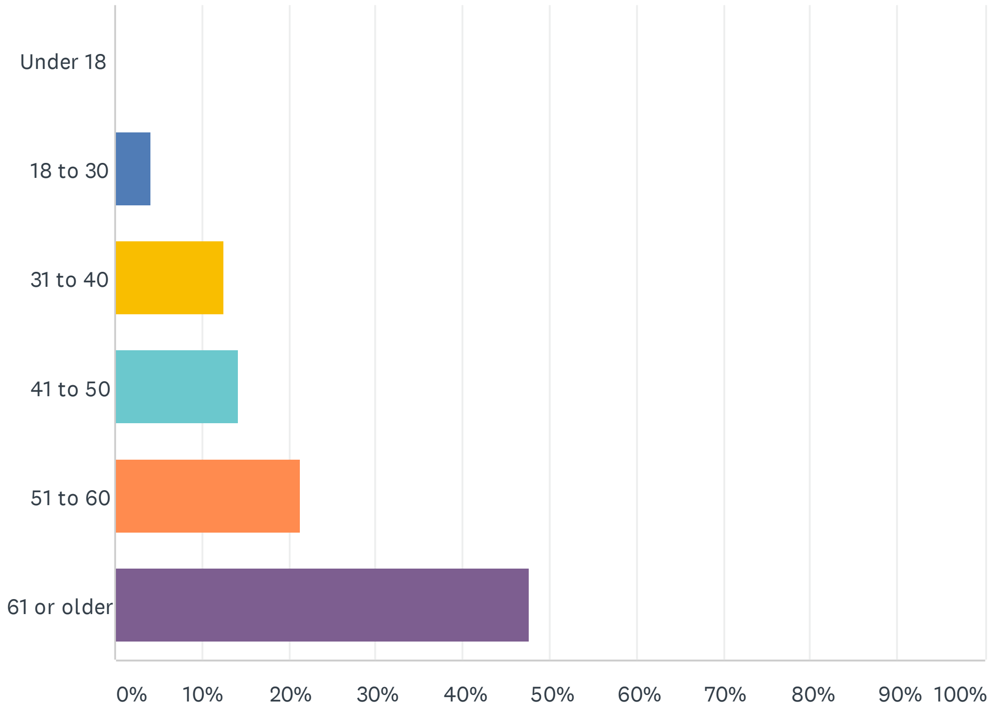
Answered: 615 Skipped: 76



	STRONGLY DISAGREE	NEITHER AGREE NOR DISAGREE	STRONGLY AGREE	TOTAL	WEIGHTED AVERAGE
Choose one:	16.91% 104	58.70% 361	24.39% 150	615	2.07

Q24 Please indicate your age range:

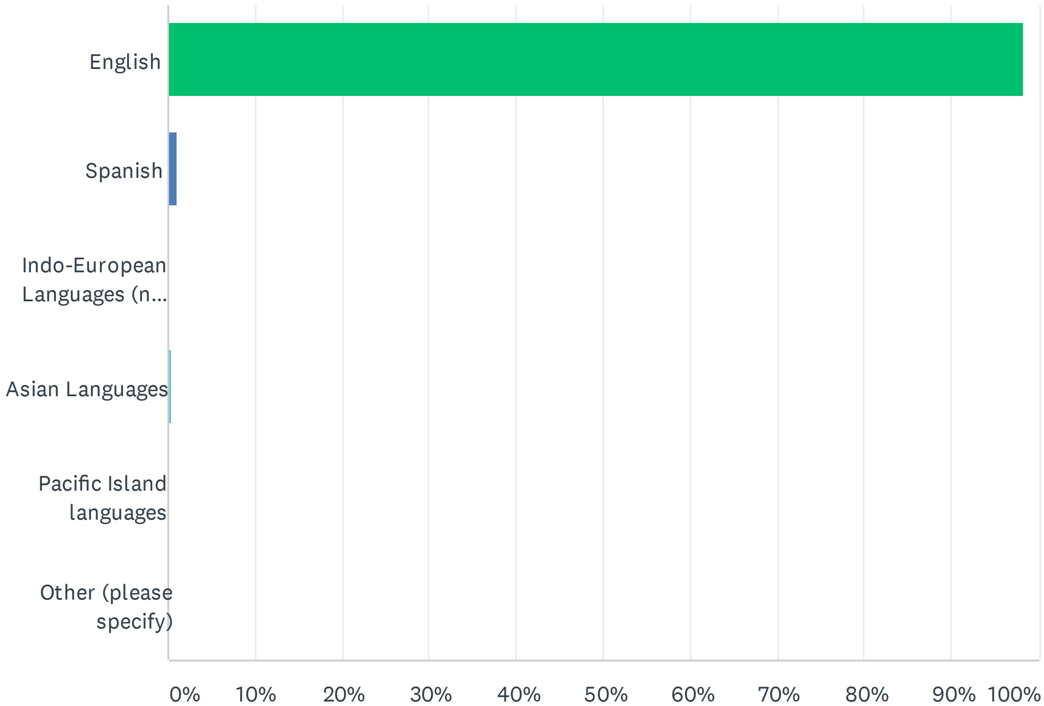
Answered: 612   Skipped: 79



ANSWER CHOICES	RESPONSES	
Under 18	0.00%	0
18 to 30	4.08%	25
31 to 40	12.58%	77
41 to 50	14.22%	87
51 to 60	21.41%	131
61 or older	47.71%	292
TOTAL		612

Q25 Please indicate the primary language spoken in your household.

Answered: 608   Skipped: 83

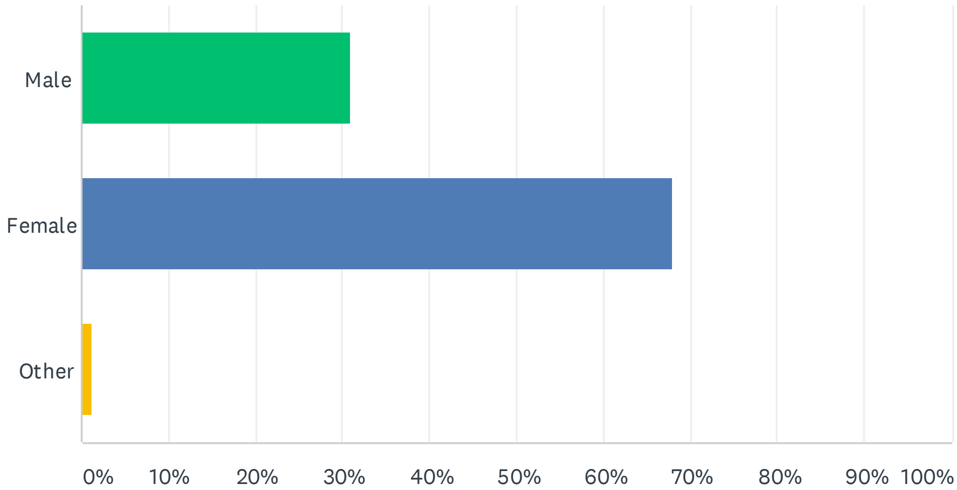


ANSWER CHOICES	RESPONSES	
English	98.36%	598
Spanish	0.99%	6
Indo-European Languages (not including English or Spanish)	0.00%	0
Asian Languages	0.33%	2
Pacific Island languages	0.16%	1
Other (please specify)	0.16%	1
TOTAL		608

#	OTHER (PLEASE SPECIFY)	DATE
1	French	12/19/2020 11:10 AM

Q26 Please indicate your gender:

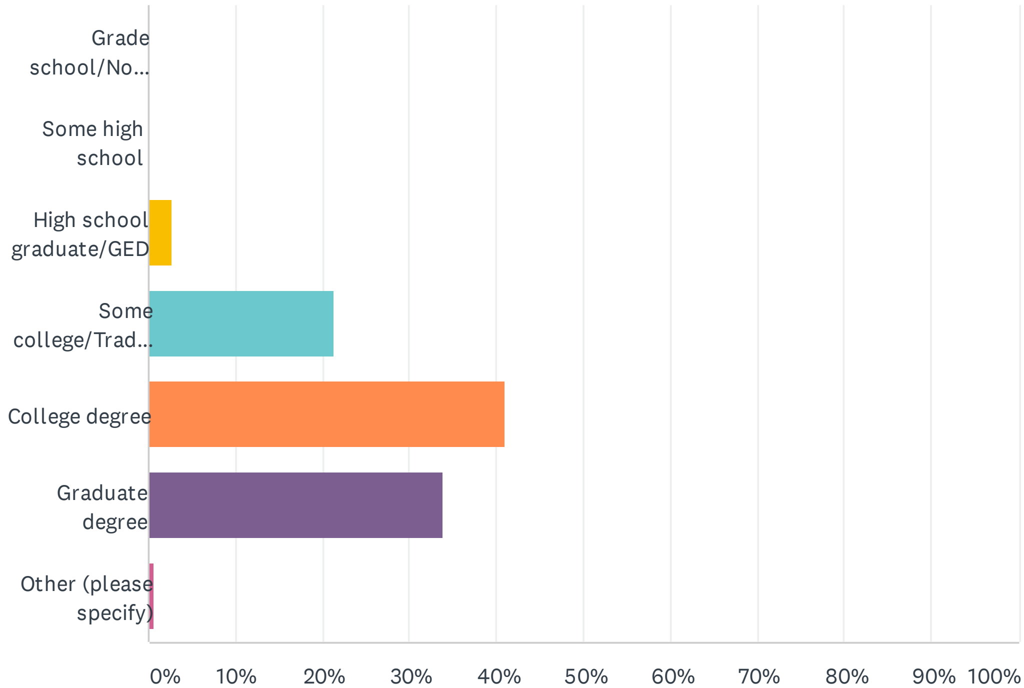
Answered: 605 Skipped: 86



ANSWER CHOICES	RESPONSES	
Male	30.91%	187
Female	67.93%	411
Other	1.16%	7
TOTAL		605

Q27 Please indicate your highest level of education.

Answered: 610 Skipped: 81

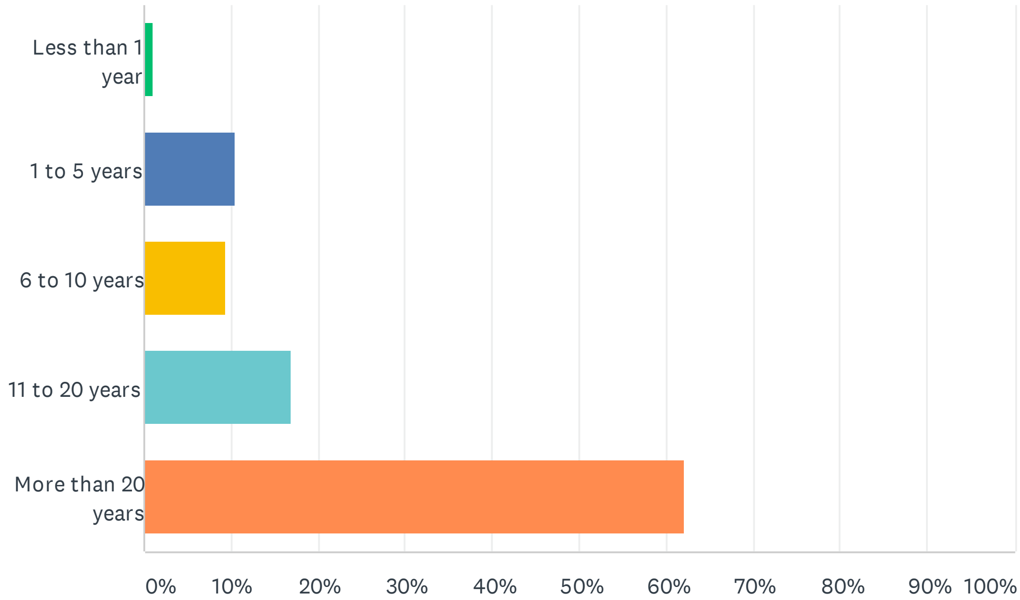


ANSWER CHOICES	RESPONSES	
Grade school/No schooling	0.16%	1
Some high school	0.16%	1
High school graduate/GED	2.79%	17
Some college/Trade school	21.31%	130
College degree	40.98%	250
Graduate degree	33.93%	207
Other (please specify)	0.66%	4
TOTAL		610

#	OTHER (PLEASE SPECIFY)	DATE
1	Law degree	1/23/2021 10:15 AM
2	None of your business	1/10/2021 4:25 PM
3	AA Degree	1/10/2021 2:58 PM
4	Law degree	12/21/2020 11:29 AM

Q28 How long have you lived in Sonoma County?

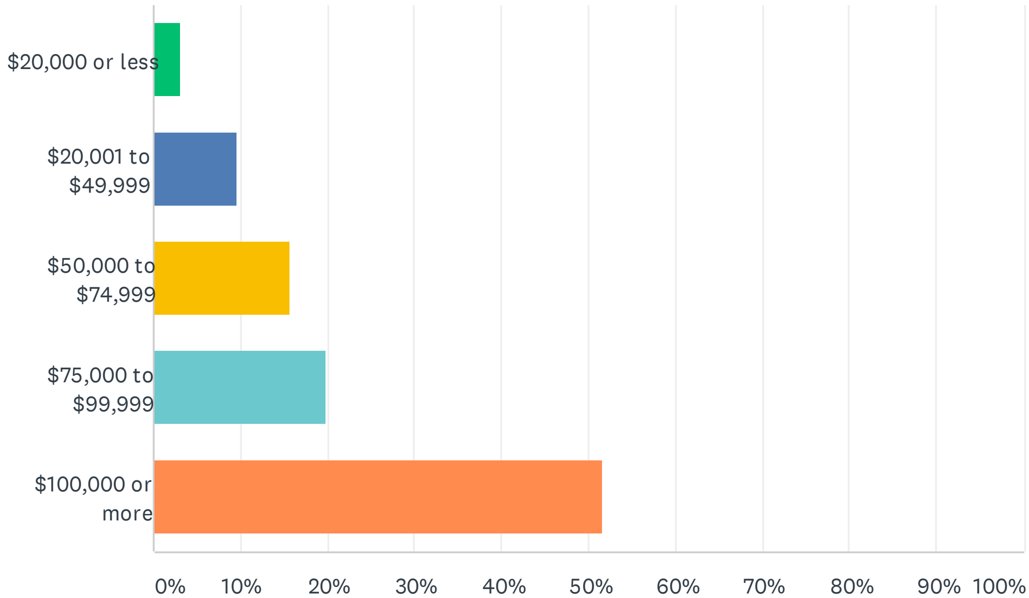
Answered: 610 Skipped: 81



ANSWER CHOICES	RESPONSES	
Less than 1 year	0.98%	6
1 to 5 years	10.49%	64
6 to 10 years	9.51%	58
11 to 20 years	16.89%	103
More than 20 years	62.13%	379
TOTAL		610

Q29 What is your gross household income?

Answered: 580 Skipped: 111



ANSWER CHOICES	RESPONSES	
$20,000 or less	3.10%	18
$20,001 to $49,999	9.66%	56
$50,000 to $74,999	15.69%	91
$75,000 to $99,999	19.83%	115
$100,000 or more	51.72%	300
TOTAL		580

Q30 Comments

Answered: 173 Skipped: 518

**COMMENTS AVAILABLE
BY REQUEST TO
PERMIT SONOMA**

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix B. Summary of Federal and State Agencies, Programs and Regulations

B. SUMMARY OF FEDERAL AND STATE AGENCIES, PROGRAMS AND REGULATIONS

Existing laws, ordinances, plans and programs at the federal and state level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). The following federal and state programs have been identified as programs that may interface with the actions identified in this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan. Information presented in this section can be used to review local capabilities to implement the actions found in the jurisdictional annexes of Volume 2. Each planning partner has individually reviewed existing local plans, studies, reports, and technical information in its jurisdictional annex, presented in Volume 2.

FEDERAL

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. Title II of the ADA deals with compliance with the Act in emergency management and disaster-related programs, services, and activities. It applies to state and local governments as well as third parties, including religious entities and private nonprofit organizations.

The ADA has implications for sheltering requirements and public notifications. During an emergency alert, officials must use a combination of warning methods to ensure that all residents have all necessary information. Those with hearing impairments may not hear radio, television, sirens, or other audible alerts, while those with visual impairments may not see flashing lights or other visual alerts. Two technical documents for shelter operators address physical accessibility needs of people with disabilities, as well as medical needs and service animals.

The ADA intersects with disaster preparedness programs in regards to transportation, social services, temporary housing, and rebuilding. Persons with disabilities may require additional assistance in evacuation and transit (e.g., vehicles with wheelchair lifts or paratransit buses). Evacuation and other response plans should address the unique needs of residents. Local governments may be interested in implementing a special-needs registry to identify the home addresses, contact information, and needs for residents who may require more assistance.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Bureau of Land Management

The U.S. Bureau of Land Management (BLM) funds and coordinates wildfire management programs and structural fire management and prevention on BLM lands. BLM works closely with the Forest Service and state and local governments to coordinate fire safety activities. The Interagency Fire Coordination Center in Boise, Idaho serves as the center for this effort.

Civil Rights Act of 1964

The Civil Rights Act of 1964 prohibits discrimination based on race, color, religion, sex or nation origin and requires equal access to public places and employment. The Act is relevant to emergency management and hazard mitigation in that it prohibits local governments from favoring the needs of one population group over another. Local government and emergency response must ensure the continued safety and well-being of all residents equally, to the extent possible. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. Numerous issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The CWA is important to hazard mitigation in several ways. There are often permitting requirements for any construction within 200 feet of water of the United States, which may have implications for mitigation projects identified by a local jurisdiction. Additionally, CWA requirements apply to wetlands, which serve important functions related to preserving and protecting the natural and beneficial functions of floodplains and are linked with a community's floodplain management program. Finally, the National Pollutant Discharge Elimination System is part of the CWA and addresses local stormwater management programs. Stormwater management plays a critical role in hazard mitigation by addressing urban drainage or localized flooding issues within jurisdictions.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Community Development Block Grant Disaster Resilience Program

In response to disasters, Congress may appropriate additional funding for the U.S. Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities and neighborhoods that otherwise might not recover due to limited resources. CDBG-DR grants often supplement disaster programs of FEMA, the Small Business Administration, and the U.S. Army Corps of Engineers. Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other federal disaster assistance programs. To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a presidentially declared county for the covered disaster
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective.

Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger. CDBG-DR funding is a potential alternative source of funding for actions identified in this plan.

Community Rating System

The CRS 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 meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The discount partially depends on location of the property. Properties outside the special flood hazard area receive smaller discounts: a 10-percent discount if the community is at Class 1 to 6 and a 5-percent discount if the community is at Class 7 to 9. The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation’s flood risk; over 66 percent of the NFIP’s policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Emergency Relief for Federally Owned Roads Program

The U.S. Forest Service's Emergency Relief for Federally Owned Roads Program was established to assist federal agencies with repair or reconstruction of tribal transportation facilities, federal lands transportation facilities, and other federally owned roads that are open to public travel and have suffered serious damage by a natural disaster over a wide area or by a catastrophic failure. The program funds both emergency and permanent repairs. Eligible activities under this program meet some of the goals and objectives for this plan and the program is a possible funding source for actions identified in this plan.

Emergency Watershed Program

The USDA Natural Resources Conservation Service administers the Emergency Watershed Protection (EWP) Program, which responds to emergencies created by natural disasters. Eligibility for assistance is not dependent on a national emergency declaration. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. EWP is an emergency recovery program. Financial and technical assistance are available for the following activities:

- Remove debris from stream channels, road culverts, and bridges
- Reshape and protect eroded banks
- Correct damaged drainage facilities
- Establish cover on critically eroding lands
- Repair levees and structures
- Repair conservation practices.

This federal program could be a possible funding source for actions identified in this plan.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- Endangered means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- Threatened means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- Critical habitat means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- Section 4: Listing of a Species—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- Section 7: Consultation—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- Section 9: Prohibition of Take—It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- Section 10: Permitted Take—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- Section 11: Citizen Lawsuits—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors seismic research and applies it in performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication Engineering Guidelines for the Evaluation of Hydropower Projects guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

Federal Wildfire Management Policy and Healthy Forests Restoration Act

Federal Wildfire Management Policy and Healthy Forests Restoration Act (2003). These documents call for a single comprehensive federal fire policy for the Interior and Agriculture Departments (the agencies using federal fire management resources). They mandate community-based collaboration to reduce risks from wildfire.

National Dam Safety Act

Potential for catastrophic flooding due to dam failures led to passage of the National Dam Inspection Act in 1972, creation of the National Dam Safety Program in 1996, and reauthorization of the program through the Dam Safety Act in 2006. National Dam Safety Program, administered by FEMA requires a periodic engineering analysis of the majority of dams in the country; exceptions include the following:

- Dams under jurisdiction of the Bureau of Reclamation, Tennessee Valley Authority, or International Boundary and Water Commission
- Dams constructed pursuant to licenses issued under the Federal Power Act
- Dams that the Secretary of the Army determines do not pose any threat to human life or property.

The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect lives and property of the public. The National Dam Safety Program is a partnership among the states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under FEMA’s leadership, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and purchases of needed equipment. FEMA has also expanded existing and initiated new training programs. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most of the dams in the United States.

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. The National Environmental Policy Act established the Council on Environmental Quality, whose regulations (40 CFR Parts 1500-1508) set standards for compliance. Consideration and decision-making regarding environmental impacts must be documented in an environmental impact statement or environmental assessment. Environmental impact assessment requires the evaluation of reasonable alternatives to a proposed action, solicitation of input from organizations and individuals that could be affected, and an unbiased presentation of direct, indirect, and cumulative environmental impacts. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

National Fire Plan (2001)

The 2001 National Fire Plan was developed based on the National Fire Policy. A major aspect of the National Fire Plan is joint risk reduction planning and implementation carried out by federal, state and local agencies and communities. The National Fire Plan presented a comprehensive strategy in five key initiatives:

- Firefighting—Be adequately prepared to fight fires each fire season.
- Rehabilitation and Restoration—Restore landscapes and rebuild communities damaged by wildfires.
- Hazardous Fuel Reduction—Invest in projects to reduce fire risk.
- Community Assistance—Work directly with communities to ensure adequate protection.
- Accountability—Be accountable and establish adequate oversight, coordination, program development, and monitoring for performance.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities that enact floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act.

For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent-annual-chance flood and the 0.2-percent-annual-chance flood. Base flood elevations and the boundaries of the flood hazard areas are shown on Flood Insurance Rate Maps, which are the principle tool for identifying the extent and location of the flood hazard. Flood Insurance Rate Maps are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under the local floodplain management program. In recent years, Flood Insurance Rate Maps have been digitized as Digital Flood Insurance Rate Maps, which are more accessible to residents, local governments and stakeholders.

NFIP participants must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 1-percent-annual-chance flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

NFIP participation is limited to local governments that possess permit authority and have the ability to adopt and enforce regulations that govern land use. This does not typically apply to special purpose districts. None of the special purpose district planning partners covered by this plan are eligible to participate in the NFIP, so their action plans do not address NFIP participation.

National Incident Management System

The National Incident Management System (NIMS) is a systematic approach for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards. The NIMS provides a flexible but standardized set of incident management practices. Incidents typically begin and end locally, and they are managed at the lowest possible geographical, organizational, and jurisdictional level. In some cases, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency responder disciplines. These cases necessitate coordination across a spectrum of organizations. Communities using NIMS follow a comprehensive national approach that improves the effectiveness of emergency management and response personnel across the full spectrum of potential hazards (including natural hazards, technological hazards, and human-caused hazards) regardless of size or complexity.

Although participation is voluntary, federal departments and agencies are required to make adoption of NIMS by local and state jurisdictions a condition to receive federal preparedness grants and awards. The content of this plan is considered to be a viable support tool for any phase of emergency management. The NIMS program is considered as a response function, and information in this hazard mitigation plan can support the implementation and update of all NIMS-compliant plans within the planning area.

Presidential Executive Order 11988, Floodplain Management

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. It requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values of floodplains. The requirements apply to the following activities:

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

Presidential Executive Order 11990, Protection of Wetlands

Executive Order 11990 requires federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The requirements apply to the following activities:

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers operates and maintains approximately 700 dams nationwide. It is also responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency’s capabilities, practices and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety. The Corps maintains the National Inventory of Dams, which contains information about a dam’s location, size, purpose, type, last inspection and regulatory status.

U.S. Army Corps of Engineers Flood Hazard Management

The following U.S. Army Corps of Engineers authorities and programs related to flood hazard management:

- The Floodplain Management Services program offers 100-percent federally funded technical services such as development and interpretation of site-specific data related to the extent, duration and frequency of flooding. Special studies may be conducted to help a community understand and respond to flood risk. These may include flood hazard evaluation, flood warning and preparedness, or flood modeling.
- For more extensive studies, the Corps of Engineers offers a cost-shared program called Planning Assistance to States and Tribes. Studies under this program generally range from $25,000 to $100,000 with the local jurisdiction providing 50 percent of the cost.
- The Corps of Engineers has several cost-shared programs (typically 65 percent federal and 35 percent non-federal) aimed at developing, evaluating and implementing structural and non-structural capital projects to address flood risks at specific locations or within a specific watershed:
    - The Continuing Authorities Program for smaller-scale projects includes Section 205 for Flood Control, with a $7 million federal limit and Section 14 for Emergency Streambank Protection with a $1.5 million federal limit. These can be implemented without specific authorization from Congress.
    - Larger scale studies, referred to as General Investigations, and projects for flood risk management, for ecosystem restoration or to address other water resource issues, can be pursued through a specific authorization from Congress and are cost-shared, typically at 65 percent federal and 35 percent non-federal.
    - Watershed management planning studies can be specifically authorized and are cost-shared at 50 percent federal and 50 percent non-federal.

- The Corps of Engineers provides emergency response assistance during and following natural disasters. Public Law 84-99 enables the Corps to assist state and local authorities in flood fight activities and cost share in the repair of flood protective structures. Assistance is provided in the flowing categories:
  - Preparedness—The Flood Control and Coastal Emergency Act establishes an emergency fund for preparedness for emergency response to natural disasters; for flood fighting and rescue operations; for rehabilitation of flood control and hurricane protection structures. Funding for Corps of Engineers emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act. Disaster preparedness activities include coordination, planning, training and conduct of response exercises with local, state and federal agencies.
  - Response Activities—Public Law 84-99 allows the Corps of Engineers to supplement state and local entities in flood fighting urban and other non-agricultural areas under certain conditions (Engineering Regulation 500-1-1 provides specific details). All flood fight efforts require a project cooperation agreement signed by the public sponsor and the sponsor must remove all flood fight material after the flood has receded. Public Law 84-99 also authorizes emergency water support and drought assistance in certain situations and allows for "advance measures" assistance to prevent or reduce flood damage conditions of imminent threat of unusual flooding.
  - Rehabilitation—Under Public Law 84-99, an eligible flood protection system can be rehabilitated if damaged by a flood event. The flood system would be restored to its pre-disaster status at no cost to the federal system owner, and at 20-percent cost to the eligible non-federal system owner. All systems considered eligible for Public Law 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. The Corps has the responsibility to coordinate levee repair issues with interested federal, state, and local agencies following natural disaster events where flood control works are damaged.

These authorities and programs are all available to the planning partners to support any related mitigation actions.

U.S. Fire Administration

There are federal agencies that provide technical support to fire agencies/organizations. For example, the U.S. Fire Administration, which is a part of FEMA, provides leadership, advocacy, coordination, and support for fire agencies and organizations.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service fire management strategy uses prescribed fire to maintain early successional fire-adapted grasslands and other ecological communities throughout the National Wildlife Refuge system.

STATE

AB 9: Fire safety: wildfires: fire adapted communities.

Establishes the Regional Forest and Fire Capacity Program to support regional leadership, build local and regional capacity, and develop, prioritize, and implement strategies and projects that create fire-adapted communities by improving watershed health, forest health, community wildfire preparedness, and fire resilience.

AB 32: The California Global Warming Solutions Act

This bill identifies the following potential adverse impacts of global warming:

> "… the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems."

AB 32 establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020 (a reduction of approximately 25 percent from forecast emission levels), with further reductions to follow. The law requires the state Air Resources Board to do the following:

- Establish a program to track and report greenhouse gas emissions.
- Approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions from sources of greenhouse gas emissions.
- Adopt early reduction measures to begin moving forward.
- Adopt, implement and enforce regulations—including market mechanisms such as "cap and-trade" programs—to ensure that the required reductions occur.

The Air Resources Board has adopted a statewide greenhouse gas emissions limit and an emissions inventory, along with requirements to measure, track, and report greenhouse gas emissions by the industries it determined to be significant sources of greenhouse gas emissions.

AB 38: Fire safety: Low-Cost Retrofits: Regional Capacity Review: Wildfire Mitigation

Requires the seller of any real property located in a high or very fire hazard severity zone to provide a disclosure notice, as specified, to the buyer with information relating to fire hardening improvements on the property.

Requires the California Natural Resources Agency, in consultation with the State Fire Marshal and the Forest Management Task Force, to review the regional capacity of each county that contains a very high fire hazard severity zone to improve forest health, fire resilience, and safety.

Requires the California Office of Emergency Services to enter into a joint powers agreement with the Department of Forestry and Fire Protection to administer a comprehensive wildfire mitigation and assistance program to encourage cost-effective structure hardening and facilitate vegetation management, contingent upon appropriation by the Legislature.

AB 70: Flood Liability

This bill provides that a city or county may be required to contribute a fair and reasonable share to compensate for property damage caused by a flood to the extent that it has increased the state's exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project, unless the city or county meets specified requirements.

AB 162: Flood Planning

This California State Assembly Bill passed in 2007 requires cities and counties to address flood-related matters in the land use, conservation, and safety and housing elements of their general plans. The land use element must identify and annually review the areas covered by the general plan that are subject to flooding as identified in floodplain mapping by either FEMA or the state Department of Water Resources (DWR). During the next revision of the housing element on or after January 1, 2009, the conservation element of the general plan must identify rivers, creeks, streams, flood corridors, riparian habitat, and land that may accommodate floodwater for the purpose of groundwater recharge and stormwater management. The safety element must identify information regarding flood hazards, including:

- Flood hazard zones
- Maps published by FEMA, DWR, the U.S. Army Corps of Engineers, the Central Valley Flood Protection Board, and the Governor's Office of Emergency Services (Cal OES)
- Historical data on flooding
- Existing and planned development in flood hazard zones.

The general plan must establish goals, policies and objectives related to flooding risks, including:

- Avoiding or minimizing the risks of flooding new development
- Evaluating whether new development should be located in flood hazard zones
- Identifying construction methods to minimize damage.

AB 162 establishes goals, policies and objectives related to flooding risks. It establishes procedures for the determination of available land suitable for urban development, which may exclude lands where FEMA or DWR has concluded that the flood management infrastructure is not adequate to avoid the risk of flooding.

AB 267: California Environmental Quality Act: Exemption: Prescribed Fire, Thinning, and Fuel Reduction Projects

Current law, until January 1, 2023, exempts from the requirements of CEQA prescribed fire, thinning, or fuel reduction projects undertaken on federal lands to reduce the risk of high-severity wildfire that have been reviewed under the federal National Environmental Policy Act of 1969. Current law requires the Department of Forestry and Fire Protection, beginning December 31, 2019, and annually thereafter until January 1, 2023, to report to the relevant policy committees of the Legislature the number of times the exemption was used. This extends the exemption from CEQA and the requirement on the department to report to the relevant policy committees of the Legislature to January 1, 2026.

AB 380: Forestry: Priority Fuel Reduction Projects

On March 22, 2019, the Governor issued a proclamation of a state of emergency directing the Department of Forestry and Fire Protection to implement fuel reduction projects for communities at greatest risk of wildfire to reduce the risk of catastrophic wildfire. The proclamation of a state of emergency exempts the identified fuel reduction projects from various legal requirements, including, among others, requirements regarding public contracting for those projects, requirements for environmental review under the California Environmental Quality Act for those projects, and licensure requirements for individuals conducting certain activities for those projects.

This bill requires the department, before December 31, 2022, and before December 31 of each year thereafter, to identify priority fuel reduction projects, as provided. The bill exempts the identified priority fuel reduction projects from legal requirements in a similar manner as provided in the proclamation of a state of emergency described above.

AB 431: Forestry: Timber Harvesting Plans: Defensible Space: Exemptions

The Z'berg-Nejedly Forest Practice Act of 1973 prohibits a person from conducting timber operations, as defined, unless a timber harvesting plan prepared by a registered professional forester has been submitted to, and approved by, the Department of Forestry and Fire Protection. The act authorizes the State Board of Forestry and Fire Protection to exempt from some or all of those provisions of the act a person engaging in specified forest management activities, as prescribed, including, only until January 1, 2022, the cutting or removal of trees on the person's property in compliance with specified defensible space requirements. This bill extends to January 1, 2026, the board's authorization to exempt a person engaging in the cutting or removal of trees on the person's property in compliance with the specified defensible space requirements.

AB 497: Forestry and Fire Protection: Local Assistance Grant Program: Fire Prevention Activities: Street and Road Vegetation Management

Under existing law, the Department of Forestry and Fire Protection is required to develop, implement, and administer forest improvement and fire prevention programs in the state. Existing law requires the department to establish a local assistance grant program for fire prevention activities in California. Existing law requires the department to prioritize, to the extent feasible, projects that are multiyear efforts and to prioritize grant applications from specified local agencies.

This bill appropriated $25,000,000 to provide the local assistance grants. It requires the department to prioritize projects that manage vegetation along streets and roads to prevent the ignition of wildfire and that require the funds for purposes of purchasing equipment necessary for the project.

AB 575: Civil Liability: Prescribed Burning Activities: Gross Negligence

This bill provides that a private entity engaging in a prescribed burning activity that is supervised by a person certified as burn boss is liable for damages to a third party only if the prescribed burning activity was carried out in a grossly negligent manner.

AB 642: Wildfires

This omnibus fire prevention bill makes changes to support cultural and prescribed fire, including the creation of a Cultural Burning Liaison at the Department of Forestry and Fire Protection, and requires a proposal for creating a prescribed fire training center in California. The Act requires the Director of Forestry and Fire Protection to identify areas in the state as moderate and high fire hazard severity zones and to classify areas into fire hazard severity zones based on additional factors including possible lightning caused ignition. The bill requires a local agency, within 30 days of receiving a transmittal from the director that identifies fire hazard severity zones, to make the information available for public comment.

AB 747: Required Information for General Plan Safety Elements

This bill requires California communities with general plans to address evacuation routes in the safety element of the general plan. Information on the evacuation routes and their capacity, safety and viability under a range of emergency scenarios must be provided. For communities that have not adopted a local hazard mitigation plan, the safety element must be updated with this information by January 1, 2022. For those with a local hazard mitigation plan, the requirement applies upon the next revision of the hazard mitigation plan on or after January 1, 2022. Communities that have adopted a local hazard mitigation plan, emergency operations plan, or other document that fulfills the goals and objectives of this law may comply with this requirement by summarizing and incorporating by reference the other plan or document in the safety element.

In subsequent revisions to the safety element, communities also will be required to identify new information relating to flood and fire hazards and climate adaptation and resiliency strategies applicable to the city or county that was not available during the previous revision of the safety element. These subsequent updates must occur upon each revision of the general plan housing element or local hazard mitigation plan and not less than once every eight years.

AB 800: Wildfires: Local General Plans: Safety Elements: Fire Hazard Severity Zones

Existing law requires the Director of Forestry and Fire Protection to identify areas of the state as very high fire hazard severity zones, and requires each planning agency to prepare, and the legislative body of each county and city to adopt, a comprehensive, long-term general plan, including a safety element, for the physical development of the county or city. Existing law requires each city or county that contains a very high fire hazard severity zone to submit the draft element of, or draft amendment to the safety element its general plan to the State Board of Forestry and Fire Protection and to every local agency that provides fire protection to territory in the city or county at least 90 days before adoption or amendment.

This requires the director to also identify areas of the state as moderate and high fire hazard severity zones. It requires the draft element of, or draft amendment to, the safety element of a county or city’s general plan to be submitted to the state board and to every local agency that provides fire protection to territory in the city or county at least 90 days before the adoption or amendment to the safety element of its general plan for each city or county that contains a moderate or high fire hazard severity zone.

Existing law requires the state board and authorizes a local agency to review the draft or an existing safety element and recommend changes to the planning agency regarding uses of land and policies in state responsibility areas and very high fire hazard severity zones and regarding methods and strategies for wildland fire risk reduction and prevention within state responsibility areas and very high fire hazard severity zones.

This bill also requires the state board and authorizes a local agency to review the draft or an existing safety element and recommend changes to the planning agency regarding uses of land and policies in moderate and high fire hazard severity zones and regarding methods and strategies for wildland fire risk reduction and prevention within moderate and high fire hazard severity zones.

The existing Subdivision Map Act vests the authority to regulate and control the design and improvement of subdivisions in the legislative body of a local agency, and sets forth procedures governing the local agency’s processing, approval, conditional approval, or disapproval, and filing of tentative, final, and parcel maps, and the modification thereof. The act generally requires a subdivider to file a tentative map or vesting tentative map with the local agency, and requires the local agency to approve, conditionally approve, or disapprove the map within a specified time period. Before approving a tentative map, or a parcel map for which a tentative map was not required, for an area located in a state responsibility area or a very high fire hazard severity zone, existing law requires a legislative body of a county to make specified findings. Existing law requires a legislative body of a county to transmit these findings to the State Board of Forestry and Fire Protection.

This requires a legislative body of a county to make specified findings before approving a tentative map, or a parcel map for which a tentative map was not required, for areas located in moderate and high fire hazard severity zones, and requires these findings to be transmitted to the state board.

By requiring new duties on a county, the bill imposes a state-mandated local program. The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement. This bill provides that, if the Commission on State Mandates determines that the bill contains costs mandated by the state, reimbursement for those costs shall be made pursuant to statutory provisions.

AB 1255: Fire Prevention: Fire Risk Reduction Guidance: Local Assistance Grants

This bill requires the Department of Forestry and Fire Protection, in coordination with the Secretary of the Natural Resources Agency, to facilitate regional, habitat-specific, and area-specific approaches to fire risk reduction, prevention, and restoration of projects that improve community safety, protect sites and structures, restore burned habitat, reduce catastrophic wildfires, and protect natural resources. It requires the department to develop policies, funding programs for which the funding shall be contingent upon subsequent appropriation in the annual Budget Act or a similar statute for this purpose, and relevant program guidelines that promote specified objectives. The bill requires various state entities to establish grant programs, for which funding shall be contingent upon subsequent appropriation, to fulfill the specified objectives.

AB 1295: Residential Development Agreements: Very High Fire Risk Areas

Current law requires the Director of Forestry and Fire Protection to identify areas in the state as very high fire hazard severity zones based on the severity of fire hazard that is expected to prevail in those areas and requires each local agency to designate, by ordinance, the very high fire hazard severity zones in its jurisdiction. Current law additionally requires the director to classify lands within state responsibility areas into fire hazard severity zones. This bill, prohibits the legislative body of a city or county from entering into a residential development agreement for property in a very high fire risk area. The bill defines “very high fire risk area” for these purposes to mean a very high fire hazard severity zone designated by a local agency or a fire hazard severity zone classified by the director.

AB 1439: Property Insurance Discounts

This bill requires a residential property insurance policy to include a discount if a local government of the jurisdiction where the insured property is located funds a local wildfire protection or mitigation program. Because the bill mandates discounts for specified residential property insurance policies, thus affecting the Insurance Commissioner’s consideration of a rate, the bill would amend Proposition 103.

AB 1500: Safe Drinking Water, Wildfire Prevention, Drought Preparation, Flood Protection, Extreme Heat Mitigation, and Workforce Development Bond Act of 2022

If approved by the voters, this bill would authorize the issuance of bonds in the amount of $6,700,000,000 pursuant to the State General Obligation Bond Law to finance projects for safe drinking water, wildfire prevention, drought preparation, flood protection, extreme heat mitigation, and workforce development programs.

AB 2140: General Plans—Safety Element

This bill provides that the state may allow for more than 75 percent of public assistance funding under the California Disaster Assistance Act only if the local agency is in a jurisdiction that has adopted a local hazard mitigation plan as part of the safety element of its general plan. The local hazard mitigation plan needs to include elements specified in this legislation. In addition, this bill requires Cal OES to give preference for federal mitigation funding to cities and counties that have adopted local hazard mitigation plans. The intent of the bill is to encourage cities and counties to create and adopt hazard mitigation plans.

AB 2800: Climate Change—Infrastructure Planning

This California State Assembly bill passed in 2016 and until July 1, 2020, requires state agencies to take into account the current and future impacts of climate change when planning, designing, building, operating, maintaining, and investing in state infrastructure. The bill, by July 1, 2017, and until July 1, 2020, requires an agency to establish a Climate-Safe Infrastructure Working Group to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Act’s main purpose is to prevent construction of buildings used for human occupancy on the surface trace of active faults. Before a new project is permitted, cities and counties require a geologic investigation to demonstrate that proposed buildings will not be constructed on active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as liquefaction or seismically induced landslides. The law requires the State of California Geologist to establish regulatory zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones. Projects include all land divisions and most structures for human occupancy. All seismic hazard mitigation actions identified in this plan will seek full compliance with the Alquist-Priolo Earthquake Fault Zoning Act.

Board of Forestry and Fire Protection Fire Safe Regulations

California’s Board of Forestry and Fire Protection is authorized to adopt regulations to implement specified programs. To become effective, the Office of Administrative Law must approve these regulations. Once adopted, Board regulations are placed in Title 14 of the California Code of Regulations. The Department of Forestry and Fire Protection then implements the regulations.

Since 1991, the Board's Fire Safe Regulations have set the floor for fire safety standards for perimeters and access to all residential, commercial, and industrial building construction in state responsibility areas. They address road standards for fire equipment access, standards for road and building signs, minimum private water supplies for emergency fire use, and fuel breaks and greenbelts. Starting on July 1, 2021, these requirements will also apply in the local responsibility areas and will address construction on ridgelines.

California Coastal Management Program

The California Coastal Management Program under the California Coastal Act requires each city or county lying wholly or partly within the coastal zone to prepare a local coastal plan. The specific contents of such plans are not specified by state law, but they must be certified by the Coastal Commission as consistent with policies of the Coastal Act (Public Resources Code, Division 20). The Coastal Act has provisions relating to geologic hazards, but does not mention tsunamis specifically. Section 30253(1) of the Coastal Act states that new development shall minimize risks to life and property in areas of high geologic, flood, and fire hazard. Development should be prevented or limited in high hazard areas whenever possible. However, where development cannot be prevented or limited, land use density, building value, and occupancy should be kept at a minimum. Any mitigation project identified in this plan that intersects the mapped coastal zone will be consistent with the recommendations of the local coastal plan.

California Department of Forestry and Fire Protection

CAL FIRE has responsibility for wildfires in areas that are not under the jurisdiction of the Forest Service or a local fire organization, including lands designated as State Responsibility Areas. CAL FIRE also has fire protection responsibilities by contract and mutual aid agreements. For example, CAL FIRE provides year-round fire protection under Amador Plan agreements with certain local government agencies (Public Resources Code §4144). Through these agreements, CAL FIRE provides local structural and wildfire protection or dispatch services to a community and maintains a staffing level that otherwise would be available only during the fire season. The local entity pays the additional cost of the service.

California Department of Parks and Recreation (State Parks)

State Parks manages portions of the California coastline including coastal wetlands, estuaries, beaches, and dune systems. The State Parks Resources Management Division has limited wildfire protection resources available to suppress fires on State Park lands.

California Department of Water Resources

In California, the DWR is the coordinating agency for floodplain management. The DWR works with FEMA and local governments by providing grants and technical assistance, evaluating community floodplain management programs, reviewing local floodplain ordinances, participating in statewide flood hazard mitigation planning, and facilitating annual statewide workshops. Compliance is monitored by FEMA regional staff and by the DWR.

California Division of Safety of Dams

California's Division of Safety of Dams (a division of the DWR) monitors the dam safety program at the state level and maintains a working list of dams in the state. When a new dam is proposed, Division engineers and geologists inspect the site and the subsurface. Upon submittal of an application, the Division reviews the plans and specifications prepared by the owner to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for the known geologic conditions. After approval of the application, the Division inspects all aspects of the construction to ensure that the work is done in accordance with the approved plans and specifications. After construction, the Division inspects each dam to ensure that it is performing as intended and is not developing problems. The Division periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California. Over 1,200 dams are inspected by Division engineers on a yearly schedule to ensure performance and maintenance of dams.

California Environmental Quality Act

The California Environmental Quality Act (CEQA) was passed in 1970, shortly after the federal government enacted the National Environmental Policy Act, to institute a statewide policy of environmental protection. CEQA requires state and local agencies in California to follow a protocol of analysis and public disclosure of the potential environmental impacts of development projects. CEQA makes environmental protection a mandatory part of every California state and local agency's decision-making process.

CEQA establishes a statewide environmental policy and mandates actions all state and local agencies must take to advance the policy. Jurisdictions conduct analysis of the project to determine if there are potentially significant environmental impacts, identify mitigation measures, and possible project alternatives by preparing environmental reports for projects that requires CEQA review. This environmental review is required before an agency takes action on any policy, program, or project. Any project action identified in this plan will seek full CEQA compliance upon implementation.

California Fire Alliance

The California Fire Alliance (CFA) was established in response to directives from the 2001 National Fire Plan. The CFA pursues four strategies to deal with the National Fire Plan's community assistance initiative:

- Work with communities at risk from wildfires to develop community-based planning leadership and facilitate the development of community fire loss mitigation plans, which transcend jurisdiction and ownership boundaries.
- Assist communities in development of fire loss mitigation planning, education and projects to reduce the threat of wildfire losses on public and private lands.
- Develop an information and education outreach plan to increase awareness of wildfire protection program opportunities available to communities at risk.
- Work collaboratively to develop, modify and maintain a comprehensive list of communities at risk.

California Fire Plan

The State Board of Forestry and CAL FIRE have prepared a comprehensive update of the California Fire Plan for wildfire protection. The planning process included defining a level of service measurement; considering assets at risk; incorporating the cooperative interdependent relationships of wildfire protection providers; providing for public stakeholder involvement; and creating a fiscal framework for policy analysis. The California Fire Plan's overall goal is to reduce costs and losses from wildfire in the state by protecting assets at risk through pre-fire management and by reducing the spread of fire through more successful initial response.

California Fire Safe Council

In 1993, the statewide Fire Safe Council, consisting of private and public membership, was formed to educate and encourage Californians to plan and prepare for wildfires by reducing the risk of fire to property, communities, and natural/structural resources. In 2002, this group created a nonprofit organization and board of directors, called the California Fire Safe Council. The Council works with the California Fire Alliance to facilitate the distribution of National Fire Plan grants for wildfire risk reduction and education (www.grants.firesafecouncil.org). The Council also provides assistance to local Fire Safe Councils through its website (www.firesafecouncil.org), the distribution of educational materials, and technical assistance, primarily through regional representatives. More than 130 local Fire Safe Councils have formed in California to plan, coordinate, and implement fire prevention activities.

California Fire Service and Rescue Emergency Mutual Aid Plan

The Governor's Office of Emergency Services Fire and Rescue Branch administers the California Fire Service and Rescue Emergency Mutual Aid Plan. The agency provides guidance and procedures for agencies developing emergency operations plans, as well as training and technical support, primarily to overall emergency service organizations and urban search and rescue teams.

California General Planning Law

California state law requires that every county and city prepare and adopt a comprehensive long-range plan to serve as a guide for community development. The general plan expresses the community's goals, visions, and policies relative to future land uses, both public and private. The general plan is mandated and prescribed by state law (Cal. Gov. Code §65300 et seq.), and forms the basis for most local government land use decision-making.

The plan must consist of an integrated, internally consistent set of goals, policies, and implementation measures. In addition, the plan must focus on issues of the greatest concern to the community and be written in a clear and concise manner. City and county actions, such as those relating to land use allocations, annexations, zoning, subdivision and design review, redevelopment, and capital improvements, must be consistent with the plan.

California Multi-Hazard Mitigation Plan

Under the DMA, California must adopt a federally approved state multi-hazard mitigation plan to be eligible for certain disaster assistance and mitigation funding. The intent of the State of California Multi-Hazard Mitigation Plan is to reduce or prevent injury and damage from hazards in the state through the following:

- Documenting statewide hazard mitigation planning in California
- Describing strategies and priorities for future mitigation activities
- Facilitating the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meeting state and federal statutory and regulatory requirements.

The plan is an annex to the State Emergency Plan, and it identifies past and present mitigation activities, current policies and programs, and mitigation strategies for the future. It also establishes hazard mitigation goals and objectives. The plan will be reviewed and updated annually to reflect changing conditions and new information, especially information on local planning activities. Under 44 CFR Section 201.6, local hazard mitigation plans must be consistent with their state's hazard mitigation plan.

California Residential Mitigation Program

The California Residential Mitigation Program was established in 2011 to help Californians strengthen their homes against damage from earthquakes. The program is a joint powers authority created by Cal OES and the California Earthquake Authority, which is a not-for-profit, publicly managed, privately funded provider of home earthquake insurance to California homeowners and renters.

Earthquake Brace + Bolt was developed to help homeowners lessen the potential for damage to their houses during an earthquake. A residential seismic retrofit strengthens an existing older house, making it more resistant to earthquake activity such as ground shaking and soil failure. The seismic retrofitting involves bolting the house to its foundation and adding bracing around the perimeter of the crawl space. Most homeowners hire a contractor to do the retrofit work, and owners of houses in ZIP Codes with house characteristics suitable for this type of retrofit are eligible for up to $3,000 toward the cost. A typical retrofit by a contractor may cost between $3,000 and $7,000, depending on the location and size of the house, contractor fees, and the amount of materials and work involved. If the homeowner is an experienced do-it-yourselfer, a retrofit can cost less than $3,000.

California State Building Code

California Code of Regulations Title 24 (CCR Title 24), also known as the California Building Standards Code, is a compilation of building standards from three sources:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions
- Building standards authorized by the California legislature that constitute extensive additions not covered by the model codes adopted to address particular California concerns.

The state Building Standards Commission is authorized by California Building Standards Law (Health and Safety Code Sections 18901 through 18949.6) to administer the processes related to the adoption, approval, publication, and implementation of California's building codes. These building codes serve as the basis for the design and construction of buildings in California. The national model code standards adopted into Title 24 apply to all occupancies in California, except for modifications adopted by state agencies and local governing bodies. Since 1989, the Building Standards Commission has published new editions of Title 24 every three years.

On January 1, 2014, California Building Code Accessibility Standards found in Chapter 11B incorporated the 2010 Americans with Disabilities Act (ADA) Standards as the model accessibility code for California. The purpose was to ensure consistency with federal guidelines. As a result of this incorporation, the California standards will fully implement and include 2010 ADA Standards within the California Building Code while maintaining enhanced levels of accessibility already provided by existing California accessibility regulations. All planning partners that have building code and permit authority have adopted building codes that are in full compliance with the California State Building Code.

Disadvantaged and Low-income Communities Investments

Senate Bill (SB) 535 directs state and local agencies to make investments that benefit California's disadvantaged communities. It also directs the California Environmental Protection Agency to identify disadvantaged communities for the purposes of these investments based on geographic, socio-economic, public health, and environmental hazard criteria. Assembly Bill (AB) 1550 increased the percent of funds for projects located in disadvantaged communities from 10 to 25 percent and added a focus on investments in low-income communities and households. This program is a potential alternative source of funding for actions identified in this plan.

Division of the State Architect's AB 300 List of Seismically At-Risk Schools

In 2002, California's Division of the State Architect completed an inventory of public school buildings built before 1978 that identifies buildings with characteristics that might make them unsafe in future earthquakes. This inventory provides a list of potentially at-risk schools known as the AB 300 list (the inventory was authorized by Assembly Bill 300 in 1999). Using available information on school buildings' dates of construction, seismic retrofits, and structural systems (wood-frame, concrete shear wall, or steel moment frame, etc.), the inventory categorized California public school buildings into one of two categories: those expected to perform well in future earthquakes; and those that are not expected to perform well and require more detailed seismic evaluation.

The Division of the State Architect recommends that public schools on this list undergo detailed seismic evaluations to determine if they pose life safety risks, but the state has neither required nor funded school districts to do this.

Governor's Executive Order S-13-08

Governor's Executive Order S-13-08 enhances the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events. There are four key actions in the executive order:

- Initiate California's first statewide climate change adaptation strategy to assess expected climate change impacts, identify where California is most vulnerable, and recommend adaptation policies. This effort will improve coordination within state government so that better planning can more effectively address climate impacts on human health, the environment, the state's water supply and the economy.
- Request that the National Academy of Science establish an expert panel to report on sea level rise impacts in California, to inform state planning and development efforts.
- Issue interim guidance to state agencies for how to plan for sea level rise in designated coastal and floodplain areas for new projects.
- Initiate a report on critical infrastructure projects vulnerable to sea level rise.

Office of the State Fire Marshal

The Office of the State Fire Marshal is a division of CAL FIRE that has a wide variety of fire safety and training responsibilities and provides technical support to fire agencies/organizations.

Senate Bill 12: Local government: planning and zoning: wildfires.

This bill imposes new planning requirements on local governments, as follows:

- Defines "very high fire risk areas" to be the VHFHSZ in both the SRA and the Local Responsibility Area.

- Requires each city or county, upon the next revision of the housing element or local hazard mitigation plan on or after July 1, 2024, whichever occurs first, to review and update its safety element to include a comprehensive retrofit strategy that includes specified contents.
- Requires a city or county with VHFHSZ within its jurisdiction to amend the land use element of its general plan upon the next revision of the housing element on or after July 1, 2024. This amendment of the land use element must include the locations of all VHFHSZ within the city or county, the data and analysis described in the Office of Planning and Research's publication *Fire Hazard Planning–General Plan Technical Advice Series*, and other specified goals, objectives, and implementation measures.
- Requires, after the initial amendment to the land use element, that a city or county review upon each revision of the housing element the implementation of the wildfire risk reduction standards within the jurisdiction and the designation of VHFHSZ.
- Provides for review and comment on draft findings by the Board and local fire agencies on whether the city or county has implemented the standards or made adequate progress, as defined.
- Requires, on or before January 1, 2023, to develop and post on its web site a clearinghouse of local ordinances, policies, and best practices relating to land use planning in VHFHSZ, wildfire risk reduction, and wildfire preparedness. The Office of Planning and Research must also regularly update the clearinghouse.

Senate Bill 92: Dam Emergency Action Plans; Public Resources Portion of Biennial Budget Bill

The State of California updated its requirements regarding emergency action plans (EAPs) via Senate Bill 92, which became effective in June 2017 as part of the state Legislature's biennial budget process. The bill required dam owners to submit EAPs to Cal OES and the Department of Water Resources for approval by January 1, 2018 (for extremely high hazard dams), January 1, 2019 (for high-hazard dams), and January 1, 2021 (for significant hazard dams). The EAPs were to include the following:

- Emergency notification flow charts
- Information on a four-step response process
- Description of agencies' roles and actions in response to an emergency incident
- Description of actions to be taken in advance of an emergency
- Inundation maps
- Additional information such as revision records and distribution lists.

After the EAPs are approved by the state, the law requires dam owners to send the approved EAPs to relevant stakeholders. Local public agencies can then adopt emergency procedures that incorporate the information in the EAP in a manner that conforms to local needs and includes methods and procedures for alerting and warning the public and other response and preparedness related items.

SB 92 also requires dams other than low-risk dams to have current inundation mapping, which must be updated every 10 years, or sooner if specific circumstances change. EAPs also must be updated every 10 years. It provides DWR with enforcement tools, including fines and operational restrictions for failure to comply. Cal OES is required by the law to work with state and federal agencies, dam owners, planners, and the public to make dam inundation maps available to citizens interested in learning their dam failure inundation risk.

Senate Bill 97: Guidelines for Greenhouse Gas Emissions

Senate Bill 97, enacted in 2007, amends CEQA to clearly establish that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for CEQA analysis. It directs the Governor's Office of Planning and Research to develop draft CEQA guidelines for the mitigation of greenhouse gas emissions or their effects by July 1, 2009 and directs the California Natural Resources Agency to certify and adopt the CEQA Guidelines by January 1, 2010.

Senate Bill 99: Evacuation Route Planning

Senate Bill 99, enacted in 2019, requires that cities' and counties' general plans address evacuation routes from any hazard area identified in the safety element. Under this law, the safety element must include information to identify residential developments in hazard areas that do not have at least two emergency evacuation routes. Each city or county must update its safety element with the new information upon the next revision of its housing element on or after January 1, 2020.

Senate Bill 182 Local Government: Planning and Zoning: Wildfires

California Senate Bill 182 made a number of changes to state law regarding planning for and permitting development in areas designated as very high fire risk areas. The bill requires a local jurisdiction to do the following:

- Include a comprehensive retrofit strategy in its safety element to reduce the risk of property loss and damage during wildfires.
- Amend its land use element to identify all very high fire risk areas and to establish measures to protect lives and property from unreasonable risk of wildfire.
- Adopt a very high fire risk overlay zone for its zoning ordinance.
- Allocate a lower portion of projected future housing to very high fire hazard severity zones

This bill prohibits local governments from entering into a development agreement for property in a very high fire risk area, approving a permit for a project in a very high fire risk area, or approving a tentative map for a subdivision in a very high fire risk area, unless the jurisdiction makes specified findings based on substantial evidence.

Senate Bill 379: General Plans: Safety Element—Climate Adaptation

Senate Bill 379 builds upon the flood planning inclusions into the safety and housing elements and the hazard mitigation planning safety element inclusions in general plans outlined in AB 162 and AB 2140, respectively. SB 379 focuses on a new requirement that cities and counties include climate adaptation and resiliency strategies in the safety element of their general plans beginning January 1, 2017. In addition, this bill requires general plans to include a set of goals, policies and objectives, and specified implementation measures based on the conclusions drawn from climate adaptation research and recommendations.

Senate Bill 1000: General Plan Amendments—Safety and Environmental Justice Elements

In 2016, Senate Bill 1000 amended California's Planning and Zoning Law in two ways:

- The original law established requirements for initial revisions of general plan safety elements to address flooding, fire, and climate adaptation and resilience. It also required subsequent review and revision as necessary based on new information. Senate Bill 1000 specifies that the subsequent reviews and revision based on new information are required to address only flooding and fires (not climate adaptation and resilience).
- Senate Bill 1000 adds a requirement that, upon adoption or revision of any two other general plan elements on or after January 1, 2018, an environmental justice element be adopted for the general plan or environmental justice goals, policies and objectives be incorporated into other elements of the plan.

Senate Bill 1241: General Plans: Safety Element—Fire Hazard Impacts

In 2012, Senate Bill 1241 passed requiring that the safety elements of all future general plans address fire risk in state responsibility areas and very high fire hazard severity zones. The bill requires cities and counties to make findings regarding available fire protection and suppression services before approving a tentative map or parcel map.

Standardized Emergency Management System

CCR Title 19 establishes the Standardized Emergency Management System (SEMS) to standardize the response to emergencies involving multiple jurisdictions. SEMS is intended to be flexible and adaptable to the needs of all emergency responders in California. It requires emergency response agencies to use basic principles and components of emergency management. Local governments must use SEMS by December 1, 1996, to be eligible for state funding of response-related personnel costs under CCR Title 19 (Sections 2920, 2925 and 2930). The roles and responsibilities of Individual agencies contained in existing laws or the state emergency plan are not superseded by these regulations. This hazard mitigation plan is considered to be a support document for all phases of emergency management, including those associated with SEMS.

Western Governors Association Ten-Year Comprehensive Strategy

The *Western Governors Association Ten-Year Comprehensive Strategy: A Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment* (August 2001) is strategy implementation plan prepared by federal and Western state agencies that outlines measures to restore fire-adapted ecosystems and reduce hazardous fuels.

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix C. Mapping Methods and Data Sources

C. MAPPING METHODS AND DATA SOURCES

DAM FAILURE INUNDATION MAPPING

Dam breach inundation maps, including inundation boundaries and depth grids, were downloaded from the California Department of Water Resources' (DWR) website - https://fmds.water.ca.gov/maps/damim/. As required by California Water Code section 6161, the Division of Safety of Dams (DSOD) at DWR reviews and approves inundation maps prepared by licensed civil engineers and submitted by dam owners for extremely high, high, and significant hazard dams and their critical appurtenant structures. Inundation maps are based on a hypothetical failure of a dam or critical appurtenant structure and the information depicted on the maps is approximate. The dams and failure scenarios are as follows:

- Annadel No. 1 (National Dam ID CA00056) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 11/15/2018.
- Cook No. 2 (NID CA01056) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 7/30/2020.
- Delta Pond (NID CA01272) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 3/13/2019.
- Dutcher Creek (NID CA01362) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 7/14/2020.
- Fern Lake (NID CA00007) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 3/7/2019.
- Foothill Regulating Park (NID CA01057) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 2/4/2019.
- Foss Creek North Area (NID CA01431) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 3/19/2020.
- Lagunita (NID CA00992) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 3/6/2019.
- Lake Helen (NID CA01060) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 10/1/2020.
- Lytton (NID CA01042) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 3/22/2019.
- Lytton (NID CA01042) - Scenario shows an inundation extent for a sunny day failure of Northern (Auxiliary) Dam. File downloaded from DSOD website generated on 3/22/2019.

- Mallacomes (NID CA00591) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 1/11/2019.
- Matanzas Creek (NID CA00794) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 8/19/2020.
- Merlo (NID CA01313) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 12/5/2019.
- Middle Fork Brush Creek (NID CA00793) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 12/24/2020.
- Piner Creek (NID CA00792) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 12/24/2020.
- Piner Creek (NID CA00792) - Scenario shows an inundation extent for a sunny day failure of Saddle Dam 1. File downloaded from DSOD website generated on 12/24/2020.
- Santa Rosa Creek Reservoir (NID CA00795) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 8/18/2020.
- Suttenfield (NID CA00010) - Scenario shows an inundation extent for a sunny day failure of Main Dam. File downloaded from DSOD website generated on 4/29/2019.
- Suttenfield (NID CA00010) - Scenario shows an inundation extent for a sunny day failure of Saddle Dam 1. File downloaded from DSOD website generated on 4/29/2019.

Additional dam inundation areas data for Azalea, Fountaingrove, Lake Ralphine, and Warm Springs Dam was provided by Sonoma County. This data was originally used in the County's 2011 Hazard Mitigation Plan.

EARTHQUAKE MAPPING

Liquefaction Susceptibility

The Liquefaction dataset provided by the County presents a map and database of Quaternary deposits and liquefaction susceptibility areas the urban core of the San Francisco Bay region within the County of Sonoma. It supersedes the equivalent area of U.S. Geological Survey Open-File Report 00-444 (Knudsen and others, 2000), which covers the larger 9-county San Francisco Bay region. The report consists of (1) a spatial database, (2) two small-scale colored maps (Quaternary deposits and liquefaction susceptibility), (3) a text describing the Quaternary map and liquefaction interpretation (part 3), and (4) a text introducing the report and describing the database (part 1).

The nine counties surrounding San Francisco Bay straddle the San Andreas fault system, which exposes the region to serious earthquake hazard (Working Group on California Earthquake Probabilities, 1999). Much of the land adjacent to the Bay and the major rivers and streams is underlain by unconsolidated deposits that are particularly vulnerable to earthquake shaking and liquefaction of water-saturated granular sediment. This new map provides a consistent detailed treatment of the central part of the 9-county region in which much of the mapping of Open-File Report 00-444 was either at smaller (less detailed) scale or represented only preliminary revision of earlier work.

Like Open-File Report 00-444, the current mapping uses geomorphic expression, pedogenic soils, inferred depositional environments, and geologic age to define and distinguish the map units. Further scrutiny of the factors controlling liquefaction susceptibility has led to some changes relative to Open-File Report 00-444: particularly the reclassification of San Francisco Bay mud (Qhbm) to have only MODERATE susceptibility and the rating of artificial fills according to the Quaternary map units inferred to underlie them.

The report is the product of cooperative work by the National Earthquake Hazards Reduction Program (NEHRP) and National Cooperative Geologic Mapping Program of the U.S. Geological Survey, William Lettis and & Associates, Inc. (WLA), and the California Geological Survey. An earlier version was submitted to the U.S. Geological Survey by WLA as a final report for a NEHRP grant (Witter and others, 2005). The mapping has been carried out by WLA geologists under contract to the NEHRP Earthquake Program (Grant 99-HQ-GR-0095) and by the California Geological Survey. For detailed information about the map the USGS has an open report, "Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California. U.S. Geological Survey Open File Report 2006-1037 Version 1.1. http://pubs.usgs.gov/of/2006/1037/

National Earthquake Hazard Reduction Program (NEHRP) Soils

NEHRP soils information is derived from a shear wave velocity (Vs30) data produced by the California Geological Survey in 2015. The Vs30 data represents simplified geologic units that have been correlated to the time-averaged shear-wave velocity in the upper 30 meters of the earth's surface. The geologic units were compiled from published maps that range in scale from 1:250,000 to 1:24,000. (Wills, et. al., 2015)

Probabilistic Peak Ground Acceleration Maps

Probabilistic peak ground acceleration data, by Census tract, are generated by Hazus 4.2 SP03. In Hazus' probabilistic analysis procedure, the ground shaking demand is characterized by spectral contour maps developed by the U.S. Geological Survey (USGS) as part of a 2018 update of the National Seismic Hazard Maps. USGS probabilistic seismic hazard maps are revised about every six years to reflect newly published or thoroughly reviewed earthquake science and to keep pace with regular updates of the building code. Hazus includes maps for eight probabilistic hazard levels: ranging from ground shaking with a 39 percent probability of being exceeded in 50 years (100-year return period) to the ground shaking with a 2 percent probability of being exceeded in 50 years (2,500-year return period).

Shake Maps

A shake map is designed as a rapid response tool to portray the extent and variation of ground shaking throughout the affected region immediately following significant earthquakes. Ground motion and intensity maps are derived from peak ground motion amplitudes recorded on seismic sensors (accelerometers), with interpolation based on estimated amplitudes where data are lacking, and site amplification corrections. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. For this plan, shake maps were prepared by the USGS for four earthquake scenarios:

- An earthquake on the Hayward fault with the following characteristics:
  - Magnitude: 7.57
  - Epicenter: N 38.08 W 122.41
  - Depth: 7.1 km
- An earthquake on the Maacama fault with the following characteristics:
  - Magnitude: 7.55

  - Epicenter: N 39.18 W 123.14
  - Depth: 7.2 km
- An earthquake on the Rodgers Creek-Healdsburg fault with the following characteristics:
  - Magnitude: 7.19
  - Epicenter: N 38.48 W 122.69
  - Depth: 8.4 km
- An earthquake on the San Andreas fault with the following characteristics:
  - Magnitude: 8.04
  - Epicenter: N 38.4 W 123.11
  - Depth: 6.6 km

FLOOD MAPPING

Flood hazard areas are a combination of areas from the countywide effective FEMA Digital Flood Insurance Rate Map (DFIRM), the Preliminary FIRM (PFIRM), and the County's Russian River Flood Modeling. The DFIRM is dated March 7,2017 with latest incorporated LOMR effective June 19, 2020. The PFIRM is dated May 15, 2020.

The Russian River Flood Modeling data, produced by Sonoma County and QSI, includes polygon features and water depth rasters for each flood stage. The following metadata was provided by the County:

- The polygon features within this dataset represent the extent of modeled water surfaces within the Russian River Modeling and Buildings study area. The water surface extents were estimated using HEC RAS 5.0.1 hydrologic modeling software. The projection is CASP 2 with horizontal datum NAD83(2011), vertical datum NAVD88 (Geoid 12A), and the units are US Survey Feet.
- The water depth digital elevation model (DEM) represents the difference between water surface elevation models and bare earth (all vegetation and man-made structures removed) digital elevation models. The water surface elevations were estimated using HEC RAS 5.0.1 hydrologic modeling software. Each pixel is three feet by three feet and represents an average height above ground for that area. QSI collected the LiDAR and created this data set for the Russian River Modeling and Buildings study area. The projection is CASP 2 with horizontal datum NAD83(2011), vertical datum NAVD88 (Geoid 12A), and the units are US Survey Feet. See Process Steps for derivation of raster datasets.

LANDSLIDE MAPPING

Susceptibility to Deep-Seated Landslides data provided by the California Geological Survey. The map, and associated data, show the relative likelihood of deep-seated landsliding based on regional estimates of rock strength and steepness of slopes. On the most basic level, weak rocks and steep slopes are most likely to generate landslides. The map uses detailed information on the location of past landslides, the location and relative strength of rock units, and steepness of slope to estimate susceptibility to deep-seated landsliding (0 to X, low to high). The USGS 2009 National Elevation Dataset (NED) with 10-m grid size was used as the base map. This landslide susceptibility map is intended to provide infrastructure owners, emergency planners and the public with a general overview of where landslides are more likely to occur. (Wills, et. al., 2011)

SEA LEVEL RISE MAPPING

Projected sea level rise data are from the USGS Coastal Storm Modeling System (CoSMoS), accessed via the Our Coast Our Future web platform (Point Blue Conservation Science and USGS). The data for Sonoma County is a seamless mashup of v2.1 (inner bay), and v2.0 and v2.2 for different stretches of the outer coast. The projections were generated using the latest downscaled climate projections and calibrated hydrodynamic models by the CoSMoS project team led by Patrick Barnard, at the USGS Pacific Coastal and Marine Science Center.

TSUNAMI MAPPING

Initial tsunami modeling was performed by the University of Southern California Tsunami Research Center funded through the California Emergency Management Agency by the National Tsunami Hazard Mitigation Program. The tsunami modeling process utilized the MOST (Method of Splitting Tsunamis) computational program (Version 0), which allows for wave evolution over a variable bathymetry and topography used for the inundation mapping (Titov and Gonzalez, 1997; Titov and Synolakis, 1998). The bathymetric/topographic data that were used in the tsunami models consist of a series of nested grids. Near-shore grids with a 3 arc-second (75- to 90-meters) resolution or higher, were adjusted to “Mean High Water” sea-level conditions, representing a conservative sea level for the intended use of the tsunami modeling and mapping. A suite of tsunami source events was selected for modeling, representing realistic local and distant earthquakes and hypothetical extreme undersea, near-shore landslides.

Local tsunami sources that were considered include offshore reverse-thrust faults, restraining bends on strike-slip fault zones and large submarine landslides capable of significant seafloor displacement and tsunami generation. Distant tsunami sources that were considered include great subduction zone events that are known to have occurred historically (1960 Chile and 1964 Alaska earthquakes) and others which can occur around the Pacific Ocean “Ring of Fire.” In order to enhance the result from the 75- to 90-meter inundation grid data, a method was developed utilizing higher-resolution digital topographic data (3- to 10-meters resolution) that better defines the location of the maximum inundation line (U.S. Geological Survey, 1993; Intermap, 2003; NOAA, 2004). The location of the enhanced inundation line was determined by using digital imagery and terrain data on a GIS platform with consideration given to historic inundation information (Lander, et al., 1993). This information was verified, where possible, by field work coordinated with local county personnel.

The accuracy of the inundation line shown on these maps is subject to limitations in the accuracy and completeness of available terrain and tsunami source information, and the current understanding of tsunami generation and propagation phenomena as expressed in the models. Thus, although an attempt has been made to identify a credible upper bound to inundation at any location along the coastline, it remains possible that actual inundation could be greater in a major tsunami event. This map does not represent inundation from a single scenario event. It was created by combining inundation results for an ensemble of source events affecting a given region. For this reason, all of the inundation region in a particular area will not likely be inundated during a single tsunami event. (State of California, 2009)

WILDFIRE MAPPING

Sonoma County Wildfire Hazard Index data developed by Sonoma County PRMD, Sonoma County, FireSAFE Sonoma, Tukman Geospatial, Digital Mapping Solutions, and Wildland Resource Management. The Sonoma County Wildfire Hazard Index is a model that predicts relative wildfire hazard on the landscape. Higher index values represent a higher relative hazard. The index is based on inputs that inform potential fire behavior, inputs that represent fire probability occurrence in any 1 pixel, and a model of wildfire suppression difficulty. For a full description of input and methods, go to the story map: https://storymaps.arcgis.com/stories/a64d596a8be941c8b28263718880e433. The hazard index reflects landscape conditions through the 2018 fire season.

REFERENCES

Barnard, P.L., Erikson, L.H., Foxgrover, A.C., Finzi Hart, J.A., Limber, P., O'Neill, A.C., van Ormondt, M., Vitousek, S., Wood, N., Hayden, M.K., and Jones, J.M., 2019. Dynamic flood modeling essential to assess the coastal impacts of climate change. Scientific Reports, Volume 9, Article #4309, 13 pp., http://dx.doi.org/10.1038/s41598-019-40742-z.

Intermap Technologies, Inc., 2003, Intermap product handbook and quick start guide: Intermap NEXTmap document on 5-meter resolution data, 112 p.

Lander, J.F., Lockridge, P.A., and Kozuch, M.J., 1993, Tsunamis Affecting the West Coast of the United States 1806-1992: National Geophysical Data Center Key to Geophysical Record Documentation No. 29, NOAA, NESDIS, NGDC, 242 p.

State of California. 2009. Tsunami Inundation Map for Emergency Planning; produced by California Emergency Management Agency, California Geological Survey, and University of Southern California – Tsunami Research Center; dated December 9, 2009.

Titov, V.V., and Gonzalez, F.I., 1997, Implementation and Testing of the Method of Tsunami Splitting (MOST): NOAA Technical Memorandum ERL PMEL –112, 11 p.

Titov, V.V., and Synolakis, C.E., 1998, Numerical modeling of tidal wave runup: Journal of Waterways, Port, Coastal and Ocean Engineering, ASCE, 124 (4), pp 157-171.

USGS. 2006. Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California. Open-File Report 2006-1037. Version 1.1. U.S. Geological Survey in cooperation with the California Geological Survey.

U.S. Geological Survey, 1993, Digital Elevation Models: National Mapping Program, Technical Instructions, Data Users Guide 5, 48 p.

Wills, C.J., Gutierrez, C.I., Perez, F.G., and Branum, D.B., 2015, A next-generation Vs30 map for California based on geology and topography: Bulletin of the Seismological Society of America.

Wills C.J., Perez, F., Gutierrez, C. 2011. Susceptibility to deep-seated landslides in California: California Geological Survey Map Sheet 58.

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix D. Risk Assessment Results

EXPOSURE AND VULNERABILITY RESULTS BY JURISDICTION

Jurisdiction (7)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Es		
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	0	0	0.0%
Cotati	7,533	2,682	2,450	$2,163,132,258	26	3	0.0%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	4,035	10,607	87.7%
Petaluma	61,873	19,609	18,275	$18,679,915,783	0	0	0.0%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	118	95	0.2%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	10,157	30,660	17.7%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	324	445	5.7%
Sonoma	11,050	4,605	4,109	$3,658,235,342	0	0	0.0%
Windsor	28,248	8,444	8,017	$6,407,101,168	4,791	15,958	56.5%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	147	392	1.1%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	426	846	4.3%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	27	58	0.8%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	2,057	3,939	16.1%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	5,956	9,949	22.9%
Total	**485,459**	**173,484**	**151,196**	**$218,574,570,981**	**28,064**	**72,953**	**15.0%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020. Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.

(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, and adjusted to reflect the estimated population.

(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

(7) Supervisorial Districts exclude the incorporated areas.

Dam Failure Combined

Jurisdiction (7)	timated Building Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Cloverdale	$0	$0	$0	0.0%
Cotati	$67,316,628	$75,119,715	$142,436,343	6.6%
Healdsburg	$2,384,958,969	$1,950,444,290	$4,335,403,259	90.3%
Petaluma	$0	$0	$0	0.0%
Rohnert Park	$566,943,053	$482,141,386	$1,049,084,440	10.8%
Santa Rosa	$6,608,317,015	$5,508,762,434	$12,117,079,448	27.5%
Sebastopol	$391,640,260	$374,628,175	$766,268,434	28.6%
Sonoma	$0	$0	$0	0.0%
Windsor	$1,764,292,857	$1,088,437,382	$2,852,730,239	44.5%
1st Supervisorial District	$105,242,814	$109,419,221	$214,662,035	0.9%
2nd Supervisorial District	$854,366,563	$809,580,795	$1,663,947,359	10.1%
3rd Supervisorial District	$63,394,977	$60,627,642	$124,022,619	6.1%
4th Supervisorial District	$2,880,316,002	$2,784,308,444	$5,664,624,445	19.1%
5th Supervisorial District	$4,436,214,711	$3,874,980,907	$8,311,195,618	16.4%
Total	**$20,123,003,848**	**$17,118,450,390**	**$37,241,454,238**	**17.0%**

Jurisdiction (7)	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Cloverdale	0	0	0	0	$0	$0	$0	0.0%
Cotati	80	1	0	8	$729,043	$3,082,717	$3,811,760	0.2%
Healdsburg	730,525	9,668	741	3,997	$1,769,745,504	$1,612,943,535	$3,382,689,039	70.4%
Petaluma	0	0	0	0	$0	$0	$0	0.0%
Rohnert Park	27,620	81	8	63	$31,870,674	$44,588,987	$76,459,662	0.8%
Santa Rosa	284,716	14,149	1,049	9,452	$638,136,928	$1,011,352,894	$1,649,489,822	3.7%
Sebastopol	120,496	189	8	320	$198,847,307	$285,004,542	$483,851,850	18.1%
Sonoma	0	0	0	0	$0	$0	$0	0.0%
Windsor	101,363	12,679	869	3,828	$402,022,974	$364,962,991	$766,985,965	12.0%
1st Supervisorial District	4,597	55	2	147	$9,396,528	$18,089,301	$27,485,829	0.1%
2nd Supervisorial District	118,237	381	17	337	$98,517,852	$311,915,643	$410,433,494	2.5%
3rd Supervisorial District	115	7	0	19	$1,204,506	$5,172,321	$6,376,826	0.3%
4th Supervisorial District	580,308	1,897	90	1,937	$2,079,433,982	$1,966,748,294	$4,046,182,276	13.6%
5th Supervisorial District	755,141	5,253	373	5,294	$2,316,307,472	$2,299,577,011	$4,615,884,483	9.1%
Total	**2,723,197**	**44,359**	**3,157**	**25,402**	**$7,546,212,770**	**$7,923,438,235**	**$15,469,651,005**	**7.1%**

Jurisdiction (7)	Acres of Inundation Area	Number of Structures in Inundation Area (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	0	0	0	0	0	0	0	0	0
Cotati	93	1	14	6	0	0	5	0	26
Healdsburg	4,041	3,551	341	45	37	15	30	16	4035
Petaluma	0	0	0	0	0	0	0	0	0
Rohnert Park	720	25	69	11	6	0	6	1	118
Santa Rosa	9,343	8,895	969	47	25	21	156	44	10157
Sebastopol	600	143	166	6	0	0	7	2	324
Sonoma	0	0	0	0	0	0	0	0	0
Windsor	5,159	4,529	192	9	19	5	30	7	4791
1st Supervisorial District	1,008	135	3	0	2	0	6	1	147
2nd Supervisorial District	4,822	245	15	0	136	1	29	0	426
3rd Supervisorial District	234	6	13	2	3	0	3	0	27
4th Supervisorial District	58,513	1,061	41	24	890	2	37	2	2057
5th Supervisorial District	35,104	4,973	231	8	592	11	131	10	5956
Total	**119,638**	**23,564**	**2054**	**158**	**1710**	**55**	**440**	**83**	**28064**

Jurisdiction (5)	Estimated Exposure				
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed
Cloverdale	9,213	100%	3,158	$2,499,664,593	100%
Cotati	7,533	100%	2,682	$2,163,132,258	100%
Healdsburg	12,089	100%	4,552	$4,803,401,892	100%
Petaluma	61,873	100%	19,609	$18,679,915,783	100%
Rohnert Park	43,069	100%	11,790	$9,749,459,659	100%
Santa Rosa	173,628	100%	53,547	$44,098,486,212	100%
Sebastopol	7,745	100%	2,832	$2,676,395,901	100%
Sonoma	11,050	100%	4,605	$3,658,235,342	100%
Windsor	28,248	100%	8,444	$6,407,101,168	100%
1st Supervisorial District	36,194	100%	15,141	$24,979,542,737	100%
2nd Supervisorial District	19,634	100%	7,529	$16,492,697,080	100%
3rd Supervisorial District	7,192	100%	986	$2,021,097,760	100%
4th Supervisorial District	24,507	100%	11,044	$29,660,322,569	100%
5th Supervisorial District	43,484	100%	27,565	$50,685,118,028	100%
TOTAL	**485,459**	100%	**173,484**	**$218,574,570,981**	100%

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.
Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 4.2 SP03.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	Economic Impact						
	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Cloverdale	48.24	32	24	$379,953,882	$164,329,166	$544,283,048	21.8%
Cotati	46.08	35	22	$210,003,336	$87,341,089	$297,344,425	13.7%
Healdsburg	197.37	59	39	$757,507,578	$344,109,215	$1,101,616,793	22.9%
Petaluma	559.20	553	331	$2,128,763,746	$905,475,398	$3,034,239,144	16.2%
Rohnert Park	278.68	836	526	$1,200,251,226	$459,829,300	$1,660,080,526	17.0%
Santa Rosa	1,686.90	2,771	1,845	$6,668,591,060	$2,725,718,264	$9,394,309,324	21.3%
Sebastopol	29.02	8	4	$120,890,370	$50,789,629	$171,680,000	6.4%
Sonoma	56.43	34	17	$321,664,974	$128,590,609	$450,255,582	12.3%
Windsor	155.53	177	112	$662,620,937	$273,811,705	$936,432,643	14.6%
1st Supervisorial District	255.26	231	139	$2,241,550,989	$1,130,182,247	$3,371,733,236	13.5%
2nd Supervisorial District	224.52	69	40	$1,136,565,223	$588,891,469	$1,725,456,692	10.5%
3rd Supervisorial District	94.28	62	46	$285,956,617	$124,733,871	$410,690,488	20.3%
4th Supervisorial District	318.72	115	76	$2,743,432,262	$1,555,375,845	$4,298,808,107	14.5%
5th Supervisorial District	166.92	37	27	$2,510,707,319	$1,367,391,987	$3,878,099,306	7.7%
TOTAL	**4,117.15**	**5,020**	**3,250**	**$21,368,459,518**	**$9,906,569,794**	**31,275,029,312**	14.3%

Jurisdiction (5)	Estimated Exposure				
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed
Cloverdale	9,213	100%	3,158	$2,499,664,593	100%
Cotati	7,533	100%	2,682	$2,163,132,258	100%
Healdsburg	12,089	100%	4,552	$4,803,401,892	100%
Petaluma	61,873	100%	19,609	$18,679,915,783	100%
Rohnert Park	43,069	100%	11,790	$9,749,459,659	100%
Santa Rosa	173,628	100%	53,547	$44,098,486,212	100%
Sebastopol	7,745	100%	2,832	$2,676,395,901	100%
Sonoma	11,050	100%	4,605	$3,658,235,342	100%
Windsor	28,248	100%	8,444	$6,407,101,168	100%
1st Supervisorial District	36,194	100%	15,141	$24,979,542,737	100%
2nd Supervisorial District	19,634	100%	7,529	$16,492,697,080	100%
3rd Supervisorial District	7,192	100%	986	$2,021,097,760	100%
4th Supervisorial District	24,507	100%	11,044	$29,660,322,569	100%
5th Supervisorial District	43,484	100%	27,565	$50,685,118,028	100%
TOTAL	**485,459**	100%	**173,484**	**$218,574,570,981**	100%

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.

Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 4.2 SP03.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	Economic Impact						
	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Cloverdale	33.96	27	20	$303,669,156	$127,819,155	$431,488,311	17.3%
Cotati	11.11	3	2	$86,385,552	$40,070,307	$126,455,859	5.8%
Healdsburg	123.31	16	11	$481,613,664	$218,865,334	$700,478,997	14.6%
Petaluma	69.00	18	11	$649,619,149	$282,985,000	$932,604,149	5.0%
Rohnert Park	76.21	124	78	$727,546,422	$282,803,295	$1,010,349,717	10.4%
Santa Rosa	1,028.84	1,290	830	$4,527,180,892	$1,824,513,863	$6,351,694,755	14.4%
Sebastopol	12.61	1	1	$60,084,422	$28,375,434	$88,459,856	3.3%
Sonoma	4.80	0	0	$41,668,458	$18,231,869	$59,900,327	1.6%
Windsor	76.64	78	49	$438,866,780	$182,696,198	$621,562,978	9.7%
1st Supervisorial District	48.12	20	11	$1,066,302,825	$561,187,897	$1,627,490,722	6.5%
2nd Supervisorial District	47.00	5	3	$349,900,334	$185,464,936	$535,365,270	3.2%
3rd Supervisorial District	36.55	10	8	$125,305,537	$56,089,889	$181,395,425	9.0%
4th Supervisorial District	222.47	64	43	$2,283,462,553	$1,311,514,078	$3,594,976,631	12.1%
5th Supervisorial District	72.30	9	7	$1,470,937,624	$802,319,064	$2,273,256,688	4.5%
TOTAL	**1,862.92**	**1,663**	**1,072**	**$12,612,543,369**	**$5,922,936,318**	**18,535,479,687**	8.5%

Jurisdiction (5)	Estimated Exposure				
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed
Cloverdale	9,213	100%	3,158	$2,499,664,593	100%
Cotati	7,533	100%	2,682	$2,163,132,258	100%
Healdsburg	12,089	100%	4,552	$4,803,401,892	100%
Petaluma	61,873	100%	19,609	$18,679,915,783	100%
Rohnert Park	43,069	100%	11,790	$9,749,459,659	100%
Santa Rosa	173,628	100%	53,547	$44,098,486,212	100%
Sebastopol	7,745	100%	2,832	$2,676,395,901	100%
Sonoma	11,050	100%	4,605	$3,658,235,342	100%
Windsor	28,248	100%	8,444	$6,407,101,168	100%
1st Supervisorial District	36,194	100%	15,141	$24,979,542,737	100%
2nd Supervisorial District	19,634	100%	7,529	$16,492,697,080	100%
3rd Supervisorial District	7,192	100%	986	$2,021,097,760	100%
4th Supervisorial District	24,507	100%	11,044	$29,660,322,569	100%
5th Supervisorial District	43,484	100%	27,565	$50,685,118,028	100%
TOTAL	**485,459**	100%	**173,484**	**$218,574,570,981**	100%

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.
Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 4.2 SP03.

(5) Supervisorial Districts exclude the incorporated areas.

Earthquake Rodgers Cr M7.19

Jurisdiction (5)	Economic Impact						
	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Cloverdale	24.98	22	17	$263,351,591	$111,201,703	$374,553,293	15.0%
Cotati	24.74	23	15	$146,672,788	$66,051,524	$212,724,312	9.8%
Healdsburg	141.62	37	25	$564,188,183	$261,333,291	$825,521,474	17.2%
Petaluma	291.98	376	225	$1,636,528,478	$720,663,646	$2,357,192,124	12.6%
Rohnert Park	167.82	630	397	$966,776,257	$384,337,784	$1,351,114,041	13.9%
Santa Rosa	1,197.51	2,177	1,454	$5,188,940,590	$2,155,812,203	$7,344,752,794	16.7%
Sebastopol	11.33	3	2	$72,511,103	$36,385,476	$108,896,580	4.1%
Sonoma	32.60	22	11	$233,961,487	$96,983,376	$330,944,863	9.0%
Windsor	95.01	143	90	$516,202,150	$220,446,027	$736,648,177	11.5%
1st Supervisorial District	161.98	169	103	$1,877,310,021	$981,229,178	$2,858,539,199	11.4%
2nd Supervisorial District	115.10	47	28	$820,452,854	$446,960,813	$1,267,413,667	7.7%
3rd Supervisorial District	61.24	42	31	$191,366,765	$88,078,652	$279,445,417	13.8%
4th Supervisorial District	183.34	76	51	$2,297,201,865	$1,340,567,134	$3,637,769,000	12.3%
5th Supervisorial District	83.36	24	18	$1,775,846,039	$987,177,663	$2,763,023,702	5.5%
TOTAL	**2,592.60**	**3,792**	**2,466**	**$16,551,310,172**	**$7,897,228,469**	**24,448,538,642**	11.2%

Earthquake San Andreas M8.04

Jurisdiction (5)	Estimated Exposure				
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed
Cloverdale	9,213	100%	3,158	$2,499,664,593	100%
Cotati	7,533	100%	2,682	$2,163,132,258	100%
Healdsburg	12,089	100%	4,552	$4,803,401,892	100%
Petaluma	61,873	100%	19,609	$18,679,915,783	100%
Rohnert Park	43,069	100%	11,790	$9,749,459,659	100%
Santa Rosa	173,628	100%	53,547	$44,098,486,212	100%
Sebastopol	7,745	100%	2,832	$2,676,395,901	100%
Sonoma	11,050	100%	4,605	$3,658,235,342	100%
Windsor	28,248	100%	8,444	$6,407,101,168	100%
1st Supervisorial District	36,194	100%	15,141	$24,979,542,737	100%
2nd Supervisorial District	19,634	100%	7,529	$16,492,697,080	100%
3rd Supervisorial District	7,192	100%	986	$2,021,097,760	100%
4th Supervisorial District	24,507	100%	11,044	$29,660,322,569	100%
5th Supervisorial District	43,484	100%	27,565	$50,685,118,028	100%
TOTAL	**485,459**	100%	**173,484**	**$218,574,570,981**	100%

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.
Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 4.2 SP03.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	Economic Impact						
	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Cloverdale	5.57	1	1	$65,279,411	$28,257,026	$93,536,437	3.7%
Cotati	14.26	6	4	$94,867,644	$43,138,923	$138,006,567	6.4%
Healdsburg	28.92	0	0	$154,671,237	$71,743,254	$226,414,491	4.7%
Petaluma	189.42	152	90	$1,282,511,409	$556,790,333	$1,839,301,742	9.8%
Rohnert Park	70.73	172	109	$694,526,564	$273,145,514	$967,672,078	9.9%
Santa Rosa	290.68	202	136	$1,686,884,763	$700,219,007	$2,387,103,769	5.4%
Sebastopol	19.14	5	2	$80,605,692	$35,024,707	$115,630,399	4.3%
Sonoma	4.92	0	0	$45,567,141	$19,876,361	$65,443,501	1.8%
Windsor	16.20	8	5	$170,326,379	$68,042,999	$238,369,378	3.7%
1st Supervisorial District	27.58	4	3	$509,543,680	$258,475,943	$768,019,623	3.1%
2nd Supervisorial District	87.26	11	7	$592,919,793	$317,021,981	$909,941,774	5.5%
3rd Supervisorial District	14.02	3	2	$65,443,357	$30,983,244	$96,426,601	4.8%
4th Supervisorial District	38.57	4	3	$944,402,725	$540,751,038	$1,485,153,763	5.0%
5th Supervisorial District	188.45	15	8	$3,353,192,426	$1,820,447,851	$5,173,640,277	10.2%
TOTAL	**995.71**	**584**	**370**	**$9,740,742,221**	**$4,763,918,178**	**14,504,660,400**	6.6%

Jurisdiction (5)	Estimated Exposure				
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed
Cloverdale	9,213	100%	3,158	$2,499,664,593	100%
Cotati	7,533	100%	2,682	$2,163,132,258	100%
Healdsburg	12,089	100%	4,552	$4,803,401,892	100%
Petaluma	61,873	100%	19,609	$18,679,915,783	100%
Rohnert Park	43,069	100%	11,790	$9,749,459,659	100%
Santa Rosa	173,628	100%	53,547	$44,098,486,212	100%
Sebastopol	7,745	100%	2,832	$2,676,395,901	100%
Sonoma	11,050	100%	4,605	$3,658,235,342	100%
Windsor	28,248	100%	8,444	$6,407,101,168	100%
1st Supervisorial District	36,194	100%	15,141	$24,979,542,737	100%
2nd Supervisorial District	19,634	100%	7,529	$16,492,697,080	100%
3rd Supervisorial District	7,192	100%	986	$2,021,097,760	100%
4th Supervisorial District	24,507	100%	11,044	$29,660,322,569	100%
5th Supervisorial District	43,484	100%	27,565	$50,685,118,028	100%
TOTAL	**485,459**	100%	**173,484**	**$218,574,570,981**	100%

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.
Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 4.2 SP03.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	Economic Impact						
	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
Cloverdale	8.54	4	3	$82,168,859	$38,644,277	$120,813,136	4.8%
Cotati	7.11	6	4	$91,248,116	$45,142,948	$136,391,064	6.3%
Healdsburg	26.61	5	3	$189,182,234	$95,827,814	$285,010,048	5.9%
Petaluma	142.04	127	74	$1,068,192,713	$484,594,569	$1,552,787,282	8.3%
Rohnert Park	50.74	155	98	$727,049,946	$292,241,881	$1,019,291,826	10.5%
Santa Rosa	305.91	445	294	$2,396,675,918	$1,043,144,948	$3,439,820,866	7.8%
Sebastopol	7.68	3	1	$55,563,516	$28,953,291	$84,516,807	3.2%
Sonoma	10.05	7	4	$76,876,369	$37,655,594	$114,531,963	3.1%
Windsor	20.66	24	15	$251,310,398	$104,378,205	$355,688,603	5.6%
1st Supervisorial District	65.17	47	28	$1,075,922,602	$569,144,411	$1,645,067,014	6.6%
2nd Supervisorial District	50.67	13	8	$436,893,194	$252,553,641	$689,446,835	4.2%
3rd Supervisorial District	15.57	8	6	$62,336,473	$34,041,626	$96,378,099	4.8%
4th Supervisorial District	60.55	17	11	$1,314,042,352	$771,444,751	$2,085,487,103	7.0%
5th Supervisorial District	65.51	12	7	$1,768,679,534	$998,200,432	$2,766,879,966	5.5%
TOTAL	**836.82**	**874**	**558**	**$9,596,142,225**	**$4,795,968,387**	**14,392,110,613**	6.6%

Flood 100-yr

Jurisdiction (7)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Es		
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	44	133	1.4%
Cotati	7,533	2,682	2,450	$2,163,132,258	219	615	8.2%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	14	3	0.0%
Petaluma	61,873	19,609	18,275	$18,679,915,783	261	271	0.4%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	54	137	0.3%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	130	283	0.2%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	116	171	2.2%
Sonoma	11,050	4,605	4,109	$3,658,235,342	43	86	0.8%
Windsor	28,248	8,444	8,017	$6,407,101,168	73	215	0.8%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	251	421	1.2%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	268	242	1.2%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	95	502	7.0%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	285	197	0.8%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	2,717	4,493	10.3%
Total	**485,459**	**173,484**	**151,196**	**$218,574,570,981**	**4,570**	**7,768**	**1.6%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.
Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, and adjusted to reflect the estimated population.

(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

(7) Supervisorial Districts exclude the incorporated areas.

Flood 100-yr

Jurisdiction (7)	timated Building Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Cloverdale	$14,305,167	$8,934,309	$23,239,476	0.9%
Cotati	$96,111,845	$65,510,668	$161,622,513	7.5%
Healdsburg	$65,936,658	$76,125,566	$142,062,224	3.0%
Petaluma	$883,955,331	$903,787,136	$1,787,742,467	9.6%
Rohnert Park	$150,734,068	$115,987,059	$266,721,127	2.7%
Santa Rosa	$290,176,657	$282,998,998	$573,175,655	1.3%
Sebastopol	$167,918,615	$166,382,980	$334,301,595	12.5%
Sonoma	$29,772,068	$27,833,996	$57,606,064	1.6%
Windsor	$42,129,955	$35,300,010	$77,429,966	1.2%
1st Supervisorial District	$489,557,483	$474,268,685	$963,826,168	3.9%
2nd Supervisorial District	$742,027,242	$730,983,665	$1,473,010,906	8.9%
3rd Supervisorial District	$122,603,934	$125,770,271	$248,374,205	12.3%
4th Supervisorial District	$1,059,823,134	$1,140,175,496	$2,199,998,629	7.4%
5th Supervisorial District	$2,127,094,669	$1,908,290,329	$4,035,384,998	8.0%
Total	**$6,282,146,827**	**$6,062,349,168**	**$12,344,495,994**	**5.6%**

Flood 100-yr

Jurisdiction (7)	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Cloverdale	829	25	1	37	$2,183,139	$3,527,398	$5,710,537	0.2%
Cotati	246	146	9	21	$1,142,660	$1,387,160	$2,529,820	0.1%
Healdsburg	6,244	0	0	13	$27,737,548	$30,582,300	$58,319,848	1.2%
Petaluma	23,517	44	3	164	$31,818,052	$58,452,775	$90,270,827	0.5%
Rohnert Park	1,169	12	1	47	$8,453,640	$5,553,814	$14,007,453	0.1%
Santa Rosa	21,055	24	1	56	$81,255,363	$108,516,153	$189,771,516	0.4%
Sebastopol	1,309	51	2	60	$12,747,300	$21,149,410	$33,896,710	1.3%
Sonoma	122	10	1	11	$741,842	$3,391,473	$4,133,315	0.1%
Windsor	28	16	0	7	$401,507	$2,388,267	$2,789,774	0.0%
1st Supervisorial District	51,261	41	1	152	$106,166,900	$183,478,274	$289,645,175	1.2%
2nd Supervisorial District	88,833	22	0	193	$93,382,312	$234,797,588	$328,179,899	2.0%
3rd Supervisorial District	1,367	78	3	67	$2,551,228	$12,228,816	$14,780,044	0.7%
4th Supervisorial District	173,781	28	1	248	$381,467,683	$570,212,620	$951,680,303	3.2%
5th Supervisorial District	287,351	1,188	61	2,518	$845,480,010	$1,059,721,759	$1,905,201,769	3.8%
Total	**657,111**	**1,684**	**85**	**3,594**	**$1,595,529,184**	**$2,295,387,807**	**$3,890,916,991**	**1.8%**

Flood 100-yr

Jurisdiction (7)	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	128	42	2	0	0	0	0	0	44
Cotati	59	200	4	0	0	1	14	0	219
Healdsburg	113	1	2	5	5	0	0	1	14
Petaluma	1,604	80	121	29	6	1	24	0	261
Rohnert Park	105	36	11	0	4	0	3	0	54
Santa Rosa	1,241	82	19	0	3	0	26	0	130
Sebastopol	198	55	52	6	0	0	3	0	116
Sonoma	46	32	2	0	0	0	9	0	43
Windsor	394	61	4	0	3	0	5	0	73
1st Supervisorial District	18,343	145	20	3	75	0	8	0	251
2nd Supervisorial District	13,674	70	33	6	129	0	28	2	268
3rd Supervisorial District	299	52	17	5	11	1	8	1	95
4th Supervisorial District	12,322	53	13	20	180	0	19	0	285
5th Supervisorial District	9,969	2,246	136	5	221	9	93	7	2717
Total	**58,495**	**3,155**	**436**	**79**	**637**	**12**	**240**	**11**	**4570**

Flood 500-yr

Jurisdiction (7)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Es		
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	46	133	1.4%
Cotati	7,533	2,682	2,450	$2,163,132,258	533	1,516	20.1%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	15	3	0.0%
Petaluma	61,873	19,609	18,275	$18,679,915,783	912	2,082	3.4%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	169	573	1.3%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	544	1,541	0.9%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	151	212	2.7%
Sonoma	11,050	4,605	4,109	$3,658,235,342	945	2,232	20.2%
Windsor	28,248	8,444	8,017	$6,407,101,168	574	1,941	6.9%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	331	630	1.7%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	357	370	1.9%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	175	869	12.1%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	525	598	2.4%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	3,139	5,163	11.9%
Total	**485,459**	**173,484**	**151,196**	**$218,574,570,981**	**8,416**	**17,861**	**3.7%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.
Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, and adjusted to reflect the estimated population.

(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

(7) Supervisorial Districts exclude the incorporated areas.

Flood 500-yr

Jurisdiction (7)	timated Building Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
Cloverdale	$31,211,515	$25,840,656	$57,052,171	2.3%
Cotati	$246,335,257	$177,345,038	$423,680,294	19.6%
Healdsburg	$71,171,118	$83,977,256	$155,148,374	3.2%
Petaluma	$1,528,830,217	$1,510,084,804	$3,038,915,021	16.3%
Rohnert Park	$197,329,821	$140,324,347	$337,654,168	3.5%
Santa Rosa	$538,423,205	$473,713,335	$1,012,136,540	2.3%
Sebastopol	$214,806,323	$206,577,958	$421,384,281	15.7%
Sonoma	$363,120,342	$232,546,848	$595,667,190	16.3%
Windsor	$260,084,153	$214,682,138	$474,766,291	7.4%
1st Supervisorial District	$536,904,811	$508,213,331	$1,045,118,142	4.2%
2nd Supervisorial District	$917,141,038	$898,006,387	$1,815,147,425	11.0%
3rd Supervisorial District	$262,764,367	$257,433,437	$520,197,804	25.7%
4th Supervisorial District	$1,505,058,283	$1,602,649,884	$3,107,708,167	10.5%
5th Supervisorial District	$2,421,241,484	$2,161,731,965	$4,582,973,449	9.0%
Total	**$9,094,421,934**	**$8,493,127,383**	**$17,587,549,317**	**8.0%**

Flood 500-yr

Jurisdiction (7)	Economic Impact							
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
Cloverdale	838	25	1	38	$2,445,691	$3,660,429	$6,106,119	0.2%
Cotati	665	537	32	83	$4,448,746	$8,025,539	$12,474,285	0.6%
Healdsburg	6,253	1	0	13	$28,995,807	$32,558,522	$61,554,330	1.3%
Petaluma	47,789	558	40	531	$61,219,393	$98,592,564	$159,811,956	0.9%
Rohnert Park	130	74	4	45	$8,752,491	$5,235,926	$13,988,417	0.1%
Santa Rosa	23,685	245	12	222	$88,354,715	$127,155,086	$215,509,801	0.5%
Sebastopol	1,859	68	2	83	$15,895,806	$29,022,401	$44,918,207	1.7%
Sonoma	952	890	50	406	$9,269,943	$14,921,178	$24,191,121	0.7%
Windsor	1,322	379	24	29	$3,076,215	$5,812,157	$8,888,372	0.1%
1st Supervisorial District	56,210	69	2	199	$109,777,687	$189,954,156	$299,731,843	1.2%
2nd Supervisorial District	100,788	40	0	254	$97,942,466	$252,978,633	$350,921,099	2.1%
3rd Supervisorial District	9,491	238	11	106	$7,651,725	$22,717,225	$30,368,950	1.5%
4th Supervisorial District	200,230	147	9	329	$429,116,682	$642,570,725	$1,071,687,408	3.6%
5th Supervisorial District	334,045	1,532	83	2,926	$979,240,050	$1,200,989,375	$2,180,229,425	4.3%
Total	**784,257**	**4,802**	**273**	**5,264**	**$1,846,187,418**	**$2,634,193,916**	**$4,480,381,334**	**2.0%**

Flood 500-yr

Jurisdiction (7)	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	145	42	3	0	1	0	0	0	46
Cotati	245	493	24	0	1	1	14	0	533
Healdsburg	127	1	2	6	5	0	0	1	15
Petaluma	2,041	615	208	48	9	1	31	0	912
Rohnert Park	138	150	11	0	4	0	4	0	169
Santa Rosa	1,701	447	55	3	6	1	31	1	544
Sebastopol	225	68	73	6	0	0	4	0	151
Sonoma	329	830	93	1	1	5	13	2	945
Windsor	647	551	12	3	3	0	5	0	574
1st Supervisorial District	18,731	217	22	3	81	0	8	0	331
2nd Supervisorial District	14,274	107	41	6	167	1	33	2	357
3rd Supervisorial District	528	90	49	9	16	1	9	1	175
4th Supervisorial District	14,526	161	64	56	223	0	21	0	525
5th Supervisorial District	10,884	2,581	177	7	246	10	110	8	3139
Total	**64,542**	**6,353**	**834**	**148**	**763**	**20**	**283**	**15**	**8416**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Flood Awareness Areas (3)							
					Estimated Exposure							
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	9,213	3,158	2,914	$2,499,664,593	39	82	0.89%	64,655,538	64,446,989	129,102,528	5.16%
Cotati	7,533	2,682	2,450	$2,163,132,258	0	0	0.00%	0	0	0	0.00%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	11	6	0.05%	33,523,012	33,279,221	66,802,232	1.39%
Petaluma	61,873	19,609	18,275	$18,679,915,783	45	95	0.15%	121,387,057	100,303,862	221,690,919	1.19%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.00%	0	0	0	0.00%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	17	10	0.01%	179,815,607	179,330,010	359,145,616	0.81%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	79	81	1.04%	131,553,171	134,005,763	265,558,934	9.92%
Sonoma	11,050	4,605	4,109	$3,658,235,342	4	11	0.10%	792,271	396,136	1,188,407	0.03%
Windsor	28,248	8,444	8,017	$6,407,101,168	9	14	0.05%	13,364,204	12,419,696	25,783,901	0.40%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	255	560	1.55%	303,157,456	274,465,264	577,622,720	2.31%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	136	111	0.56%	374,115,679	367,668,573	741,784,252	4.50%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	0	0	0.00%	0	0	0	0.00%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	683	1,028	4.20%	1,383,540,358	1,439,075,604	2,822,615,961	9.52%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	3,376	5,526	12.71%	2,636,044,983	2,372,651,833	5,008,696,816	9.88%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**4,654**	**7,524**	**1.55%**	**5,241,949,336**	**4,978,042,951**	**10,219,992,287**	**4.68%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Hazard data provided by Sonoma County

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	26	8	1	2	0	2	0	39
Cotati	0	0	0	0	0	0	0	0
Healdsburg	2	1	0	7	0	1	0	11
Petaluma	28	11	2	2	0	2	0	45
Rohnert Park	0	0	0	0	0	0	0	0
Santa Rosa	3	12	0	1	0	1	0	17
Sebastopol	26	45	6	0	0	2	0	79
Sonoma	4	0	0	0	0	0	0	4
Windsor	4	2	0	2	0	1	0	9
1st Supervisorial District	193	12	2	41	1	6	0	255
2nd Supervisorial District	32	17	4	63	0	20	0	136
3rd Supervisorial District	0	0	0	0	0	0	0	0
4th Supervisorial District	277	17	22	341	0	25	1	683
5th Supervisorial District	2,762	188	9	300	12	97	8	3,376
Total	**3,357**	**313**	**46**	**759**	**13**	**157**	**9**	**4,654**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Lands		
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	2	6	0.1%
Cotati	7,533	2,682	2,450	$2,163,132,258	0	0	0.0%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	0	0	0.0%
Petaluma	61,873	19,609	18,275	$18,679,915,783	954	3,193	5.2%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.0%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	56	172	0.1%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	0	0	0.0%
Sonoma	11,050	4,605	4,109	$3,658,235,342	0	0	0.0%
Windsor	28,248	8,444	8,017	$6,407,101,168	0	0	0.0%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	404	879	2.4%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	210	421	2.1%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	0	0	0.0%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	199	282	1.2%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	1,348	1,965	4.5%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**3,173**	**6,919**	**1.4%**

Jurisdiction (5)	slide Susceptibility Category Very High (3)			
	Estimated Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	$675,200	$337,600	$1,012,800	0.0%
Cotati	$0	$0	$0	0.0%
Healdsburg	$0	$0	$0	0.0%
Petaluma	$429,487,331	$237,680,735	$667,168,067	3.6%
Rohnert Park	$0	$0	$0	0.0%
Santa Rosa	$47,360,237	$35,776,504	$83,136,741	0.2%
Sebastopol	$0	$0	$0	0.0%
Sonoma	$0	$0	$0	0.0%
Windsor	$0	$0	$0	0.0%
1st Supervisorial District	$462,624,881	$389,394,708	$852,019,589	3.4%
2nd Supervisorial District	$396,620,127	$374,865,087	$771,485,214	4.7%
3rd Supervisorial District	$0	$0	$0	0.0%
4th Supervisorial District	$391,387,867	$382,058,026	$773,445,893	2.6%
5th Supervisorial District	$1,633,370,547	$1,516,697,051	$3,150,067,598	6.2%
Total	**$3,361,526,190**	**$2,936,809,711**	**$6,298,335,902**	**2.9%**

Jurisdiction (5)	Number of Structures in Category Very High (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	2	0	0	0	0	0	0	2
Cotati	0	0	0	0	0	0	0	0
Healdsburg	0	0	0	0	0	0	0	0
Petaluma	943	4	0	4	1	0	2	954
Rohnert Park	0	0	0	0	0	0	0	0
Santa Rosa	50	2	0	1	0	3	0	56
Sebastopol	0	0	0	0	0	0	0	0
Sonoma	0	0	0	0	0	0	0	0
Windsor	0	0	0	0	0	0	0	0
1st Supervisorial District	303	17	0	83	0	1	0	404
2nd Supervisorial District	122	3	2	79	0	4	0	210
3rd Supervisorial District	0	0	0	0	0	0	0	0
4th Supervisorial District	76	6	0	114	0	3	0	199
5th Supervisorial District	982	31	1	301	3	29	1	1,348
Total	**2,478**	**63**	**3**	**582**	**4**	**40**	**3**	**3,173**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	La		
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	615	1,853	20.1%
Cotati	7,533	2,682	2,450	$2,163,132,258	66	194	2.6%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	477	1,326	11.0%
Petaluma	61,873	19,609	18,275	$18,679,915,783	1,370	4,405	7.1%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	16	61	0.1%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	3,688	12,123	7.0%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	118	342	4.4%
Sonoma	11,050	4,605	4,109	$3,658,235,342	139	325	2.9%
Windsor	28,248	8,444	8,017	$6,407,101,168	214	722	2.6%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	3,332	7,176	19.8%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	522	1,074	5.5%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	74	608	8.5%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	2,976	5,554	22.7%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	10,676	16,032	36.9%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**24,283**	**51,796**	**10.7%**

Jurisdiction (5)	ndslide Susceptibility Category High (3)			
	Estimated Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	$268,731,497	$174,912,491	$443,643,988	17.7%
Cotati	$54,467,843	$42,948,389	$97,416,231	4.5%
Healdsburg	$248,728,578	$165,791,305	$414,519,884	8.6%
Petaluma	$697,146,436	$498,183,462	$1,195,329,898	6.4%
Rohnert Park	$5,015,639	$2,507,820	$7,523,459	0.1%
Santa Rosa	$2,134,356,419	$1,383,144,613	$3,517,501,032	8.0%
Sebastopol	$68,969,229	$50,557,468	$119,526,696	4.5%
Sonoma	$100,337,689	$69,925,487	$170,263,176	4.7%
Windsor	$84,796,379	$46,998,001	$131,794,380	2.1%
1st Supervisorial District	$4,364,597,074	$3,873,843,493	$8,238,440,567	33.0%
2nd Supervisorial District	$888,658,247	$830,322,637	$1,718,980,884	10.4%
3rd Supervisorial District	$51,850,883	$38,131,243	$89,982,126	4.5%
4th Supervisorial District	$5,670,078,536	$5,406,470,795	$11,076,549,330	37.3%
5th Supervisorial District	$12,869,009,143	$11,962,682,210	$24,831,691,353	49.0%
Total	**$27,506,743,592**	**$24,546,419,412**	**$52,053,163,004**	**23.8%**

Jurisdiction (5)	Number of Structures in Category High (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	586	14	0	10	1	4	0	615
Cotati	63	0	0	1	0	0	2	66
Healdsburg	444	18	4	8	2	1	0	477
Petaluma	1,301	48	1	6	1	8	5	1,370
Rohnert Park	16	0	0	0	0	0	0	16
Santa Rosa	3,517	92	2	30	6	37	4	3,688
Sebastopol	110	6	0	1	0	1	0	118
Sonoma	121	6	0	6	1	5	0	139
Windsor	205	3	0	0	1	5	0	214
1st Supervisorial District	2,473	101	4	723	4	25	2	3,332
2nd Supervisorial District	311	32	5	168	1	5	0	522
3rd Supervisorial District	63	0	0	11	0	0	0	74
4th Supervisorial District	1,496	48	11	1,388	3	27	3	2,976
5th Supervisorial District	8,014	281	13	2,178	27	149	14	10,676
Total	**18,720**	**649**	**40**	**4,530**	**47**	**267**	**30**	**24,283**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Lands		
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	111	310	3.4%
Cotati	7,533	2,682	2,450	$2,163,132,258	309	925	12.3%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	331	908	7.5%
Petaluma	61,873	19,609	18,275	$18,679,915,783	1,312	4,344	7.0%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.0%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	4,793	16,183	9.3%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	1,308	3,834	49.5%
Sonoma	11,050	4,605	4,109	$3,658,235,342	21	40	0.4%
Windsor	28,248	8,444	8,017	$6,407,101,168	38	127	0.4%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	2,704	6,204	17.1%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	2,814	7,637	38.9%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	75	656	9.1%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	1,274	2,714	11.1%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	6,383	10,357	23.8%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**21,473**	**54,240**	**11.2%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.

Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Susceptibility to Deep-Seated Landslides data provided by CA Geological Survey.

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	slide Susceptibility Category Moderate (3)			
	Estimated Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	$107,364,685	$96,528,716	$203,893,401	8.2%
Cotati	$131,305,826	$79,109,383	$210,415,209	9.7%
Healdsburg	$183,723,320	$128,760,564	$312,483,884	6.5%
Petaluma	$475,720,807	$266,193,571	$741,914,379	4.0%
Rohnert Park	$0	$0	$0	0.0%
Santa Rosa	$2,574,738,315	$1,667,322,998	$4,242,061,313	9.6%
Sebastopol	$581,882,733	$396,902,197	$978,784,931	36.6%
Sonoma	$21,933,349	$17,987,842	$39,921,191	1.1%
Windsor	$20,264,070	$11,523,628	$31,787,697	0.5%
1st Supervisorial District	$2,735,776,944	$2,243,707,099	$4,979,484,043	19.9%
2nd Supervisorial District	$2,870,876,060	$2,372,423,299	$5,243,299,360	31.8%
3rd Supervisorial District	$46,423,068	$32,789,226	$79,212,294	3.9%
4th Supervisorial District	$1,385,620,571	$1,208,647,192	$2,594,267,764	8.7%
5th Supervisorial District	$4,964,110,406	$4,070,074,016	$9,034,184,422	17.8%
Total	**$16,099,740,155**	**$12,591,969,732**	**$28,691,709,887**	**13.1%**

Jurisdiction (5)	Number of Structures in Category Moderate (2)							
	Residential	**Commercial**	**Industrial**	**Agriculture**	**Religion**	**Government**	**Education**	**Total**
Cloverdale	98	8	1	3	0	1	0	111
Cotati	301	1	1	4	1	0	1	309
Healdsburg	304	8	1	12	4	2	0	331
Petaluma	1,283	18	0	4	1	6	0	1,312
Rohnert Park	0	0	0	0	0	0	0	0
Santa Rosa	4,695	46	3	25	8	13	3	4,793
Sebastopol	1,232	58	1	3	4	8	2	1,308
Sonoma	15	1	0	2	1	2	0	21
Windsor	36	1	0	0	0	1	0	38
1st Supervisorial District	2,138	60	1	491	2	11	1	2,704
2nd Supervisorial District	2,211	44	6	521	8	15	9	2,814
3rd Supervisorial District	68	0	0	6	0	1	0	75
4th Supervisorial District	731	22	3	507	2	8	1	1,274
5th Supervisorial District	5,177	150	5	970	19	48	14	6,383
Total	**18,289**	**417**	**22**	**2,548**	**50**	**116**	**31**	**21,473**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	0	0	0.00%
Cotati	7,533	2,682	2,450	$2,163,132,258	0	0	0.00%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	0	0	0.00%
Petaluma	61,873	19,609	18,275	$18,679,915,783	108	213	0.34%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.00%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	0	0	0.00%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	0	0	0.00%
Sonoma	11,050	4,605	4,109	$3,658,235,342	0	0	0.00%
Windsor	28,248	8,444	8,017	$6,407,101,168	0	0	0.00%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	73	20	0.06%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	75	24	0.12%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	0	0	0.00%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	0	0	0.00%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	72	98	0.23%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**328**	**356**	**0.07%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.

Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Sea level rise - 200cm (no storm) - data provided by Our Coast Our Future (OCOF).

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Supervisorial Districts exclude the incorporated areas.

SLR 200cm No Storm

Jurisdiction (5)	Sea Level Rise 200cm No Storm (3)			
	Estimated Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	0	0	0	0.00%
Cotati	0	0	0	0.00%
Healdsburg	0	0	0	0.00%
Petaluma	264,005,056	232,490,418	496,495,474	2.66%
Rohnert Park	0	0	0	0.00%
Santa Rosa	0	0	0	0.00%
Sebastopol	0	0	0	0.00%
Sonoma	0	0	0	0.00%
Windsor	0	0	0	0.00%
1st Supervisorial District	265,065,335	263,686,342	528,751,677	2.12%
2nd Supervisorial District	249,680,891	248,103,274	497,784,166	3.02%
3rd Supervisorial District	0	0	0	0.00%
4th Supervisorial District	0	0	0	0.00%
5th Supervisorial District	92,881,743	88,206,768	181,088,511	0.36%
Total	**871,633,025**	**832,486,802**	**1,704,119,828**	**0.78%**

SLR 200cm No Storm

Jurisdiction (5)	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	0	0	0	0	0	0	0	0
Cotati	0	0	0	0	0	0	0	0
Healdsburg	0	0	0	0	0	0	0	0
Petaluma	63	28	10	2	0	5	0	108
Rohnert Park	0	0	0	0	0	0	0	0
Santa Rosa	0	0	0	0	0	0	0	0
Sebastopol	0	0	0	0	0	0	0	0
Sonoma	0	0	0	0	0	0	0	0
Windsor	0	0	0	0	0	0	0	0
1st Supervisorial District	7	10		52	0	4	0	73
2nd Supervisorial District	7	8	2	57	0	1	0	75
3rd Supervisorial District	0	0	0	0	0	0	0	0
4th Supervisorial District	0	0	0	0	0	0	0	0
5th Supervisorial District	49	7	1	11	0	4	0	72
Total	**126**	**53**	**13**	**122**	**0**	**14**	**0**	**328**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	S		
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	0	0	0.00%
Cotati	7,533	2,682	2,450	$2,163,132,258	0	0	0.00%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	0	0	0.00%
Petaluma	61,873	19,609	18,275	$18,679,915,783	439	880	1.42%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.00%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	0	0	0.00%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	0	0	0.00%
Sonoma	11,050	4,605	4,109	$3,658,235,342	0	0	0.00%
Windsor	28,248	8,444	8,017	$6,407,101,168	0	0	0.00%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	85	32	0.09%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	80	24	0.12%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	0	0	0.00%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	0	0	0.00%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	133	170	0.39%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**737**	**1,106**	**0.23%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.

Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Sea level rise - 200cm with 100-year storm - data provided by Our Coast Our Future (OCOF).

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	ea Level Rise 200cm 100-yr Storm (3)			
	Estimated Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	0	0	0	0.00%
Cotati	0	0	0	0.00%
Healdsburg	0	0	0	0.00%
Petaluma	737,089,813	690,352,052	1,427,441,865	7.64%
Rohnert Park	0	0	0	0.00%
Santa Rosa	0	0	0	0.00%
Sebastopol	0	0	0	0.00%
Sonoma	0	0	0	0.00%
Windsor	0	0	0	0.00%
1st Supervisorial District	317,287,920	314,809,434	632,097,354	2.53%
2nd Supervisorial District	279,608,743	278,031,126	557,639,870	3.38%
3rd Supervisorial District	0	0	0	0.00%
4th Supervisorial District	0	0	0	0.00%
5th Supervisorial District	153,141,665	151,412,009	304,553,674	0.60%
Total	**1,487,128,142**	**1,434,604,620**	**2,921,732,763**	**1.34%**

SLR 200cm 100-yr Storm

Jurisdiction (5)	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	0	0	0	0	0	0	0	0
Cotati	0	0	0	0	0	0	0	0
Healdsburg	0	0	0	0	0	0	0	0
Petaluma	260	129	29	4	0	13	4	439
Rohnert Park	0	0	0	0	0	0	0	0
Santa Rosa	0	0	0	0	0	0	0	0
Sebastopol	0	0	0	0	0	0	0	0
Sonoma	0	0	0	0	0	0	0	0
Windsor	0	0	0	0	0	0	0	0
1st Supervisorial District	11	14	0	56	0	4	0	85
2nd Supervisorial District	7	9	2	61	0	1	0	80
3rd Supervisorial District	0	0	0	0	0	0	0	0
4th Supervisorial District	0	0	0	0	0	0	0	0
5th Supervisorial District	85	17	1	18	0	11	1	133
Total	**363**	**169**	**32**	**139**	**0**	**29**	**5**	**737**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Cloverdale	9,213	3,158	2,914	$2,499,664,593	0	0	0.00%
Cotati	7,533	2,682	2,450	$2,163,132,258	0	0	0.00%
Healdsburg	12,089	4,552	4,047	$4,803,401,892	0	0	0.00%
Petaluma	61,873	19,609	18,275	$18,679,915,783	0	0	0.00%
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.00%
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	0	0	0.00%
Sebastopol	7,745	2,832	2,489	$2,676,395,901	0	0	0.00%
Sonoma	11,050	4,605	4,109	$3,658,235,342	0	0	0.00%
Windsor	28,248	8,444	8,017	$6,407,101,168	0	0	0.00%
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	0	0	0.00%
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	4	0	0.00%
3rd Supervisorial District	7,192	986	745	$2,021,097,760	0	0	0.00%
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	0	0	0.00%
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	73	102	0.23%
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**77**	**102**	**0.02%**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.

Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Tsunami inundation zones data provided by CA Department of Conservation.

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	Tsunami Zone (3)			
	Estimated Exposure			
	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
Cloverdale	0	0	0	0.00%
Cotati	0	0	0	0.00%
Healdsburg	0	0	0	0.00%
Petaluma	0	0	0	0.00%
Rohnert Park	0	0	0	0.00%
Santa Rosa	0	0	0	0.00%
Sebastopol	0	0	0	0.00%
Sonoma	0	0	0	0.00%
Windsor	0	0	0	0.00%
1st Supervisorial District	0	0	0	0.00%
2nd Supervisorial District	8,667,759	9,316,564	17,984,323	0.11%
3rd Supervisorial District	0	0	0	0.00%
4th Supervisorial District	0	0	0	0.00%
5th Supervisorial District	33,226,385	35,393,712	68,620,097	0.14%
Total	**41,894,144**	**44,710,276**	**86,604,420**	**0.04%**

Tsunami

Jurisdiction (5)	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Cloverdale	0	0	0	0	0	0	0	0
Cotati	0	0	0	0	0	0	0	0
Healdsburg	0	0	0	0	0	0	0	0
Petaluma	0	0	0	0	0	0	0	0
Rohnert Park	0	0	0	0	0	0	0	0
Santa Rosa	0	0	0	0	0	0	0	0
Sebastopol	0	0	0	0	0	0	0	0
Sonoma	0	0	0	0	0	0	0	0
Windsor	0	0	0	0	0	0	0	0
1st Supervisorial District	0	0	0	0	0	0	0	0
2nd Supervisorial District	0	1	1	1	0	1	0	4
3rd Supervisorial District	0	0	0	0	0	0	0	0
4th Supervisorial District	0	0	0	0	0	0	0	0
5th Supervisorial District	51	8	1	1	0	11	1	73
Total	**51**	**9**	**2**	**2**	**0**	**12**	**1**	**77**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Wildfire - Very High Rela			
					Estimated Expo			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)
Cloverdale	9,213	3,158	2,914	$2,499,664,593	0	0	0.0%	$0
Cotati	7,533	2,682	2,450	$2,163,132,258	1	3	0.0%	$125,413
Healdsburg	12,089	4,552	4,047	$4,803,401,892	0	0	0.0%	$0
Petaluma	61,873	19,609	18,275	$18,679,915,783	0	0	0.0%	$0
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.0%	$0
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	18	41	0.0%	$23,263,731
Sebastopol	7,745	2,832	2,489	$2,676,395,901	0	0	0.0%	$0
Sonoma	11,050	4,605	4,109	$3,658,235,342	3	3	0.0%	$5,525,689
Windsor	28,248	8,444	8,017	$6,407,101,168	0	0	0.0%	$0
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	504	635	1.8%	$1,441,378,135
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	12	17	0.1%	$28,536,793
3rd Supervisorial District	7,192	986	745	$2,021,097,760	0	0	0.0%	$0
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	278	238	1.0%	$1,012,231,311
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	359	220	0.5%	$1,291,396,384
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**1,175**	**1,158**	**0.2%**	**$3,802,457,456**

Jurisdiction (5)	tive Hazard (3)									
	osure			Number of Structures in Very High Relative Hazard (2)						
	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Cloverdale	$0	$0	0.0%	0	0	0	0	0	0	0
Cotati	$62,706	$188,119	0.0%	1	0	0	0	0	0	0
Healdsburg	$0	$0	0.0%	0	0	0	0	0	0	0
Petaluma	$0	$0	0.0%	0	0	0	0	0	0	0
Rohnert Park	$0	$0	0.0%	0	0	0	0	0	0	0
Santa Rosa	$21,684,903	$44,948,634	0.1%	12	1	0	3	0	2	0
Sebastopol	$0	$0	0.0%	0	0	0	0	0	0	0
Sonoma	$5,416,105	$10,941,794	0.3%	1	0	0	2	0	0	0
Windsor	$0	$0	0.0%	0	0	0	0	0	0	0
1st Supervisorial District	$1,406,899,298	$2,848,277,432	11.4%	219	33	0	250	0	2	0
2nd Supervisorial District	$27,682,883	$56,219,676	0.3%	5	1	0	6	0	0	0
3rd Supervisorial District	$0	$0	0.0%	0	0	0	0	0	0	0
4th Supervisorial District	$999,841,184	$2,012,072,496	6.8%	64	5	0	205	2	2	0
5th Supervisorial District	$1,285,285,169	$2,576,681,553	5.1%	110	11	2	229	1	5	1
Total	**$3,746,872,248**	**$7,549,329,704**	**3.5%**	**412**	**51**	**2**	**695**	**3**	**11**	**1**

Jurisdiction (5)	Total
Cloverdale	0
Cotati	1
Healdsburg	0
Petaluma	0
Rohnert Park	0
Santa Rosa	18
Sebastopol	0
Sonoma	3
Windsor	0
1st Supervisorial District	504
2nd Supervisorial District	12
3rd Supervisorial District	0
4th Supervisorial District	278
5th Supervisorial District	359
Total	**1,175**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Wildfire - High Relativ			
					Estimated Expo			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)
Cloverdale	9,213	3,158	2,914	$2,499,664,593	26	66	0.7%	$33,322,165
Cotati	7,533	2,682	2,450	$2,163,132,258	8	22	0.3%	$2,692,664
Healdsburg	12,089	4,552	4,047	$4,803,401,892	20	48	0.4%	$21,390,895
Petaluma	61,873	19,609	18,275	$18,679,915,783	28	68	0.1%	$97,424,188
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	0	0	0.0%	$0
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	354	1,106	0.6%	$241,082,248
Sebastopol	7,745	2,832	2,489	$2,676,395,901	13	40	0.5%	$3,494,923
Sonoma	11,050	4,605	4,109	$3,658,235,342	54	126	1.1%	$36,035,283
Windsor	28,248	8,444	8,017	$6,407,101,168	11	32	0.1%	$12,813,103
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	1,666	3,520	9.7%	$2,304,080,769
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	127	259	1.3%	$218,852,782
3rd Supervisorial District	7,192	986	745	$2,021,097,760	16	106	1.5%	$20,885,839
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	831	1,240	5.1%	$2,219,788,994
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	1,644	1,734	4.0%	$3,846,977,512
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**4,798**	**8,368**	**1.7%**	**$9,058,841,363**

Jurisdiction (5)	e Hazard (3)										
	osure			Number of Structures in High Relative Hazard (2)							
	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Cloverdale	$31,013,567	$64,335,733	2.6%	21	2	0	2	0	1	0
Cotati	$1,497,536	$4,190,200	0.2%	7	0	0	1	0	0	0
Healdsburg	$18,588,752	$39,979,647	0.8%	16	0	0	4	0	0	0
Petaluma	$94,268,053	$191,692,241	1.0%	20	2	0	1	0	3	2
Rohnert Park	$0	$0	0.0%	0	0	0	0	0	0	0
Santa Rosa	$195,205,102	$436,287,350	1.0%	321	14	0	6	0	13	0
Sebastopol	$1,747,461	$5,242,384	0.2%	13	0	0	0	0	0	0
Sonoma	$29,126,092	$65,161,375	1.8%	47	0	0	3	1	3	0
Windsor	$11,641,011	$24,454,114	0.4%	9	0	0	2	0	0	0
1st Supervisorial District	$2,088,708,180	$4,392,788,949	17.6%	1,213	53	2	383	1	14	0
2nd Supervisorial District	$205,505,416	$424,358,198	2.6%	75	1	0	46	1	4	0
3rd Supervisorial District	$18,558,241	$39,444,080	2.0%	11	0	0	3	0	2	0
4th Supervisorial District	$2,171,397,397	$4,391,186,391	14.8%	334	13	4	467	4	9	0
5th Supervisorial District	$3,746,343,631	$7,593,321,142	15.0%	867	45	4	699	5	23	1
Total	**$8,613,600,440**	**$17,672,441,803**	**8.1%**	**2,954**	**130**	**10**	**1,617**	**12**	**72**	**3**

Jurisdiction (5)	Total
Cloverdale	26
Cotati	8
Healdsburg	20
Petaluma	28
Rohnert Park	0
Santa Rosa	354
Sebastopol	13
Sonoma	54
Windsor	11
1st Supervisorial District	1,666
2nd Supervisorial District	127
3rd Supervisorial District	16
4th Supervisorial District	831
5th Supervisorial District	1,644
Total	**4,798**

Jurisdiction (5)	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Wildfire - Moderate Rela			
					Estimated Exp			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)
Cloverdale	9,213	3,158	2,914	$2,499,664,593	117	338	3.7%	$62,405,333
Cotati	7,533	2,682	2,450	$2,163,132,258	359	1,048	13.9%	$137,063,621
Healdsburg	12,089	4,552	4,047	$4,803,401,892	264	696	5.8%	$136,877,365
Petaluma	61,873	19,609	18,275	$18,679,915,783	1,396	4,506	7.3%	$655,813,939
Rohnert Park	43,069	11,790	11,284	$9,749,459,659	433	1,622	3.8%	$154,132,790
Santa Rosa	173,628	53,547	50,372	$44,098,486,212	6,624	21,960	12.6%	$2,817,112,382
Sebastopol	7,745	2,832	2,489	$2,676,395,901	390	1,154	14.9%	$171,287,057
Sonoma	11,050	4,605	4,109	$3,658,235,342	1,405	3,579	32.4%	$474,702,889
Windsor	28,248	8,444	8,017	$6,407,101,168	743	2,509	8.9%	$280,415,475
1st Supervisorial District	36,194	15,141	12,473	$24,979,542,737	5,668	14,100	39.0%	$4,231,435,846
2nd Supervisorial District	19,634	7,529	5,684	$16,492,697,080	1,120	2,580	13.1%	$1,670,041,905
3rd Supervisorial District	7,192	986	745	$2,021,097,760	109	772	10.7%	$147,740,719
4th Supervisorial District	24,507	11,044	6,601	$29,660,322,569	2,394	5,829	23.8%	$2,925,881,264
5th Supervisorial District	43,484	27,565	21,736	$50,685,118,028	5,223	7,670	17.6%	$6,278,814,926
Total	**485,459**	**173,484**	**151,196**	**218,574,570,981**	**26,245**	**68,365**	**14.1%**	**$20,143,725,511**

(1) Incorporated Areas: 2020 population from State of California, Department of Finance, E-4 Population Estimates for Cities, Counties, and the State, 2011-2020, with 2010 Census Benchmark. Sacramento, California, May 2020.

Supervisorial Districts: Growth rate of -4.7% applied to 2010 Census population for each district. Growth rate determined from change in population (in the unincorporated county) from 2010 to 2020 as indicated in E-4 Population Estimates document.

(2) Values based off of 2020 tax assessor data provided by Sonoma County.

(3) Wildfire hazard data provided by Sonoma County.

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Supervisorial Districts exclude the incorporated areas.

Jurisdiction (5)	tive Hazard (3)									
	osure			Number of Structures in Moderate Relative Hazard (2)						
	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Cloverdale	$48,774,799	$111,180,132	4.4%	107	3	0	6	0	1	0
Cotati	$93,336,857	$230,400,478	10.7%	341	6	0	3	0	8	1
Healdsburg	$105,930,387	$242,807,753	5.1%	233	13	3	12	0	2	1
Petaluma	$470,400,034	$1,126,213,972	6.0%	1,331	29	4	13	0	19	0
Rohnert Park	$97,874,655	$252,007,446	2.6%	425	7	0	0	0	1	0
Santa Rosa	$1,759,187,049	$4,576,299,431	10.4%	6,371	103	1	41	6	92	10
Sebastopol	$109,507,390	$280,794,447	10.5%	371	14	0	2	0	3	0
Sonoma	$277,313,129	$752,016,018	20.6%	1,331	42	1	4	6	20	1
Windsor	$169,051,423	$449,466,898	7.0%	712	12	1	6	1	10	1
1st Supervisorial District	$3,373,212,645	$7,604,648,491	30.4%	4,859	112	13	644	5	33	2
2nd Supervisorial District	$1,516,171,162	$3,186,213,067	19.3%	747	34	5	319	3	11	1
3rd Supervisorial District	$133,298,703	$281,039,422	13.9%	80	3	1	23	0	1	1
4th Supervisorial District	$2,692,511,422	$5,618,392,686	18.9%	1,570	53	9	738	2	21	1
5th Supervisorial District	$5,798,996,731	$12,077,811,657	23.8%	3,834	111	4	1,197	14	61	2
Total	**$16,645,566,386**	**$36,789,291,897**	**16.8%**	**22,312**	**542**	**42**	**3,008**	**37**	**283**	**21**

Wildfire

Jurisdiction (5)	Total
Cloverdale	117
Cotati	359
Healdsburg	264
Petaluma	1,396
Rohnert Park	433
Santa Rosa	6,624
Sebastopol	390
Sonoma	1,405
Windsor	743
1st Supervisorial District	5,668
2nd Supervisorial District	1,120
3rd Supervisorial District	109
4th Supervisorial District	2,394
5th Supervisorial District	5,223
Total	**26,245**

RISK RATING RESULTS BY JURISDICTION

	RI					
	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	Medium	2	0.00%	None	0	0
Cotati	Medium	2	0.04%	Low	1	3
Healdsburg	Medium	2	87.74%	High	3	9
Petaluma	Medium	2	0.00%	None	0	0
Rohnert Park	Medium	2	0.22%	Low	1	3
Santa Rosa	Medium	2	17.66%	Medium	2	6
Sebastopol	Medium	2	5.75%	Low	1	3
Sonoma	Medium	2	0.00%	None	0	0
Windsor	Medium	2	56.49%	High	3	9
1st Supervisorial District	Medium	2	1.08%	Low	1	3
2nd Supervisorial District	Medium	2	4.31%	Low	1	3
3rd Supervisorial District	Medium	2	0.81%	Low	1	3
4th Supervisorial District	Medium	2	16.07%	Medium	2	6
5th Supervisorial District	Medium	2	22.88%	Medium	2	6
Total	Medium	2	15.03%	Medium	2	6

SK RANKING-Combined Dam Failure Inundation Areas

	Impact on Property			
	% of Total Value Exposed	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	0.00%	None	0	0
Cotati	6.58%	Low	1	2
Healdsburg	90.26%	High	3	6
Petaluma	0.00%	None	0	0
Rohnert Park	10.76%	Medium	2	4
Santa Rosa	27.48%	High	3	6
Sebastopol	28.63%	High	3	6
Sonoma	0.00%	None	0	0
Windsor	44.52%	High	3	6
1st Supervisorial District	0.86%	Low	1	2
2nd Supervisorial District	10.09%	Medium	2	4
3rd Supervisorial District	6.14%	Low	1	2
4th Supervisorial District	19.10%	Medium	2	4
5th Supervisorial District	16.40%	Medium	2	4
Total	17.04%	Medium	2	4

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	0.00%	None	0	0	**0**	**Low**
Cotati	0.18%	Low	1	1	**12**	**Low**
Healdsburg	70.42%	High	3	3	**36**	**High**
Petaluma	0.00%	None	0	0	**0**	**Low**
Rohnert Park	0.78%	Low	1	1	**16**	**Medium**
Santa Rosa	3.74%	Low	1	1	**26**	**Medium**
Sebastopol	18.08%	High	3	3	**24**	**Medium**
Sonoma	0.00%	None	0	0	**0**	**Low**
Windsor	11.97%	High	3	3	**36**	**High**
1st Supervisorial District	0.11%	Low	1	1	**12**	**Low**
2nd Supervisorial District	2.49%	Low	1	1	**16**	**Medium**
3rd Supervisorial District	0.32%	Low	1	1	**12**	**Low**
4th Supervisorial District	13.64%	High	3	3	**26**	**Medium**
5th Supervisorial District	9.11%	Medium	2	2	**24**	**Medium**
Total	7.08%	Medium	2	2	**24**	**Medium**

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	Medium	2	100.00%	High	3	9
Cotati	Medium	2	100.00%	High	3	9
Healdsburg	Medium	2	100.00%	High	3	9
Petaluma	Medium	2	100.00%	High	3	9
Rohnert Park	Medium	2	100.00%	High	3	9
Santa Rosa	Medium	2	100.00%	High	3	9
Sebastopol	Medium	2	100.00%	High	3	9
Sonoma	Medium	2	100.00%	High	3	9
Windsor	Medium	2	100.00%	High	3	9
1st Supervisorial District	Medium	2	100.00%	High	3	9
2nd Supervisorial District	Medium	2	100.00%	High	3	9
3rd Supervisorial District	Medium	2	100.00%	High	3	9
4th Supervisorial District	Medium	2	100.00%	High	3	9
5th Supervisorial District	Medium	2	100.00%	High	3	9
TOTAL	Medium	2	100.00%	High	3	9

	RISK RANKINC			
	Impact on Property			
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	100.00%	High	3	6
Cotati	100.00%	High	3	6
Healdsburg	100.00%	High	3	6
Petaluma	100.00%	High	3	6
Rohnert Park	100.00%	High	3	6
Santa Rosa	100.00%	High	3	6
Sebastopol	100.00%	High	3	6
Sonoma	100.00%	High	3	6
Windsor	100.00%	High	3	6
1st Supervisorial District	100.00%	High	3	6
2nd Supervisorial District	100.00%	High	3	6
3rd Supervisorial District	100.00%	High	3	6
4th Supervisorial District	100.00%	High	3	6
5th Supervisorial District	100.00%	High	3	6
TOTAL	100.00%	High	3	6

;-Earthquake Hayward M7.57

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	21.77%	High	3	3	36	High
Cotati	13.75%	High	3	3	36	High
Healdsburg	22.93%	High	3	3	36	High
Petaluma	16.24%	High	3	3	36	High
Rohnert Park	17.03%	High	3	3	36	High
Santa Rosa	21.30%	High	3	3	36	High
Sebastopol	6.41%	Medium	2	2	34	High
Sonoma	12.31%	High	3	3	36	High
Windsor	14.62%	High	3	3	36	High
1st Supervisorial District	13.50%	High	3	3	36	High
2nd Supervisorial District	10.46%	High	3	3	36	High
3rd Supervisorial District	20.32%	High	3	3	36	High
4th Supervisorial District	14.49%	High	3	3	36	High
5th Supervisorial District	7.65%	Medium	2	2	34	High
TOTAL	14.31%	High	3	3	36	High

Earthquake Maacama M7.55

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	Medium	2	100.00%	High	3	9
Cotati	Medium	2	100.00%	High	3	9
Healdsburg	Medium	2	100.00%	High	3	9
Petaluma	Medium	2	100.00%	High	3	9
Rohnert Park	Medium	2	100.00%	High	3	9
Santa Rosa	Medium	2	100.00%	High	3	9
Sebastopol	Medium	2	100.00%	High	3	9
Sonoma	Medium	2	100.00%	High	3	9
Windsor	Medium	2	100.00%	High	3	9
1st Supervisorial District	Medium	2	100.00%	High	3	9
2nd Supervisorial District	Medium	2	100.00%	High	3	9
3rd Supervisorial District	Medium	2	100.00%	High	3	9
4th Supervisorial District	Medium	2	100.00%	High	3	9
5th Supervisorial District	Medium	2	100.00%	High	3	9
TOTAL	Medium	2	100.00%	High	3	9

Earthquake Maacama M7.55

	Impact on Property			
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	100.00%	High	3	6
Cotati	100.00%	High	3	6
Healdsburg	100.00%	High	3	6
Petaluma	100.00%	High	3	6
Rohnert Park	100.00%	High	3	6
Santa Rosa	100.00%	High	3	6
Sebastopol	100.00%	High	3	6
Sonoma	100.00%	High	3	6
Windsor	100.00%	High	3	6
1st Supervisorial District	100.00%	High	3	6
2nd Supervisorial District	100.00%	High	3	6
3rd Supervisorial District	100.00%	High	3	6
4th Supervisorial District	100.00%	High	3	6
5th Supervisorial District	100.00%	High	3	6
TOTAL	100.00%	High	3	6

Earthquake Maacama M7.55

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	17.26%	High	3	3	**36**	**High**
Cotati	5.85%	Medium	2	2	**34**	**High**
Healdsburg	14.58%	High	3	3	**36**	**High**
Petaluma	4.99%	Low	1	1	**32**	**Medium**
Rohnert Park	10.36%	High	3	3	**36**	**High**
Santa Rosa	14.40%	High	3	3	**36**	**High**
Sebastopol	3.31%	Low	1	1	**32**	**Medium**
Sonoma	1.64%	Low	1	1	**32**	**Medium**
Windsor	9.70%	Medium	2	2	**34**	**High**
1st Supervisorial District	6.52%	Medium	2	2	**34**	**High**
2nd Supervisorial District	3.25%	Low	1	1	**32**	**Medium**
3rd Supervisorial District	8.98%	Medium	2	2	**34**	**High**
4th Supervisorial District	12.12%	High	3	3	**36**	**High**
5th Supervisorial District	4.49%	Low	1	1	**32**	**Medium**
TOTAL	8.48%	Medium	2	2	**34**	**High**

Earthquake Rodgers Cr M7.19

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	Medium	2	100.00%	High	3	9
Cotati	Medium	2	100.00%	High	3	9
Healdsburg	Medium	2	100.00%	High	3	9
Petaluma	Medium	2	100.00%	High	3	9
Rohnert Park	Medium	2	100.00%	High	3	9
Santa Rosa	Medium	2	100.00%	High	3	9
Sebastopol	Medium	2	100.00%	High	3	9
Sonoma	Medium	2	100.00%	High	3	9
Windsor	Medium	2	100.00%	High	3	9
1st Supervisorial District	Medium	2	100.00%	High	3	9
2nd Supervisorial District	Medium	2	100.00%	High	3	9
3rd Supervisorial District	Medium	2	100.00%	High	3	9
4th Supervisorial District	Medium	2	100.00%	High	3	9
5th Supervisorial District	Medium	2	100.00%	High	3	9
TOTAL	Medium	2	100.00%	High	3	9

Earthquake Rodgers Cr M7.19

	Impact on Property			
	% of Total Value Exposed	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	100.00%	High	3	6
Cotati	100.00%	High	3	6
Healdsburg	100.00%	High	3	6
Petaluma	100.00%	High	3	6
Rohnert Park	100.00%	High	3	6
Santa Rosa	100.00%	High	3	6
Sebastopol	100.00%	High	3	6
Sonoma	100.00%	High	3	6
Windsor	100.00%	High	3	6
1st Supervisorial District	100.00%	High	3	6
2nd Supervisorial District	100.00%	High	3	6
3rd Supervisorial District	100.00%	High	3	6
4th Supervisorial District	100.00%	High	3	6
5th Supervisorial District	100.00%	High	3	6
TOTAL	100.00%	High	3	6

Earthquake Rodgers Cr M7.19

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	14.98%	High	3	3	36	High
Cotati	9.83%	Medium	2	2	34	High
Healdsburg	17.19%	High	3	3	36	High
Petaluma	12.62%	High	3	3	36	High
Rohnert Park	13.86%	High	3	3	36	High
Santa Rosa	16.66%	High	3	3	36	High
Sebastopol	4.07%	Low	1	1	32	Medium
Sonoma	9.05%	Medium	2	2	34	High
Windsor	11.50%	High	3	3	36	High
1st Supervisorial District	11.44%	High	3	3	36	High
2nd Supervisorial District	7.68%	Medium	2	2	34	High
3rd Supervisorial District	13.83%	High	3	3	36	High
4th Supervisorial District	12.26%	High	3	3	36	High
5th Supervisorial District	5.45%	Medium	2	2	34	High
TOTAL	11.19%	High	3	3	36	High

Earthquake San Andreas M8.04

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	Medium	2	100.00%	High	3	9
Cotati	Medium	2	100.00%	High	3	9
Healdsburg	Medium	2	100.00%	High	3	9
Petaluma	Medium	2	100.00%	High	3	9
Rohnert Park	Medium	2	100.00%	High	3	9
Santa Rosa	Medium	2	100.00%	High	3	9
Sebastopol	Medium	2	100.00%	High	3	9
Sonoma	Medium	2	100.00%	High	3	9
Windsor	Medium	2	100.00%	High	3	9
1st Supervisorial District	Medium	2	100.00%	High	3	9
2nd Supervisorial District	Medium	2	100.00%	High	3	9
3rd Supervisorial District	Medium	2	100.00%	High	3	9
4th Supervisorial District	Medium	2	100.00%	High	3	9
5th Supervisorial District	Medium	2	100.00%	High	3	9
TOTAL	Medium	2	100.00%	High	3	9

RISK RANKING-Earth

	Impact on Property			
	% of Total Value Exposed	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	100.00%	High	3	6
Cotati	100.00%	High	3	6
Healdsburg	100.00%	High	3	6
Petaluma	100.00%	High	3	6
Rohnert Park	100.00%	High	3	6
Santa Rosa	100.00%	High	3	6
Sebastopol	100.00%	High	3	6
Sonoma	100.00%	High	3	6
Windsor	100.00%	High	3	6
1st Supervisorial District	100.00%	High	3	6
2nd Supervisorial District	100.00%	High	3	6
3rd Supervisorial District	100.00%	High	3	6
4th Supervisorial District	100.00%	High	3	6
5th Supervisorial District	100.00%	High	3	6
TOTAL	100.00%	High	3	6

quake San Andreas M8.04

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	3.74%	Low	1	1	32	Medium
Cotati	6.38%	Medium	2	2	34	High
Healdsburg	4.71%	Low	1	1	32	Medium
Petaluma	9.85%	Medium	2	2	34	High
Rohnert Park	9.93%	Medium	2	2	34	High
Santa Rosa	5.41%	Medium	2	2	34	High
Sebastopol	4.32%	Low	1	1	32	Medium
Sonoma	1.79%	Low	1	1	32	Medium
Windsor	3.72%	Low	1	1	32	Medium
1st Supervisorial District	3.07%	Low	1	1	32	Medium
2nd Supervisorial District	5.52%	Medium	2	2	34	High
3rd Supervisorial District	4.77%	Low	1	1	32	Medium
4th Supervisorial District	5.01%	Medium	2	2	34	High
5th Supervisorial District	10.21%	High	3	3	36	High
TOTAL	6.64%	Medium	2	2	34	High

Earthquake 100-yr Probabilistic

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	Medium	2	100.00%	High	3	9
Cotati	Medium	2	100.00%	High	3	9
Healdsburg	Medium	2	100.00%	High	3	9
Petaluma	Medium	2	100.00%	High	3	9
Rohnert Park	Medium	2	100.00%	High	3	9
Santa Rosa	Medium	2	100.00%	High	3	9
Sebastopol	Medium	2	100.00%	High	3	9
Sonoma	Medium	2	100.00%	High	3	9
Windsor	Medium	2	100.00%	High	3	9
1st Supervisorial District	Medium	2	100.00%	High	3	9
2nd Supervisorial District	Medium	2	100.00%	High	3	9
3rd Supervisorial District	Medium	2	100.00%	High	3	9
4th Supervisorial District	Medium	2	100.00%	High	3	9
5th Supervisorial District	Medium	2	100.00%	High	3	9
TOTAL	Medium	2	100.00%	High	3	9

RISK RANKING-Earth

	Impact on Property			
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	100.00%	High	3	6
Cotati	100.00%	High	3	6
Healdsburg	100.00%	High	3	6
Petaluma	100.00%	High	3	6
Rohnert Park	100.00%	High	3	6
Santa Rosa	100.00%	High	3	6
Sebastopol	100.00%	High	3	6
Sonoma	100.00%	High	3	6
Windsor	100.00%	High	3	6
1st Supervisorial District	100.00%	High	3	6
2nd Supervisorial District	100.00%	High	3	6
3rd Supervisorial District	100.00%	High	3	6
4th Supervisorial District	100.00%	High	3	6
5th Supervisorial District	100.00%	High	3	6
TOTAL	100.00%	High	3	6

quake 100-yr Probabilistic

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	4.83%	Low	1	1	32	Medium
Cotati	6.31%	Medium	2	2	34	High
Healdsburg	5.93%	Medium	2	2	34	High
Petaluma	8.31%	Medium	2	2	34	High
Rohnert Park	10.45%	High	3	3	36	High
Santa Rosa	7.80%	Medium	2	2	34	High
Sebastopol	3.16%	Low	1	1	32	Medium
Sonoma	3.13%	Low	1	1	32	Medium
Windsor	5.55%	Medium	2	2	34	High
1st Supervisorial District	6.59%	Medium	2	2	34	High
2nd Supervisorial District	4.18%	Low	1	1	32	Medium
3rd Supervisorial District	4.77%	Low	1	1	32	Medium
4th Supervisorial District	7.03%	Medium	2	2	34	High
5th Supervisorial District	5.46%	Medium	2	2	34	High
TOTAL	6.58%	Medium	2	2	34	High

Flood 100-yr

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	High	3	1.44%	Low	1	3
Cotati	High	3	8.16%	Low	1	3
Healdsburg	High	3	0.02%	Low	1	3
Petaluma	High	3	0.44%	Low	1	3
Rohnert Park	High	3	0.32%	Low	1	3
Santa Rosa	High	3	0.16%	Low	1	3
Sebastopol	High	3	2.21%	Low	1	3
Sonoma	High	3	0.78%	Low	1	3
Windsor	High	3	0.76%	Low	1	3
1st Supervisorial District	High	3	1.16%	Low	1	3
2nd Supervisorial District	High	3	1.23%	Low	1	3
3rd Supervisorial District	High	3	6.98%	Low	1	3
4th Supervisorial District	High	3	0.80%	Low	1	3
5th Supervisorial District	High	3	10.33%	Medium	2	6
Total	High	3	1.60%	Low	1	3

RISK RANKING-100-yr Flood

	Impact on Property			
	% of Total Value Exposed	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	0.93%	Low	1	2
Cotati	7.47%	Low	1	2
Healdsburg	2.96%	Low	1	2
Petaluma	9.57%	Low	1	2
Rohnert Park	2.74%	Low	1	2
Santa Rosa	1.30%	Low	1	2
Sebastopol	12.49%	Medium	2	4
Sonoma	1.57%	Low	1	2
Windsor	1.21%	Low	1	2
1st Supervisorial District	3.86%	Low	1	2
2nd Supervisorial District	8.93%	Low	1	2
3rd Supervisorial District	12.29%	Medium	2	4
4th Supervisorial District	7.42%	Low	1	2
5th Supervisorial District	7.96%	Low	1	2
Total	5.65%	Low	1	2

Flood 100-yr

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	0.23%	Low	1	1	**18**	**Medium**
Cotati	0.12%	Low	1	1	**18**	**Medium**
Healdsburg	1.21%	Low	1	1	**18**	**Medium**
Petaluma	0.48%	Low	1	1	**18**	**Medium**
Rohnert Park	0.14%	Low	1	1	**18**	**Medium**
Santa Rosa	0.43%	Low	1	1	**18**	**Medium**
Sebastopol	1.27%	Low	1	1	**24**	**Medium**
Sonoma	0.11%	Low	1	1	**18**	**Medium**
Windsor	0.04%	Low	1	1	**18**	**Medium**
1st Supervisorial District	1.16%	Low	1	1	**18**	**Medium**
2nd Supervisorial District	1.99%	Low	1	1	**18**	**Medium**
3rd Supervisorial District	0.73%	Low	1	1	**24**	**Medium**
4th Supervisorial District	3.21%	Low	1	1	**18**	**Medium**
5th Supervisorial District	3.76%	Low	1	1	**27**	**Medium**
Total	1.78%	Low	1	1	**18**	**Medium**

Flood 500-yr

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	**Probability Factor (3,2,1,0)**	**% Population Exposed**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	Medium	2	1.44%	Low	1	3
Cotati	Medium	2	20.12%	Medium	2	6
Healdsburg	Medium	2	0.02%	Low	1	3
Petaluma	Medium	2	3.37%	Low	1	3
Rohnert Park	Medium	2	1.33%	Low	1	3
Santa Rosa	Medium	2	0.89%	Low	1	3
Sebastopol	Medium	2	2.73%	Low	1	3
Sonoma	Medium	2	20.20%	Medium	2	6
Windsor	Medium	2	6.87%	Low	1	3
1st Supervisorial District	Medium	2	1.74%	Low	1	3
2nd Supervisorial District	Medium	2	1.88%	Low	1	3
3rd Supervisorial District	Medium	2	12.08%	Medium	2	6
4th Supervisorial District	Medium	2	2.44%	Low	1	3
5th Supervisorial District	Medium	2	11.87%	Medium	2	6
Total	Medium	2	3.68%	Low	1	3

RISK RANKING-500-yr Flood

	Impact on Property			
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	2.28%	Low	1	2
Cotati	19.59%	Medium	2	4
Healdsburg	3.23%	Low	1	2
Petaluma	16.27%	Medium	2	4
Rohnert Park	3.46%	Low	1	2
Santa Rosa	2.30%	Low	1	2
Sebastopol	15.74%	Medium	2	4
Sonoma	16.28%	Medium	2	4
Windsor	7.41%	Low	1	2
1st Supervisorial District	4.18%	Low	1	2
2nd Supervisorial District	11.01%	Medium	2	4
3rd Supervisorial District	25.74%	High	3	6
4th Supervisorial District	10.48%	Medium	2	4
5th Supervisorial District	9.04%	Low	1	2
Total	8.05%	Low	1	2

Flood 500-yr

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	0.24%	Low	1	1	**12**	**Low**
Cotati	0.58%	Low	1	1	**22**	**Medium**
Healdsburg	1.28%	Low	1	1	**12**	**Low**
Petaluma	0.86%	Low	1	1	**16**	**Medium**
Rohnert Park	0.14%	Low	1	1	**12**	**Low**
Santa Rosa	0.49%	Low	1	1	**12**	**Low**
Sebastopol	1.68%	Low	1	1	**16**	**Medium**
Sonoma	0.66%	Low	1	1	**22**	**Medium**
Windsor	0.14%	Low	1	1	**12**	**Low**
1st Supervisorial District	1.20%	Low	1	1	**12**	**Low**
2nd Supervisorial District	2.13%	Low	1	1	**16**	**Medium**
3rd Supervisorial District	1.50%	Low	1	1	**26**	**Medium**
4th Supervisorial District	3.61%	Low	1	1	**16**	**Medium**
5th Supervisorial District	4.30%	Low	1	1	**18**	**Medium**
Total	2.05%	Low	1	1	**12**	**Low**

Flood Awareness Areas

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	High	3	0.89%	Low	1	3
Cotati	High	3	0.00%	None	0	0
Healdsburg	High	3	0.05%	Low	1	3
Petaluma	High	3	0.15%	Low	1	3
Rohnert Park	High	3	0.00%	None	0	0
Santa Rosa	High	3	0.01%	None	0	0
Sebastopol	High	3	1.04%	Low	1	3
Sonoma	High	3	0.10%	Low	1	3
Windsor	High	3	0.05%	Low	1	3
1st Supervisorial District	High	3	1.55%	Low	1	3
2nd Supervisorial District	High	3	0.56%	Low	1	3
3rd Supervisorial District	High	3	0.00%	None	0	0
4th Supervisorial District	High	3	4.20%	Low	1	3
5th Supervisorial District	High	3	12.71%	Medium	2	6
Total	High	3	1.55%	Low	1	3

RISK RANKING - Flood Awareness Areas (3)

	Impact on Property				Impact on Economy					
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	5.16%	Low	1	2	5.16%	Medium	2	2	**21**	**Medium**
Cotati	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Healdsburg	1.39%	Low	1	2	1.39%	Low	1	1	**18**	**Medium**
Petaluma	1.19%	Low	1	2	1.19%	Low	1	1	**18**	**Medium**
Rohnert Park	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Santa Rosa	0.81%	Low	1	2	0.81%	Low	1	1	**9**	**Low**
Sebastopol	9.92%	Low	1	2	9.92%	Medium	2	2	**21**	**Medium**
Sonoma	0.03%	Low	1	2	0.03%	Low	1	1	**18**	**Medium**
Windsor	0.40%	Low	1	2	0.40%	Low	1	1	**18**	**Medium**
1st Supervisorial District	2.31%	Low	1	2	2.31%	Low	1	1	**18**	**Medium**
2nd Supervisorial District	4.50%	Low	1	2	4.50%	Low	1	1	**18**	**Medium**
3rd Supervisorial District	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
4th Supervisorial District	9.52%	Low	1	2	9.52%	Medium	2	2	**21**	**Medium**
5th Supervisorial District	9.88%	Low	1	2	9.88%	Medium	2	2	**30**	**Medium**
Total	4.68%	Low	1	2	4.68%	Low	1	1	**18**	**Medium**

Landslide

	RISK					
	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	High	3	20.18%	Medium	2	6
Cotati	High	3	2.57%	Low	1	3
Healdsburg	High	3	10.97%	Medium	2	6
Petaluma	High	3	12.28%	Medium	2	6
Rohnert Park	High	3	0.14%	Low	1	3
Santa Rosa	High	3	7.08%	Low	1	3
Sebastopol	High	3	4.42%	Low	1	3
Sonoma	High	3	2.94%	Low	1	3
Windsor	High	3	2.56%	Low	1	3
1st Supervisorial District	High	3	22.26%	Medium	2	6
2nd Supervisorial District	High	3	7.62%	Low	1	3
3rd Supervisorial District	High	3	8.46%	Low	1	3
4th Supervisorial District	High	3	23.81%	Medium	2	6
5th Supervisorial District	High	3	41.39%	High	3	9
Total	High	3	12.09%	Medium	2	6

RANKING- Landslide Hazard (Categories Very High & High)

	Impact on Property				Impact on Economy					
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	17.79%	Medium	2	4	4.45%	Low	1	1	**33**	**High**
Cotati	4.50%	Low	1	2	1.13%	Low	1	1	**18**	**Medium**
Healdsburg	8.63%	Low	1	2	2.16%	Low	1	1	**27**	**Medium**
Petaluma	9.97%	Low	1	2	2.49%	Low	1	1	**27**	**Medium**
Rohnert Park	0.08%	Low	1	2	0.02%	Low	1	1	**18**	**Medium**
Santa Rosa	8.16%	Low	1	2	2.04%	Low	1	1	**18**	**Medium**
Sebastopol	4.47%	Low	1	2	1.12%	Low	1	1	**18**	**Medium**
Sonoma	4.65%	Low	1	2	1.16%	Low	1	1	**18**	**Medium**
Windsor	2.06%	Low	1	2	0.51%	Low	1	1	**18**	**Medium**
1st Supervisorial District	36.39%	High	3	6	9.10%	Medium	2	2	**42**	**High**
2nd Supervisorial District	15.10%	Medium	2	4	3.78%	Low	1	1	**24**	**Medium**
3rd Supervisorial District	4.45%	Low	1	2	1.11%	Low	1	1	**18**	**Medium**
4th Supervisorial District	39.95%	High	3	6	9.99%	Medium	2	2	**42**	**High**
5th Supervisorial District	55.21%	High	3	6	13.80%	High	3	3	**54**	**High**
Total	26.70%	High	3	6	6.67%	Medium	2	2	**42**	**High**

SLR 200cm No Storm

	RISK RA						
	Probability		Impact on People				Impact on Pr
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed
Cloverdale	High	3	0.00%	None	0	0	0.00%
Cotati	High	3	0.00%	None	0	0	0.00%
Healdsburg	High	3	0.00%	None	0	0	0.00%
Petaluma	High	3	0.34%	Low	1	3	2.66%
Rohnert Park	High	3	0.00%	None	0	0	0.00%
Santa Rosa	High	3	0.00%	None	0	0	0.00%
Sebastopol	High	3	0.00%	None	0	0	0.00%
Sonoma	High	3	0.00%	None	0	0	0.00%
Windsor	High	3	0.00%	None	0	0	0.00%
1st Supervisorial District	High	3	0.06%	Low	1	3	2.12%
2nd Supervisorial District	High	3	0.12%	Low	1	3	3.02%
3rd Supervisorial District	High	3	0.00%	None	0	0	0.00%
4th Supervisorial District	High	3	0.00%	None	0	0	0.00%
5th Supervisorial District	High	3	0.23%	Low	1	3	0.36%
Total	High	3	0.07%	Low	1	3	0.78%

.NKING - Sea Level Rise 200cm No Storm (3)

	roperty			Impact on Economy					
	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	None	0	0	0.00%	None	0	0	**0**	**Low**
Cotati	None	0	0	0.00%	None	0	0	**0**	**Low**
Healdsburg	None	0	0	0.00%	None	0	0	**0**	**Low**
Petaluma	Low	1	2	0.27%	Low	1	1	**18**	**Medium**
Rohnert Park	None	0	0	0.00%	None	0	0	**0**	**Low**
Santa Rosa	None	0	0	0.00%	None	0	0	**0**	**Low**
Sebastopol	None	0	0	0.00%	None	0	0	**0**	**Low**
Sonoma	None	0	0	0.00%	None	0	0	**0**	**Low**
Windsor	None	0	0	0.00%	None	0	0	**0**	**Low**
1st Supervisorial District	Low	1	2	0.21%	Low	1	1	**18**	**Medium**
2nd Supervisorial District	Low	1	2	0.30%	Low	1	1	**18**	**Medium**
3rd Supervisorial District	None	0	0	0.00%	None	0	0	**0**	**Low**
4th Supervisorial District	None	0	0	0.00%	None	0	0	**0**	**Low**
5th Supervisorial District	Low	1	2	0.04%	Low	1	1	**18**	**Medium**
Total	Low	1	2	0.08%	Low	1	1	**18**	**Medium**

SLR 200cm 100-yr Storm

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	High	3	0.00%	None	0	0
Cotati	High	3	0.00%	None	0	0
Healdsburg	High	3	0.00%	None	0	0
Petaluma	High	3	1.42%	Low	1	3
Rohnert Park	High	3	0.00%	None	0	0
Santa Rosa	High	3	0.00%	None	0	0
Sebastopol	High	3	0.00%	None	0	0
Sonoma	High	3	0.00%	None	0	0
Windsor	High	3	0.00%	None	0	0
1st Supervisorial District	High	3	0.09%	Low	1	3
2nd Supervisorial District	High	3	0.12%	Low	1	3
3rd Supervisorial District	High	3	0.00%	None	0	0
4th Supervisorial District	High	3	0.00%	None	0	0
5th Supervisorial District	High	3	0.39%	Low	1	3
Total	High	3	0.23%	Low	1	3

RISK RANKING - Sea Level Rise 200cm 100-yr Storm (3

Impact on Property

	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	0.00%	None	0	0
Cotati	0.00%	None	0	0
Healdsburg	0.00%	None	0	0
Petaluma	7.64%	Low	1	2
Rohnert Park	0.00%	None	0	0
Santa Rosa	0.00%	None	0	0
Sebastopol	0.00%	None	0	0
Sonoma	0.00%	None	0	0
Windsor	0.00%	None	0	0
1st Supervisorial District	2.53%	Low	1	2
2nd Supervisorial District	3.38%	Low	1	2
3rd Supervisorial District	0.00%	None	0	0
4th Supervisorial District	0.00%	None	0	0
5th Supervisorial District	0.60%	Low	1	2
Total	1.34%	Low	1	2

SLR 200cm 100-yr Storm

)

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	0.00%	None	0	0	0	Low
Cotati	0.00%	None	0	0	0	Low
Healdsburg	0.00%	None	0	0	0	Low
Petaluma	0.76%	Low	1	1	18	Medium
Rohnert Park	0.00%	None	0	0	0	Low
Santa Rosa	0.00%	None	0	0	0	Low
Sebastopol	0.00%	None	0	0	0	Low
Sonoma	0.00%	None	0	0	0	Low
Windsor	0.00%	None	0	0	0	Low
1st Supervisorial District	0.25%	Low	1	1	18	Medium
2nd Supervisorial District	0.34%	Low	1	1	18	Medium
3rd Supervisorial District	0.00%	None	0	0	0	Low
4th Supervisorial District	0.00%	None	0	0	0	Low
5th Supervisorial District	0.06%	Low	1	1	18	Medium
Total	0.13%	Low	1	1	18	Medium

Tsunami

	Probability		Impact on People			
	Probability (High, Medium, Low, None)	**Probability Factor (3,2,1,0)**	**% Population Exposed**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	Low	1	0.00%	None	0	0
Cotati	Low	1	0.00%	None	0	0
Healdsburg	Low	1	0.00%	None	0	0
Petaluma	Low	1	0.00%	None	0	0
Rohnert Park	Low	1	0.00%	None	0	0
Santa Rosa	Low	1	0.00%	None	0	0
Sebastopol	Low	1	0.00%	None	0	0
Sonoma	Low	1	0.00%	None	0	0
Windsor	Low	1	0.00%	None	0	0
1st Supervisorial District	Low	1	0.00%	None	0	0
2nd Supervisorial District	Low	1	0.00%	None	0	0
3rd Supervisorial District	Low	1	0.00%	None	0	0
4th Supervisorial District	Low	1	0.00%	None	0	0
5th Supervisorial District	Low	1	0.23%	Low	1	3
Total	Low	1	0.02%	Low	1	3

RISK RANKING - Tsunami Zone (3)

	Impact on Property			
	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	0.00%	None	0	0
Cotati	0.00%	None	0	0
Healdsburg	0.00%	None	0	0
Petaluma	0.00%	None	0	0
Rohnert Park	0.00%	None	0	0
Santa Rosa	0.00%	None	0	0
Sebastopol	0.00%	None	0	0
Sonoma	0.00%	None	0	0
Windsor	0.00%	None	0	0
1st Supervisorial District	0.00%	None	0	0
2nd Supervisorial District	0.11%	Low	1	2
3rd Supervisorial District	0.00%	None	0	0
4th Supervisorial District	0.00%	None	0	0
5th Supervisorial District	0.14%	Low	1	2
Total	0.04%	Low	1	2

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	0.00%	None	0	0	0	Low
Cotati	0.00%	None	0	0	0	Low
Healdsburg	0.00%	None	0	0	0	Low
Petaluma	0.00%	None	0	0	0	Low
Rohnert Park	0.00%	None	0	0	0	Low
Santa Rosa	0.00%	None	0	0	0	Low
Sebastopol	0.00%	None	0	0	0	Low
Sonoma	0.00%	None	0	0	0	Low
Windsor	0.00%	None	0	0	0	Low
1st Supervisorial District	0.00%	None	0	0	0	Low
2nd Supervisorial District	0.01%	Low	1	1	3	Low
3rd Supervisorial District	0.00%	None	0	0	0	Low
4th Supervisorial District	0.00%	None	0	0	0	Low
5th Supervisorial District	0.01%	Low	1	1	6	Low
Total	0.00%	None	0	0	5	Low

	RISK I					
	Probability		**Impact on People**			
	Probability (High, Medium, Low, None)	**Probability Factor (3,2,1,0)**	**% Population Exposed**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**
Cloverdale	High	3	0.72%	Low	1	3
Cotati	High	3	0.33%	Low	1	3
Healdsburg	High	3	0.40%	Low	1	3
Petaluma	High	3	0.11%	Low	1	3
Rohnert Park	High	3	0.00%	None	0	0
Santa Rosa	High	3	0.66%	Low	1	3
Sebastopol	High	3	0.52%	Low	1	3
Sonoma	High	3	1.17%	Low	1	3
Windsor	High	3	0.11%	Low	1	3
1st Supervisorial District	High	3	11.48%	Medium	2	6
2nd Supervisorial District	High	3	1.41%	Low	1	3
3rd Supervisorial District	High	3	1.48%	Low	1	3
4th Supervisorial District	High	3	6.03%	Low	1	3
5th Supervisorial District	High	3	4.49%	Low	1	3
Total	High	3	1.96%	Low	1	3

RANKING- Wildfire Hazard (Very High & High Relative H

Impact on Property

	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor
Cloverdale	2.57%	Low	1	2
Cotati	0.20%	Low	1	2
Healdsburg	0.83%	Low	1	2
Petaluma	1.03%	Low	1	2
Rohnert Park	0.00%	None	0	0
Santa Rosa	1.09%	Low	1	2
Sebastopol	0.20%	Low	1	2
Sonoma	2.08%	Low	1	2
Windsor	0.38%	Low	1	2
1st Supervisorial District	28.99%	High	3	6
2nd Supervisorial District	2.91%	Low	1	2
3rd Supervisorial District	1.95%	Low	1	2
4th Supervisorial District	21.59%	Medium	2	4
5th Supervisorial District	20.07%	Medium	2	4
Total	11.54%	Medium	2	4

lazard)

	Impact on Economy					
	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Cloverdale	1.29%	Low	1	1	**18**	**Medium**
Cotati	0.10%	Low	1	1	**18**	**Medium**
Healdsburg	0.42%	Low	1	1	**18**	**Medium**
Petaluma	0.51%	Low	1	1	**18**	**Medium**
Rohnert Park	0.00%	None	0	0	**0**	**Low**
Santa Rosa	0.55%	Low	1	1	**18**	**Medium**
Sebastopol	0.10%	Low	1	1	**18**	**Medium**
Sonoma	1.04%	Low	1	1	**18**	**Medium**
Windsor	0.19%	Low	1	1	**18**	**Medium**
1st Supervisorial District	14.49%	High	3	3	**45**	**High**
2nd Supervisorial District	1.46%	Low	1	1	**18**	**Medium**
3rd Supervisorial District	0.98%	Low	1	1	**18**	**Medium**
4th Supervisorial District	10.79%	High	3	3	**30**	**Medium**
5th Supervisorial District	10.03%	High	3	3	**30**	**Medium**
Total	5.77%	Medium	2	2	**27**	**Medium**

CRITICAL FACILITY EXPOSURE
RESULTS BY JURISDICTION

Total Count

All Facilities

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	2	1	5	29	4	15	2	**58**
Cotati	1	0	0	45	4	17	1	**68**
Healdsburg	10	0	5	45	10	20	2	**92**
Petaluma	20	2	11	128	22	70	6	**259**
Rohnert Park	10	2	4	191	9	34	1	**251**
Santa Rosa	55	3	37	354	93	209	5	**756**
Sebastopol	7	0	3	27	13	19	0	**69**
Sonoma	11	1	3	65	11	19	0	**110**
Windsor	6	0	6	105	9	16	1	**143**
1st Supervisorial District	25	5	11	431	10	45	63	**590**
2nd Supervisorial District	7	8	7	340	4	31	45	**442**
3rd Supervisorial District	3	1	1	65	1	5	1	**77**
4th Supervisorial District	17	44	16	703	10	48	89	**927**
5th Supervisorial District	17	7	22	581	19	102	169	**917**
Total	**191**	**74**	**131**	**3,109**	**219**	**650**	**385**	**4,759**

Dam Failure Combined Count

Dam Failure Combined

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	0	0	0	0	**0**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	10	0	4	43	10	19	1	**87**
Petaluma	0	0	0	0	0	0	0	**0**
Rohnert Park	0	0	1	43	0	0	0	**44**
Santa Rosa	24	3	11	143	35	68	2	**286**
Sebastopol	5	0	2	18	3	8	0	**36**
Sonoma	0	0	0	0	0	0	0	**0**
Windsor	5	0	5	36	4	13	1	**64**
1st Supervisorial District	0	0	1	4	0	1	7	**13**
2nd Supervisorial District	1	1	0	5	0	0	5	**12**
3rd Supervisorial District	0	0	0	7	0	0	1	**8**
4th Supervisorial District	1	4	3	251	1	3	42	**305**
5th Supervisorial District	2	2	7	110	8	19	56	**204**
Total	**48**	**10**	**34**	**660**	**61**	**131**	**115**	**1,059**

NEHRP Soils D & E

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	2	1	4	19	3	13	2	**44**
Cotati	0	0	0	25	1	2	1	**29**
Healdsburg	8	0	2	21	4	8	0	**43**
Petaluma	19	2	7	111	15	53	6	**213**
Rohnert Park	10	2	4	191	9	34	1	**251**
Santa Rosa	48	3	20	313	74	178	4	**640**
Sebastopol	0	0	1	8	1	1	0	**11**
Sonoma	0	1	0	18	2	9	0	**30**
Windsor	6	0	5	56	6	8	0	**81**
1st Supervisorial District	2	2	6	236	5	22	53	**326**
2nd Supervisorial District	1	5	3	153	3	7	40	**212**
3rd Supervisorial District	0	1	1	64	1	5	1	**73**
4th Supervisorial District	1	10	9	313	7	28	61	**429**
5th Supervisorial District	2	1	6	169	12	39	84	**313**
Total	**99**	**28**	**68**	**1,697**	**143**	**407**	**253**	**2,695**

Flood 100-yr Count

Flood 100-yr

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	0	0	0	0	**0**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	4	0	0	0	**4**
Petaluma	1	1	0	25	2	2	2	**33**
Rohnert Park	0	0	0	5	3	1	0	**9**
Santa Rosa	0	1	1	4	0	0	0	**6**
Sebastopol	0	0	1	11	1	2	0	**15**
Sonoma	0	1	0	1	0	0	0	**2**
Windsor	0	0	0	5	0	0	0	**5**
1st Supervisorial District	1	2	0	34	0	1	26	**64**
2nd Supervisorial District	0	0	1	43	0	2	22	**68**
3rd Supervisorial District	0	1	0	14	0	1	1	**17**
4th Supervisorial District	0	0	2	13	0	0	27	**42**
5th Supervisorial District	0	1	3	40	5	11	52	**112**
Total	**2**	**7**	**8**	**199**	**11**	**20**	**130**	**377**

Flood 500-yr Count

Flood 500-yr

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	1	0	0	0	**1**
Cotati	0	0	0	4	2	0	0	**6**
Healdsburg	0	0	0	4	0	0	0	**4**
Petaluma	7	1	0	35	5	5	3	**56**
Rohnert Park	0	0	0	5	3	1	0	**9**
Santa Rosa	0	1	3	7	0	1	0	**12**
Sebastopol	0	0	1	13	1	4	0	**19**
Sonoma	2	1	0	10	1	4	0	**18**
Windsor	3	0	0	16	0	0	0	**19**
1st Supervisorial District	1	2	0	35	0	1	26	**65**
2nd Supervisorial District	1	1	1	52	0	3	22	**80**
3rd Supervisorial District	0	1	0	29	0	1	1	**32**
4th Supervisorial District	0		2	64	1	2	28	**97**
5th Supervisorial District	2	1	5	47	7	13	57	**132**
Total	**16**	**8**	**12**	**322**	**20**	**35**	**137**	**550**

Flood Awareness Areas Count

Flood Awareness Areas

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	1	1	1	0	0	1	**4**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	1	0	0	0	**1**
Petaluma	0	0	0	6	0	0	2	**8**
Rohnert Park	0	0	0	0	0	0	0	**0**
Santa Rosa	0	0	1	2	0	0	0	**3**
Sebastopol	0	0	1	10	1	1	0	**13**
Sonoma	0	0	0	0	0	0	0	**0**
Windsor	0	0	0	0	0	0	0	**0**
1st Supervisorial District	0	0	1	21	0	0	48	**70**
2nd Supervisorial District	0	1	0	5	0	0	33	**39**
3rd Supervisorial District	0	0	0	0	0	0	0	**0**
4th Supervisorial District	0	0	2	37	0	0	61	**100**
5th Supervisorial District	2	1	4	59	7	14	93	**180**
Total	**2**	**3**	**10**	**142**	**8**	**15**	**238**	**418**

Landslide Count

Landslide Very High & High

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	3	1	0	0	**4**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	2	0	1	0	**3**
Petaluma	1	0	0	9	2	11	1	**24**
Rohnert Park	0	0	0	0	0	0	0	**0**
Santa Rosa	1	0	6	11	6	7	0	**31**
Sebastopol	0	0	0	1	0	0	0	**1**
Sonoma	0	0	1	1	0	1	0	**3**
Windsor	0	0	0	0	0	0	0	**0**
1st Supervisorial District	14	1	3	70	0	9	32	**129**
2nd Supervisorial District	1	2	1	27	1	1	8	**41**
3rd Supervisorial District	3	0	0	3	0	0	0	**6**
4th Supervisorial District	6	12	4	168	0	6	39	**235**
5th Supervisorial District	6	2	11	91	5	35	93	**243**
Total	**32**	**17**	**26**	**386**	**15**	**71**	**173**	**720**

SLR 200cm No Storm Count

Sea Level Rise 200 cm No Storm

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	0	0	0	0	**0**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	0	0	0	0	**0**
Petaluma	2	0	0	6	1	2	0	**11**
Rohnert Park	0	0	0	0	0	0	0	**0**
Santa Rosa	0	0	0	0	0	0	0	**0**
Sebastopol	0	0	0	0	0	0	0	**0**
Sonoma	0	0	0	0	0	0	0	**0**
Windsor	0	0	0	0	0	0	0	**0**
1st Supervisorial District	1	1	0	4	0	0	3	**9**
2nd Supervisorial District	0	0	1	12	0	1	5	**19**
3rd Supervisorial District	0	0	0	0	0	0	0	**0**
4th Supervisorial District	0	0	0	0	0	0	0	**0**
5th Supervisorial District	0	0	0	2	0	1	14	**17**
Total	**3**	**1**	**1**	**24**	**1**	**4**	**22**	**56**

SLR 200cm 100-yr Storm Count

Sea Level Rise 200cm with 100-yr Storm

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	0	0	0	0	**0**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	0	0	0	0	**0**
Petaluma	5	0	0	19	5	7	0	**36**
Rohnert Park	0	0	0	0	0	0	0	**0**
Santa Rosa	0	0	0	0	0	0	0	**0**
Sebastopol	0	0	0	0	0	0	0	**0**
Sonoma	0	0	0	0	0	0	0	**0**
Windsor	0	0	0	0	0	0	0	**0**
1st Supervisorial District	1	2	0	10	0	0	3	**16**
2nd Supervisorial District	0	0	1	42	0	1	5	**49**
3rd Supervisorial District	0	0	0	0	0	0	0	**0**
4th Supervisorial District	0	0	0	0	0	0	0	**0**
5th Supervisorial District	0	0	1	2	1	3	17	**24**
Total	**6**	**2**	**2**	**73**	**6**	**11**	**25**	**125**

Tsunami Count

Tsunami Inundation Area

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	0	0	0	0	**0**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	0	0	0	0	**0**
Petaluma	0	0	0	0	0	0	0	**0**
Rohnert Park	0	0	0	0	0	0	0	**0**
Santa Rosa	0	0	0	0	0	0	0	**0**
Sebastopol	0	0	0	0	0	0	0	**0**
Sonoma	0	0	0	0	0	0	0	**0**
Windsor	0	0	0	0	0	0	0	**0**
1st Supervisorial District	0	0	0	0	0	0	1	**1**
2nd Supervisorial District	0	0	1	0	0	0	5	**6**
3rd Supervisorial District	0	0	0	0	0	0	0	**0**
4th Supervisorial District	0	0	0	0	0	0	0	**0**
5th Supervisorial District	0	0	1	2	0	3	9	**15**
Total	**0**	**0**	**2**	**2**	**0**	**3**	**15**	**22**

Wildfire Count

Wildfire Very High & High Relative Hazard

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
Cloverdale	0	0	0	0	0	0	0	**0**
Cotati	0	0	0	0	0	0	0	**0**
Healdsburg	0	0	0	1	0	0	0	**1**
Petaluma	0	0	0	0	0	0	0	**0**
Rohnert Park	0	0	0	1	0	0	0	**1**
Santa Rosa	0	0	1	6	1	1	0	**9**
Sebastopol	0	0	0	1	0	0	0	**1**
Sonoma	0	0	0	2	0	1	0	**3**
Windsor	0	0	0	1	0	0	0	**1**
1st Supervisorial District	18	0	1	41	0	3	3	**66**
2nd Supervisorial District	2	0	0	3	0	0	1	**6**
3rd Supervisorial District	3	0	0	0	0	0	0	**3**
4th Supervisorial District	6	1	0	26	2	1	6	**42**
5th Supervisorial District	3	0	1	10	0	1	9	**24**
Total	**32**	**1**	**3**	**92**	**3**	**7**	**19**	**157**

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix E. Peak Riverine Discharges in the Planning Area

E. PEAK RIVERINE DISCHARGES IN THE PLANNING AREA

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
Adobe Creek				
Above Petaluma River	1,410	2,033	2,226	2,417
Upstream of Ely Road	1,383	2,084	2,364	2,993
Upstream of confluence of Adobe Creek	*	*	*	*
Diversion Channel	1,084	1,290	1,342	1,372
Airport Creek				
Upstream of confluence of Windsor Creek	943	1,262	1,379	1,678
Upstream of confluence of Redwood Creek	425	562	617	745
Arroyo Seco				
At Cross Section B	1,250	1,910	2,140	2,660
At Cross Section W	725	1,070	1,200	1,470
Austin Creek				
Upstream of confluence of Russian River	14,900	22,100	24,600	30,400
Upstream of confluence of East Austin Creek	8,500	12,400	13,500	16,600
Bloomfield Creek				
Upstream of confluence of Estero Americano	1,000	1,300	1,444	1,720
Cameron Creek				
Upstream of confluence of Fulton Creek	266	345	377	460
Capri Creek				
At Southern Pacific Railroad	247	303	345	393
At Maria Drive	324	466	546	685
At Sonoma Mountain	276	410	463	583
Champlin Creek				
At Cross Section B	325	520	585	725
At Cross Section J	195	315	350	435
Cloverdale Creek				
At confluence of Russian River	*	*	835	*
Colgan Creek				
At Mouth	1,220	1,780	2,019	2,504
At Stony Point Road	1,011	1,340	1,444	1,931
At Bellevue Avenue	777	1,017	1,102	1,312

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
At Hearn Avenue	673	867	908	1,003
At Highway 101	558	787	787	787
At Petaluma Hill Road	157	252	304	452
Corona Creek				
Downstream of confluence with Capri Creek	576	736	765	908
At Highway 101	525	592	610	635
At Ely Road	462	662	727	825
Cotati Creek				
Upstream of confluence of Laguna de Santa Rosa	210	360	405	*
Upstream of Hillview Drive	210	360	440	610
Upstream of Water Avenue	110	180	220	310
Dry Creek				
Upstream of confluence with Russian River	12,500	18,000	21,000	25,000
Upstream of confluence of Mill Creek	8,700	13,000	15,000	18,000
Upstream of confluence of Pena Creek	6,200	6,500	6,900	8,800
Upstream of confluence of Dutcher Creek (Warm Springs Dam Outflow)	6,000	6,000	6,000	7,400
Dutch Bill Creek				
Upstream of confluence of Russian River	2,100	3,400	4,200	5,900
Upstream of confluence of Tyrone Creek	1,900	3,200	3,900	5,600
Downstream of confluence of Duvoul Creek	1,500	2,500	3,000	4,400
Upstream of confluence of Duvoul Creek	1,250	2,080	2,500	3,670
East Austin Creek				
Upstream of confluence with Austin Creek	7,400	11,000	12,300	15,300
East Washington Creek				
Above Washington Creek	515	635	671	692
At Ely Road	479	599	636	710
East Windsor Creek				
Upstream of confluence with Windsor Creek	929	1,223	1,339	1,616
At Highway 101	669	879	963	1,173
At Lakewood Drive	218	286	313	377
Fife Creek				
Upstream of confluence with Russian River	1,600	2,400	2,800	3,900
Downstream of confluence of Sweetwater Creek	1,400	2,100	2,400	3,400
Upstream of confluence of Sweetwater Creek	700	1,100	1,300	1,800
Fowler Creek				
At Cross Section C	9,590	11,200	11,450	12,210
At Cross Section J	2,340	5,800	6,570	10,070
At Cross Section O	2,340	4,660	5,420	8,920
At Cross Section R	2,340	3,880	4,160	6,490

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
At Cross Section AB	1,500	2,400	2,580	3,310
Fryer Creek				
At Leveroni Road	*	*	846	*
At confluence of West Fork Fryer Creek	*	*	818	*
At confluence of East Fork Fryer Creek	*	*	407	*
At Andrieux Street	*	*	395	*
North of Andrieux Street	*	*	380	*
North of Napa Street	*	*	360	*
North of Church Street	*	*	350	*
North of Spain Street	*	*	340	*
West of Fifth Street West	*	*	130	*
North of San Joaquin Drive	*	*	110	*
Fulton Creek				
Upstream of confluence with Mark West Creek	592	800	892	1,060
Gibson Creek				
Upstream of confluence with Marin Creek	185	240	265	322
Hulbert Creek				
Upstream of confluence with Russian River	3,300	4,420	4,860	5,830
Downstream of confluence of Mission Creek	2,910	3,890	4,270	5,120
Upstream of confluence of Mission Creek	2,170	2,910	3,200	3,840
Hulbert Creek Tributary				
Upstream of confluence with Hulbert Creek	650	900	1,010	1,240
Kelly Creek				
Above Thompson Creek	210	325	380	520
Kizer Creek				
Upstream of confluence with Petaluma Creek	322	420	462	555
At Middle Two Rock Road	170	220	245	290
Laguna de Santa Rosa				
Upstream of confluence with Mark West Creek	21,100	30,300	35,100	44,900
Downstream of confluence of Santa Rosa Flood Control Channel	16,800	23,900	28,000	35,700
Upstream of confluence of Santa Rosa Flood Control Channel	14,000	20,100	23,300	30,800
Upstream of confluence of Irwin Creek	13,200	19,100	22,000	29,200
Upstream of confluence of Gravenstein Creek	12,300	18,000	20,500	27,200
Upstream of confluence of Pleasant Hill Creek	11,600	16,900	19,300	25,600
Upstream of confluence of Roseland Creek	10,800	15,800	18,000	23,900
Upstream of confluence of Blucher Creek	9,570	14,000	15,950	21,200
Upstream of confluence of Colgan Creek	7,710	11,200	12,850	17,100
At Stony Point Road	7,170	10,400	11,950	15,900
Downstream of confluence of Hinebaugh Creek	5,550	7,900	9,250	12,000
Upstream of confluence of Hinebaugh Creek	2,280	3,250	3,800	5,000

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
Upstream of confluence with Copeland Creek	977	1,410	1,630	2,120
At U.S. Highway 101	720	1,250	1,500	2,100
Upstream of confluence of Cotati Creek	320	540	660	930
Liberty Creek				
Upstream of confluence with Marin Creek	490	640	710	820
At Pepper Road	180	240	260	320
Lichau Creek				
Upstream of confluence with Willow Brook	1,738	2,310	2,543	3,140
Upstream of confluence of Penngrove Creek	1,480	1,970	2,160	2,700
Upstream of confluence of Meacham Creek	1,280	1,700	1,870	2,300
Upstream of confluence of Highlands Creek	1,030	1,390	1,510	1,890
Lynch Creek				
At Highway 101	902	1,269	1,323	1,440
At Sonoma Mountain	890	1,643	1,994	2,739
Marin Creek				
Upstream of confluence with Petaluma River	1,829	2,400	2,659	3,200
Upstream of confluence of Wiggins Creek	1,040	1,360	1,510	1,815
Upstream of confluence of Wilson Creek	684	906	988	1,209
Upstream of confluence of Gibson Creek	310	410	450	548
Mark West Creek				
Upstream of confluence with Russian River	32,885	46,481	52,700	68,563
Upstream of confluence of Windsor Creek	29,602	42,248	47,900	62,318
Upstream of confluence of Laguna de Santa Rosa	8,172	11,000	12,085	15,000
Downstream of confluence of Wikiup Creek	8,340	11,300	12,430	15,500
Downstream of confluence of Leslie Creek	8,260	11,100	12,300	15,500
Upstream of confluence of Leslie Creek	7,530	10,100	11,200	14,000
McBrown Creek				
Upstream of confluence with Wiggins Creek	175	228	251	305
Mount Hood Creek				
At Cross Section A	1,430	2,090	2,330	2,850
At Cross Section C & M	270	390	440	540
At Cross Section D	1,100	1,390	1,490	1,765
At Cross Section E	375	520	565	665
Nathanson Creek				
At Cross Section A	1,760	2,470	2,780	3,450
At Cross Section G	1,480	2,070	2,320	2,870
At Cross Section O	835	1,260	1,410	1,750
At Napa Road	835	1,250	1,400	1,740
At MacArthur Street	835	1,240	1,390	1,700
At Fourth Street East	840	1,220	1,370	1,670
At Cross Section BZ	835	1,220	1,360	1,650

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
At Lovall Valley Road	710	1,030	1,150	1,400
Naval Creek				
At Mouth	297	462	555	813
At Llano Road	269	424	509	748
North Kenwood Creek				
At Mervin Avenue	310	440	490	600
At Cross Section F	290	460	460	565
At Cross Section G	180	230	250	300
At Chateau St. Jean	140	200	220	270
Petaluma River				
Downstream of confluence with Adobe Creek	8,672	11,034	11,910	15,044
At Highway 101 bridge	6,675	9,149	10,494	13,694
Downstream of confluence of Washington Creek	5,758	8,459	9,757	13,056
Downstream of confluence of Lynch Creek	5,246	7,492	8,671	11,563
Downstream of confluence of Capri Creek	4,653	6,583	7,728	10,523
Downstream of confluence of Willow Brook	3,587	4,825	5,360	6,733
Upstream of confluence of Willow Brook	1,701	2,947	3,529	4,801
Pocket Canyon				
Upstream of confluence with Russian River	1,790	2,650	3,050	3,880
Downstream of confluence of Mays Canyon	1,390	2,050	2,360	2,990
Downstream of confluence of Oregon Canyon	840	1,230	1,400	1,780
Upstream of confluence of Oregon Canyon	580	850	970	1,230
Pool Creek				
Upstream of confluence with Windsor Creek	2,283	2,970	3,258	3,815
Upstream of confluence of Pruitt Creek	1,358	1,874	1,906	2,165
At Highway 101	1,152	1,520	1,677	2,030
At Chalk Hill Road	684	895	987	1,200
Pruitt Creek				
Upstream of confluence with Pool Creek	925	1,210	1,311	1,540
At Shiloh Road (upstream crossing)	876	1,146	1,240	1,455
At Fought Road	535	618	767	930
Redwood Creek				
Upstream of confluence with Airport Creek	490	640	715	880
At NWPER	115	150	160	205
Rodgers Creek				
At Cross Section F	2,340	5,820	6,570	10,000
At Cross Section K	2,340	4,660	5,420	8,920
At Cross Section N	2,340	3,880	4,160	6,490
At Cross Section O	815	1,400	1,490	1,910
At Cross Section S	435	740	790	1,030
At Cross Section T	385	655	700	910

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
Roseland Creek				
At Mouth	622	944	1,106	1,537
At Fresno Avenue	527	781	917	1,294
At Stony Point Road	254	383	452	648
At Burbank Avenue	171	249	290	406
Russian River				
At Pacific Ocean	76,000	102,000	114,000	135,000
Upstream of Duncan Mills	75,000	100,000	112,000	133,000
Upstream of confluence of Austin Creek	74,000	98,000	107,000	131,000
Upstream of Summerhome Gage	73,000	97,000	106,000	130,000
Downstream of confluence of Mark West Creek	67,000	92,000	97,000	126,000
Upstream of confluence of Mark West Creek	60,000	88,000	103,000	140,000
Upstream of confluence of Dry Creek	56,000	79,000	90,000	129,000
Upstream of confluence of Brooks Creek	55,000	78,000	88,000	127,000
Upstream of confluence of Maacama Canal	51,000	73,000	82,000	115,000
Upstream of confluence of Sausal Creek	50,000	71,000	81,000	111,000
Upstream of confluence of Lytton Creek	50,000	70,000	80,000	110,000
Upstream of confluence of Miller Creek	48,000	68,000	79,000	106,000
Upstream of confluence of Gill Creek	47,000	67,000	76,000	105,000
Upstream of confluence of Big Sulphur Creek	46,000	58,000	73,000	100,000
Upstream of confluence of Oat Valley Creek	40,000	56,000	64,000	85,000
Russian River Split Flow				
At Healdsburg Avenue	*	215	640	9,140
Salmon Creek				
Upstream of Bodega Bay	*	*	*	*
Santa Rosa Flood Control Channel				
Downstream of Guerneville Road	21,000	30,300	35,100	44,000
Upstream of confluence of Laguna de Santa Rosa	9,900	14,500	16,500	22,000
Upstream of confluence of Channel No. 3	9,120	13,500	15,200	19,000
Schell Creek				
At Cross Section A	2,710	4,300	4,880	6,140
At Cross Section B	2,650	4,180	4,730	5,940
At Cross Section K	1,830	2,610	2,950	3,680
At Southern Pacific Railroad	1,750	2,470	2,780	3,450
At Cross Section X	1,750	4,400	5,190	8,100
At Cross Section AC	1,750	2,470	2,780	3,450
At Cross Section AI	1,750	2,470	2,780	3,450
At Cross Section AO	205	325	365	455
Sonoma Creek				
At State Route 121	10,590	17,200	18,500	24,200
At Watmaugh Road	9,820	15,500	16,700	21,500

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
At Cross Section AL	9,720	15,200	16,400	21,000
At Cross Section BB	9,280	14,500	15,600	20,000
At Cross Section BL	9,050	14,100	15,000	19,200
At Madrone Road	7,900	12,200	13,100	16,800
At Harney Road	7,770	12,000	12,800	16,400
At Cross Section BY	7,640	11,700	12,500	16,000
At Cross Section BZ	5,790	8,780	9,420	11,900
At Cross Section CG	5,500	8,320	8,950	11,300
At Cross Section CL	5,270	7,960	8,550	10,800
At Cross Section CN	4,260	6,400	6,890	8,620
At Cross Section CY	3,860	5,505	5,930	7,385
At Cross Section DD	3,295	4,910	5,300	6,575
At Cross Section DF	2,015	2,985	3,220	3,995
Spring Creek				
Upstream of confluence of Matanzas Creek	700	1,170	1,350	1,730
At Franquette Avenue	580	970	1,120	1,440
Upstream of Yulupa Avenue	400	660	770	990
Upstream of confluence of Sierra Creek	200	360	420	540
Downstream of Summerfield Road	120	200	230	300
Starr Creek				
Upstream of confluence with Windsor Creek	771	1,010	1,122	1,340
Upstream of confluence of Gumview Creek	494	650	717	870
At Windsor Road	236	310	341	415
Upstream of confluence of Wilson Creek	80	102	115135	
Thompson Creek				
At F Street Outfall	490	790	960	1,290
Above Kelly Creek	305	510	600	830
Washington Creek				
At Holly Band Lane	1,249	1,558	1,611	2,161

Source/Location	Discharge (cubic feet/second)			
	10 Percent Annual Chance	2 Percent Annual Chance	1 Percent Annual Chance	0.2 Percent Annual Chance
Downstream of Maria Drive	682	941	984	1,110
Wiggins Creek				
Upstream of confluence with Marin Creek	1,073	1,405	1,559	1,910
Upstream of confluence of Kizer Creek	768	1,010	1,108	1,385
Upstream of confluence of McBrown Creek	508	660	730	875
At King Road	438	570	627	755
Willow Brook				
At Ely Road	5,749	8,291	9,372	11,656
Upstream of confluence of Lichau Creek	5,691	8,230	9,292	11,541
Wilson Creek				
Upstream of confluence with Marin Creek	413	537	596	715
At Petaluma Valley Ford Road	365	470	525	630
Upstream of confluence of Stark Creek	205	270	295	355
Windsor Creek				
Upstream of confluence with Mark West Creek	5,148	6,860	7,571	9,290
Upstream of confluence of Airport Creek	4,377	5,896	6,436	7,942
Upstream of confluence of Pool Creek	2,472	3,280	3,632	4,497
Upstream of confluence of Starr Creek	1,854	2,461	2,723	3,346
Upstream of confluence of East Windsor Creek	964	1,293	1,415	1,747
At Brooks Road	850	1,120	1,240	1,530
Woolsey Creek				
Upstream of confluence with Mark West Creek	210	290	319	405

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix F. FEMA Approval and Planning Partner Adoption Resolutions

F. FEMA Approval and Planning Partner Adoption Resolutions

U.S. Department of Homeland Security
FEMA Region 9
1111 Broadway, Suite 1200
Oakland, CA 94607

FEMA

December 14, 2021

Lisa Hulette
Grants Manager
Permit Sonoma
2550 Ventura Ave.
Santa Rosa, CA 95403

Dear Ms. Hulette:

The Federal Emergency Management Agency (FEMA) received documentation from Sonoma County, the City of Santa Rosa, and the Sonoma Resource Conservation District, confirming their adoption of the *Sonoma County Multi-jurisdictional Hazard Mitigation Plan Update 2021.* These jurisdictions are in conformance with the Code of Federal Regulations, Title 44, Part 201, Section 6 (44 C.F.R. 201.6). An updated list of the status of participating jurisdictions is enclosed with this letter.

The adoption of this plan ensures Sonoma County, the City of Santa Rosa, and the Sonoma Resource Conservation District's continued eligibility for funding under FEMA's Hazard Mitigation Assistance programs, including the Hazard Mitigation Grant Program (HMGP), and the Building Resilient Infrastructure and Communities program (BRIC). All requests for funding are evaluated individually according to eligibility and other program requirements.

The *Sonoma County Multi-jurisdictional Hazard Mitigation Plan Update 2021* is valid for five years from the plan's original approval date, **October 13, 2021** for all approved participants. Prior to **October 13, 2026**, all participating jurisdictions must review, revise, and submit their plan to FEMA for approval to maintain eligibility for grant funding.

If you have any questions regarding the planning or review processes, please contact the FEMA Region 9 Hazard Mitigation Planning Team at fema-r9-mitigation-planning@fema.dhs.gov.

Sincerely,

MARK L SHUGART

Digitally signed by MARK L SHUGART
Date: 2021.12.14 08:13:47 -08'00'

for Alison Kearns
Risk Analysis Branch Chief
Mitigation Division
FEMA Region 9

Enclosure (1)
Status of Participating Jurisdictions, dated December 14, 2021

cc: Mark Shugart, Acting Risk Analysis Branch Chief, FEMA Region 9
Jennifer Hogan, State Hazard Mitigation Officer, California Governor's Office of Emergency Services
Victoria LaMar-Haas, Hazard Mitigation Planning Chief, California Governor's Office of Emergency Services

Status of Participating Jurisdictions as of December 14, 2021

Jurisdictions – Adopted and Approved

#	Jurisdiction	Date of Adoption
1	Cotati, City of	9/28/2021
2	Gold Ridge Resource Conservation District	10/21/2021
3	North Sonoma Coast Fire Protection District	8/18/2021
4	Northern Sonoma County Fire Protection District	8/19/2021
5	Sonoma Valley Fire District	9/28/2021
6	Timber Cove Fire Protection District	8/17/2021
7	Sonoma, City of	11/3/2021
8	Windsor, Town of	10/20/2021
9	Cloverdale Fire Protection District	11/10/2021
10	Rancho Adobe Fire Protection District	11/17/2021
11	Sonoma County	12/7/2021
12	Santa Rosa, City of	12/7/2021
13	Sonoma Resource Conservation District	8/26/2021

Jurisdictions – Approvable Pending Adoption

#	Jurisdiction

County of Sonoma

State of California

THE WITHIN INSTRUMENT IS A CORRECT COPY OF THE ORIGINAL ON FILE IN THIS OFFICE

ATTEST: December 7, 2021

SHERYL BRATTON, Clerk/Secretary

BY Noelle Francis

Date: December 7, 2021

Item Number: 20

Resolution Number: 21-0494

☐ 4/5 Vote Required

Resolution of the Board of Supervisors of the County Of Sonoma, State of California, Adopting the 2021 Sonoma County Multi-Jurisdictional Hazard Mitigation Plan and Finding the Plan Exempt from the California Environmental Quality Act

Whereas, Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

Whereas, Sonoma County is subject to various hazards including dam failure, drought, earthquake, flooding, landslide, sea level rise, severe weather, tsunami, and wildfire; and

Whereas, the County of Sonoma anticipates climate change will exacerbate the severity, frequency, and impacts of natural hazards; and

Whereas, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

Whereas, the County of Sonoma is committed to increasing the adaptive capacity and resiliency of the infrastructure, health, housing, economy, government services, education, environment, and land use systems in the County; and

Whereas, the federal Disaster Mitigation Act of 2000 requires all cities, counties, and special districts to have adopted a Hazard Mitigation Plan to receive pre-and post-disaster mitigation funding from the Federal Emergency Management Agency (FEMA); and

Whereas, the Disaster Mitigation Act made available mitigation grants to state and local governments; and

Whereas, an adopted multi-jurisdiction hazard plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post- disaster mitigation grant programs; and

Whereas, in accordance with FEMA requirements at 44 C.F.R. §201.6, the County of Sonoma formed a planning partnership with local governments and special districts to prepare the Sonoma County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), which analyzes the risk of natural hazards affecting the County and specifies potential mitigation measures to address or reduce risk that the County of Sonoma and planning partners may independently implement within the next five years if funding is secured; and

Whereas, the MJHMP partnership includes the County of Sonoma, the City of Santa Rosa, the City of Cotati, the Town of Windsor, the City of Sonoma, the Sonoma County Agricultural Preserve and Open Space District, Sonoma Resource Conservation District, Gold Ridge Resource Conservation District, Timber Cove Fire District, North Sonoma Coast Fire District, Cloverdale Fire District, Northern Sonoma County Fire District, Sonoma Valley Fire District, and Rancho Adobe Fire District; and

Whereas, the MJHMP partnership completed a coordinated planning process that engaged the public, assessed the risk and vulnerability to the impacts of natural hazards, developed a mitigation strategy consistent with a set of uniform goals and objectives, and created a plan for implementing, evaluating, and revising the strategy; and

Whereas, the County of Sonoma fully participated in the FEMA-prescribed mitigation planning process to prepare the MJHMP; and

Whereas, residents of the County of Sonoma were awarded opportunities to comment and provide input on the MJHMP and the actions in the plan; and

Whereas, the MJHMP partnership invited public comment and conducted numerous steering committee meetings and virtual public meetings to obtain countywide input, and presented the MJHMP to the Sonoma County Planning Agency on July 29, 2021; and

Whereas, the MJHMP serves as a source of critical data that will inform the County's upcoming updates to the General Plan Public Safety and Housing Elements, which processes are underway; and

Whereas, the MJHMP is comprised of two volumes: Volume 1 (Area-Wide Elements), and Volume 2 (Planning Partner Annexes); and

Whereas, Sonoma County has reviewed the MJHMP and affirms that its actions will reduce the potential for harm to people and property from future hazard occurrences within our community; and

Whereas, the MJHMP has been reviewed by the California Office of Emergency Services (CalOES) and the Federal Emergency Management Agency (FEMA), and has been determined to be eligible for final approval pending its adoption by the Sonoma County Board of Supervisors; and

Whereas, the County of Sonoma, as a fully participating jurisdiction of the MJHMP, is an eligible sub-applicant to the State of California under FEMA's hazard mitigation grant program guidance; and

Whereas, adoption by the Board of Supervisors demonstrates the jurisdiction's commitment to fulfilling the mitigation goals and objectives outlined in the MJHMP as funding allows; and

Whereas, adoption of the MJHMP helps to coordinate regional agencies to carry out their independent responsibilities as funding allows and as outlined in the plan.

Now, Therefore, Be It Resolved that the Board of Supervisors finds this action exempt from the California Environmental Quality Act (CEQA) pursuant to CEQA Guidelines Section 15262 (feasibility and planning studies) and Section 15061(b)(3) (common sense exemption).

Be It Further Resolved that based on the foregoing findings, the Board of Supervisors hereby adopts the Sonoma County Multi-Jurisdictional Hazard Mitigation Plan, consisting of Volume 1 in its entirety and the following parts of Volume 2: (1) Introduction; (2) Part 1, the Sonoma County annex; and (3) appendices.

Be It Further Resolved that the Board of Supervisors designates the adopted Sonoma County Multi-Jurisdictional Hazard Mitigation Plan as the Sonoma County Hazard Mitigation Plan that is incorporated by reference into the Public Safety Element of the General Plan.

Be It Further Resolved that the Board of Supervisors resolves to integrate the Sonoma County Multi-Jurisdictional Hazard Mitigation Plan by reference into the upcoming update to the Public Safety Element of the General Plan in accordance with the requirements of Government Code sections 65302, 65302.6, and 8685.9.

Be It Further Resolved that the Board of Supervisors directs County staff to:

1. Use the Plan to guide pre- and post-disaster hazard mitigation;
2. Pursue implementation of the identified mitigation actions subject to the

limitations of available of funding and staff;

3. Coordinate the strategies in the plan with other planning programs and mechanisms under its jurisdictional authority;
4. Continue support of ongoing countywide mitigation efforts;
5. Continue to participate in the regional planning partnership as described by the MJHMP.

Be It Further Resolved that the Board of Supervisors authorizes the Director of the Sonoma County Permit and Resource Management Department, or his designee, to submit an approved and signed copy of this resolution to the Cal OES and FEMA officials to enable the MJHMP's final approval.

Supervisors:

Gorin: Aye Rabbitt: Aye Coursey: Aye Gore: Aye Hopkins: Aye

Ayes: 5 Noes: 0 Absent: 0 Abstain: 0

So Ordered.

RESOLUTION NO. 2021 - 53
A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF COTATI AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY MULTI-JURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, the Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a Multijurisdictional Hazard Mitigation Plan (MJHMP) for implementing, evaluating, and revising this strategy; and

WHEREAS, the action of adopting the MJHMP does not constitute a project as defined by California Environmental Quality Act Guidelines Section 15378; therefore, no further environmental review is required.

NOW, THEREFORE, BE IT RESOLVED that the City of Cotati:

1.) Adopts the following portions of the Sonoma County MJHMP:
   a. In its entirety, Volume I; and
   b. The City of Cotati annex within Volume II; and
   c. The appendices of Volume II.

2.) Will use the adopted and approved portions of the MJHMP to guide pre- and post-disaster mitigation of the hazards identified.

3.) Will coordinate the strategies identified in the MJHMP with other planning programs and mechanisms under its jurisdictional authority.

4.) Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the MJHMP.

5.) Will help to promote and support the mitigation successes of all Planning Partners.

IT IS HEREBY CERTIFIED that the foregoing resolution was duly adopted at a regular meeting of the City Council of the City of Cotati held on the September 28th, 2021, by the following vote, to wit:

RESULT: **ADOPTED [UNANIMOUS]**
MOVER: Susan Harvey, Councilmember
SECONDER: Mark Landman, Vice Mayor
AYES: Moore, Landman, Harvey, Sparks, Ford

Approved: John C Moore
Mayor

Attest: ____________________
Lauren Berges, City Clerk

Approved as to form:

____
City Attorney

RESOLUTION NO. RES-2021-220

RESOLUTION OF THE COUNCIL OF THE CITY OF SANTA ROSA TO (1) ADOPT VOLUME 1 OF THE SONOMA COUNTY MULTIJURISDICTIONAL HAZARD MITIGATION PLAN, DATED OCTOBER 2021, AND (2) UPDATE THE LOCAL HAZARD MITIGATION PLAN BY ADOPTING THE CITY OF SANTA ROSA ANNEX TO VOLUME 2 OF THE SONOMA COUNTY MULTIJURISDICTIONAL HAZARD MITIGATION PLAN, DATED OCTOBER 2021, AND THE APPENDICES TO VOLUME 2 OF THE SONOMA COUNTY MULTIJURISDICTIONAL HAZARD MITIGATION PLAN, DATED OCTOBER 2021

WHEREAS, the City of Santa Rosa recognizes the threat that natural hazards pose to people and property within Santa Rosa; and

WHEREAS, the City recognizes that proactive mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to people and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, on March 13, 2012, the Council adopted the City's first Local Hazard Mitigation Plan as an Annex to the Association of Bay Area Governments' (ABAG) Hazard Mitigation Plan, meaning that it tiered off the ABAG Hazard Mitigation Plan; and

WHEREAS, on January 10, 2017, the Council adopted the current City of Santa Rosa Local Hazard Mitigation Plan in compliance with the California Department of Emergency Services (Cal OES) and the Federal Emergency Management Agency (FEMA) 5-year update requirement; and

WHEREAS, on August 22, 2018, City Manager Sean McGlynn signed a Letter of Commitment to the State Hazard Mitigation Officer to be a participating jurisdiction in the Sonoma County Multijurisdictional Hazard Mitigation Planning project which would also serve as a five-year update to the City of Santa Rosa Santa Rosa Local Hazard Mitigation Plan; and

WHEREAS, in 2019, Permit Sonoma, the County of Sonoma's land use planning and permitting department, applied for and received a FEMA Hazard Mitigation Assistance grant for the preparation of a Multijurisdictional Hazard Mitigation Plan (MJHMP); the grant covers 75 percent of the cost of developing the plan, with participating planning partners covering the remaining 25 percent through in-kind matching, such as staff time; and

WHEREAS, City staff, along with a coalition of Sonoma County stakeholders was formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, on July 13, 2021, the MJHMP draft was released for public review; and

WHEREAS, on July 21, 2021, a virtual public workshop was held to provide an overview of the plan and solicit feedback; and

WHEREAS, the MJHMP stakeholders completed a planning process that engaged the public, assessed the risk and vulnerability to the impacts of natural hazards, developed a mitigation strategy consistent with a set of uniform goals and objectives, and created a plan for implementing, evaluating, and revising this strategy; and

WHEREAS, the MJHMP identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in Santa Rosa and Countywide from the impacts of future natural hazards and disasters; and

WHEREAS, on August 6, 2021, the Draft MJHMP was submitted to Cal OES and FEMA for review; and

WHEREAS, on September 2, 2021, the MJHMP stakeholders received feedback from Cal OES and FEMA which resulted in minor edits to the MJHMP and a resubmittal of the documents to Cal OES and FEMA for approval; and

WHEREAS, on September 27, 2021, Cal OES and FEMA approved the MJHMP pending adoption by the City Council; and

WHEREAS, after adoption by the City Council, the MJHMP will be resubmitted to Cal OES and FEMA for final approval and adoption and will be incorporated into the City's General Plan update process (Santa Rosa Forward); and

WHEREAS, adoption of the City of Santa Rosa Annex and Appendices included within Volume 2 of the MJHMP, dated October 2021, will serve as an update to the existing LHMP; and

WHEREAS, adoption by the City Council demonstrates the City's commitment to hazard mitigation and achieving the goals outlined in the MJHMP, increasing the resiliency of the infrastructure, health, housing, economy, government services, education, and land use systems within the City, in collaboration with surrounding jurisdictions.

NOW, THEREFORE, BE IT RESOLVED that based on the following findings and determinations and the record of these proceedings the Council of the City of Santa Rosa (1) adopts Volume 1 of the MJHMP and (2) updates the City of Santa Rosa LHMP by adopting the City of Santa Rosa Annex to Volume 2 of the MJHMP dated October 2021, and the Appendices to Volume 2 of the MJHMP dated October 2021, and directs their implementation.

BE IT FURTHER RESOLVED that the Council of the City of Santa Rosa finds the following:

A. Adoption of the MJHMP and updating the LHMP are activities consistent with the goals and policies of the Santa Rosa General Plan, and all Specific Plans in that the MJHMP and updated LHMP provide updated data and mitigation strategies to address risk related to natural hazards; and

B. Adoption of the MJHMP and updating the LHMP would not be detrimental to the public interest, health, safety, convenience, or welfare of the City in that these plans strive to improve and enhance public readiness for disaster and provide mitigation strategies; and

C. The adoption of Volume 1 of the MJHMP dated October 2021, and updating the LHMP by adoption of the City of Santa Rosa Annex to Volume 2 of the MJHMP, dated October 2021, and the Appendices to Volume 2 of the MJHMP, dated October 2021, has been reviewed in accordance with the California Environmental Quality Act (CEQA) and is exempt from CEQA because it is not a "project" pursuant to CEQA Guidelines section 15378 (b) in that it does not involve any commitment to any specific project which may result in a potentially significant physical impact on the environment. In addition, or in the alternative, adoption of the MJHMP and LHMP is exempt from CEQA pursuant to CEQA Guidelines, Section 15061(b)3, in that it can be seen with certainty that there is no possibility that the activities in question may have a significant effect on the environment and therefore are not subject to CEQA.

The MJHMP and LHMP are consistent with the City of Santa Rosa General Plan, involve feasibility and planning studies, consist of data collection and research, and do not have the potential for causing a significant effect on the environment. Any future projects arising from mitigation activities included in the MJHMP or updated LHMP will undergo additional CEQA review.

BE IT FURTHER RESOLVED that the Council further directs that:

1. Staff will incorporate the adopted MJHMP and updated LHMP into the City's General Plan Update process (Santa Rosa Forward) consistent with state law and will file necessary documentation with the California Governor's Office of Emergency Services to confirm incorporation of the 2021 MJHMP and updated LHMP into the General Plan to maintain eligibility for State and Federal funding; and
2. City departments identified within the MJHMP and LHMP shall collaborate with other Sonoma County jurisdictions to pursue implementation of the mitigation actions subject to the limitations of available funding and resources and shall seek additional outside sources of funding where feasible.

///

///

///

3. Staff will provide an annual report summarizing implementation of the plans as part of the General Plan Annual Report prepared by Planning and Economic Development.

IN COUNCIL DULY PASSED this 7th day of December, 2021.

AYES: (6) Mayor C. Rogers, Vice Mayor Alvarez, Council Members Fleming N. Rogers, Schwedhelm, Tibbetts

NOES: (0)

ABSENT: (1) Council Member Sawyer

ABSTAIN: (0)

ATTEST: Stephanie A. Williams
City Clerk

APPROVED: Chris Rogers (Dec 13, 2021 11:59 PST)
Mayor

APPROVED AS TO FORM: Sue Gallagher
City Attorney

City of Sonoma

RESOLUTION # 70-2021

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SONOMA ADOPTING VOLUME 1, VOLUME 2 - SECTION 4 (THE CITY OF SONOMA ANNEX), AND THE APPENDICES OF VOLUME 2 OF THE SONOMA COUNTY MULTIJURISDICTIONAL HAZARD MITIGATION PLAN UPDATE 2021

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the economy within the County; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster local hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, in June of 2020, the City Council adopted Resolution # 36-2020 authorizing the City Manager to formally withdraw from a Federal Emergency Management Agency (FEMA) Local Hazard Mitigation Grant and to commit to participation in the Sonoma County Multi-Jurisdictional Hazard Mitigation Planning Process; and

WHEREAS, a coalition of County partners has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy; and

WHEREAS, the City of Sonoma participated in the FEMA-prescribed mitigation planning process to prepare this hazard mitigation plan; and

WHEREAS, the California Office of Emergency Services and Federal Emergency Management Agency have reviewed the Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update 2021 and approved it contingent upon official adoption of the plan by all participating governing jurisdictions; and

WHEREAS, the City of Sonoma desires to comply with the requirements of the Disaster Mitigation Act and to augment its emergency planning efforts by formally adopting the Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update 2021; and

WHEREAS, the proposed hazard mitigation plan being considered is either: not a project subject to the requirements of the California Environmental Quality Act (CEQA) as continuing administrative or maintenance activity, such as general policy and procedure making, or governmental administrative activity, that will not result in direct or indirect physical changes in the environment in accordance with Section 15378(b); and/or exempt from the common sense exemption that CEQA applies only to projects which have the potential for causing a significant effect on the environment, and it can be seen with certainty that there is no possibility that the current activity may affect the environment, in accordance with Section 15061(b)(3) (Common Sense Exemption); and/or categorically exempt from CEQA in accordance with Section 15306 as basic data collection, research, resource evaluation activities or studies that do not result in a disturbance to an environmental resource.

WHEREAS, City Council adoption of a current Hazard Mitigation Plan will make the City of Sonoma eligible to receive earmarked mitigation grant funding as well as eligible to apply for additional federal mitigation grants; and

WHEREAS, adoption by the City Council of the City of Sonoma, demonstrates the jurisdiction's commitment to fulfilling the mitigation goals and objectives outlined in Section 4 of Volume 2 of the Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Update 2021; and

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Sonoma:

1.) Adopts Volume 1, Volume 2 - Section 4 (the City of Sonoma annex), and the appendices of Volume 2 of the Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021 (Exhibit A).

2.) Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

3.) Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

4.) Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

5.) Will help to promote and support the mitigation successes of all planning partners.

PASSED AND ADOPTED at a regular meeting of the City Council on November 3, 2021, by the following vote:

AYES: ***BARNETT, DING, FELDER, AGRIMONTI***
NOES:
ABSTAIN:
ABSENT:

Madolyn Agrimonti

Madolyn Agrimonti, Mayor

ATTEST:

Rebekah Barr, MMC, City Clerk

RESOLUTION NO. 3707-21

A RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF WINDSOR ADOPTING SONOMA COUNTY MUTLI-JURISDICTIONAL HAZARD MITIGATION PLAN VOLUME 1, THE WINDSOR ANNEX, AND APPENDICES OF VOLUME II

WHEREAS, the Disaster Mitigation Act of 2000 requires state and local governments to develop and adopt a Local Hazard Mitigation Plan (LHMP) in order to be eligible to receive federal grants pertaining to disaster preparedness; and

WHEREAS, on September 21, 2011, the Town Council adopted the Plan "Taming Natural Disasters" as the Town of Windsor Annex to the 2010 Association of Bay Area Governments Local Hazard Mitigation Plan; and

WHEREAS, on February 21, 2018, the Town Council adopted the current Local Hazard Mitigation Plan, which is a 5-year plan; and

WHEREAS, in April 2018, the Town Council adopted the 2040 General Plan which calls for the Town to prepare and maintain the LHMP and supports the implementation of the Local Hazard Mitigation Plan actions; and

WHEREAS, in 2019 Permit Sonoma, the County of Sonoma's land use planning and permitting department, applied for and the County of Sonoma received a FEMA Hazard Mitigation Assistance grant for the preparation of a Multi-Jurisdictional Hazard Mitigation Plan ("MJHMP"), which includes a Windsor Annex that is specific to the hazards facing the Town of Windsor; and

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, recognizing the benefits of a multi-jurisdictional approach to hazard mitigation, which include: the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities; creating opportunities for coordination and collaboration; and the ability to create stronger grant applications by joining with other agencies in applying for grants. The Town Council chose to participate in the MJHMP; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy;

WHEREAS, on June 16, 2021, the Town Council reviewed the draft Windsor Annex and authorized submittal of the Windsor Annex to the California Office of Emergency Services (Cal OES) and the Federal Management Agency (FEMA) for review and approval; and

WHEREAS, the draft MJHMP and Windsor Annex were available for public review and comment from July 14 through July 30, 2021 and a community webinar was held on July 21, 2021; and

WHEREAS, the draft MJHMP and Windsor Annex were revised as necessary based on public comment and submitted to Cal OES and FEMA for review and approval; and

WHEREAS, on September 27, 2021, FEMA approved the MJHMP, including the Windsor Annex, pending Town Council adoption of a resolution adopting MJHMP Volume 1 and the Windsor Annex at a public hearing; and

WHEREAS, on October 20, 2021, the Town Council held a duly noticed public hearing for consideration of the adoption of the MJHMP and Windsor Annex, which was publicly noticed in compliance with State law and the Town Council public notice policy; and

WHEREAS, the MJHMP and Windsor Annex has been determined to be exempt from CEQA, pursuant to CEQA Guidelines Section 15306: Information Collection; and

WHEREAS, the Town Council authorizes Town staff to make minor typographical and editorial changes to the MJHMP, consistent with this resolution.

NOW, THEREFORE BE IT RESOLVED that the Town Council of the Town of Windsor:

1. Adopts in its entirety, Volume I, the Windsor Annex included in Volume II, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan, attached hereto as exhibits A, and B, respectively.

2. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

3. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

4. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

5. Will help to promote and support the mitigation successes of all Planning Partners.

PASSED, APPROVED AND ADOPTED this 20th day of October 2021, by the following vote:

AYES:	**COUNCILMEMBERS FUDGE, LEMUS, VICE MAYOR REYNOZA AND MAYOR SALMON**
NOES:	**NONE**
ABSTAIN:	**NONE**
ABSENT:	**NONE**

SAM SALMON, MAYOR

ATTEST:

IRENE CAMACHO-WERBY, TOWN CLERK

Attachments:

- **Exhibit A** - Windsor Annex
- **Exhibit B** - Sonoma County Multi-Jurisdictional Hazard Mitigation Plan Volume II Appendices

RESOLUTION NO. 07-22
A RESOLUTION OF THE BOARD OF DIRECTORS OF THE CLOVERDALE FIRE PROTECTION DISTRICT AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Cloverdale Fire Protection District;

1.) Adopts in its entirety, Volume I, the Cloverdale Fire Protection District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

2.) Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

3.) Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

4.) Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

5.) Will help to promote and support the mitigation successes of all Planning Partners.

PASSED AND ADOPTED on this 10th day of November, 2021 by the following vote:

AYES: 4 NOES: 0
ABSENT: Southard ABSTAIN: 0

L E Pigoni
Board President, Cloverdale Fire Protection District

ATTEST: Michelle Black
Clerk of the Board

RESOLUTION NO. 21-14
A RESOLUTION OF NORTH SONOMA COAST FIRE PROTECTION DISTRICT
AUTHORIZING THE ADOPTION OF THE
SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the North Sonoma Coast Fire Protection District:

1. Adopts in its entirety, Volume I, the North Sonoma Coast Fire Protection District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

2. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

3. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

4. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

5. Will help to promote and support the mitigation successes of all Planning Partners.

PASSED AND ADOPTED on this 18th of August, 2021, by the following vote:

AYES: NOES: ABSENT: ABSTAIN:

Jackie Gardener
Chair, Board of Directors
North Sonoma Coast Fire Protection District

ATTEST: Inda [signature]
Secretary, Board of Directors
North Sonoma Coast Fire Protection District

RESOLUTION NO. 21/22-0819-01
A RESOLUTION OF NORTHERN SONOMA COUNTY FIRE PROTECTION DISTRICT AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Northern Sonoma County Fire Protection District:

1. Adopts in its entirety, Volume I, the Northern Sonoma County Fire Protection District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

1. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

2. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

3. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

4. Will help to promote and support the mitigation successes of all Planning Partners.

PASSED AND ADOPTED on this 19th day of August, 2021 by the following vote:

AYES: 5 - PETERSON, NEWMAN, OKAYA, BERNIER, STEWART
NOES: Ø
ABSENT: Ø
ABSTAIN: Ø

Paul J. Bernier

President, Board of Directors
Northern Sonoma County Fire Protection District

ATTEST: Anneke Turbeville

Anneke Turbeville
Clerk of the Board

A RESOLUTION OF RANCHO ADOBE FIRE PROTECTION DISTRICT AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY LOCAL MULTIJURISDICTIONAL HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements forpre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed topool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk andvulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Rancho Adobe Fire Protection District,

1. Adopts in its entirety, Volume I, the Rancho Adobe Fire Protection District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

1. Will use the adopted and approved portions of the Hazard Mitigation Plan to guidepre- and post-disaster mitigation of the hazards identified.

2. Will coordinate the strategies identified in the Hazard Mitigation Plan with otherplanning programs and mechanisms under its jurisdictional authority.

3. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

4. Will help to promote and support the mitigation successes of all Planning Partners.

The foregoing resolution was introduced by Director Gadoua who moved its adoption, and seconded by Director Peterson, and adopted on a roll call vote by the following vote:

Director Herman aye Director Grube absent Director Hemmendinger aye Director Cozad aye
Director Peterson aye Director Proteau aye Director Gadoua aye

AYES: 6 NOES: 0 ABSTAIN: 0 ABSENT: 1

WHEREUPON, the Chair declared the foregoing resolution adopted, and SO ORDERED.

CHAIR

Attest: Jenn C Bechtold
Clerk of the Board

Resolution No: 2021/2022-05
Dated: September 28, 2021

RESOLUTION OF THE BOARD OF DIRECTORS OF THE SONOMA VALLEY FIRE DISTRICT, SONOMA, COUNTY, STATE OF CALIFORNIA, AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN.

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Sonoma Valley Fire District

1. Adopts in its entirety, Volume I, the Sonoma Valley Fire District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

1. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

2. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

3. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

4. Will help to promote and support the mitigation successes of all Planning Partners.

IN REGULAR SESSION, the foregoing resolution was introduced by Director _Johnson__________, who moved its adoption, seconded by Director ___Brady_________, and passed by the Board of Directors of the Sonoma Valley Fire District this 28th day of September 2021, on regular roll call vote of the members of said Board:

President Norton	Aye X	No	Absent
Vice President Atkinson	Aye X	No	Absent
Treasurer Johnson	Aye X	No	Absent
Director Brady	Aye X	No	Absent
Director Brunton	Aye X	No	Absent
Director Emery	Aye X	No	Absent
Director Leen	Aye	No	Absent X
Vote:	Aye 6	No	Absent 1

WHEREUPON, the President declared the foregoing resolution adopted, and

SO ORDERED:

William Norton, President

ATTEST:

Maci Jerry, Clerk

RESOLUTION NO. #02- 21/22

A RESOLUTION OF TIMBER COVE FIRE PROTECTION DISTRICT AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Timber Cove Fire Protection District:

1. Adopts in its entirety, Volume I, the Timber Cove Fire Protection District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

2. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

3. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

4. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

5. Will help to promote and support the mitigation successes of all Planning Partners.

PASSED AND ADOPTED on this August 17, 2021 by the following vote:

AYES: 3
NOES: 0
ABSENT: 0
ABSTAIN: 0

Kathleen Rasmussen

President, Board of Directors
Timber Cove Fire Protection District

ATTEST: C

RESOLUTION NO. 2021-08
A RESOLUTION OF THE GOLD RIDGE RESOURCE CONSERVATION DISTRICT
AUTHORIZING THE ADOPTION OF THE
SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Gold Ridge Resource Conservation District:

1. Adopts in its entirety, Volume I, the Gold Ridge Resource Conservation District annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

1. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post-disaster mitigation of the hazards identified.

2. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

3. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

4. Will help to promote and support the mitigation successes of all Planning Partners.

PASSED AND ADOPTED on this, October 21, 2021, by the following vote: 1st Ann Cassidy 2nd Richard Hughes

AYES: 4
NOES: Mel Sanchietti
ABSENT: 0
ABSTAIN: 0

Joseph W. Dutton
President, Board of Directors
Joseph Dutton

ATTEST: Ann Cassidy
Secretary, Board of Directors
Ann Cassidy

SONOMA
RESOURCE CONSERVATION DISTRICT

1221 Farmers Lane, Suite F
Santa Rosa, CA 95405

707.569.1448
SonomaRCD.org

RESOLUTION NO. 2122-003

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE SONOMA RESOURCE CONSERVATION DISTRICT AUTHORIZING THE ADOPTION OF THE SONOMA COUNTY LOCAL MULTIJURISDICTION HAZARD MITIGATION PLAN

WHEREAS, all of Sonoma County has exposure to natural hazards that increase the risk to life, property, environment, and the County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, The Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Sonoma County stakeholders with like planning objectives has been formed to pool resources and create consistent mitigation strategies to be implemented within each partners identified capabilities, within the Sonoma County Planning Area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating, and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the Sonoma Resource Conservation District (RCD):

1. Adopts in its entirety, Volume I, the Sonoma RCD annex, and appendices of Volume II of the Sonoma County Local Multijurisdictional Hazard Mitigation Plan.

1. Will use the adopted and approved portions of the Hazard Mitigation Plan to guide pre- and post- disaster mitigation of the hazards identified.

2. Will coordinate the strategies identified in the Hazard Mitigation Plan with other planning programs and mechanisms under its jurisdictional authority.

3. Will continue its support of the on-going countywide mitigation efforts and continue to participate in the Planning Partnership as described by the Hazard Mitigation Plan.

4. Will help to promote and support the mitigation successes of all Planning Partners.

PASSED AND ADOPTED on this August 26, 2021 by the following vote:

AYES: 5 NOES: 0 ABSENT: 1 ABSTAIN: 0

Bruce Abelli-Amen, Board Chair

Valerie Q

Attested by: Valerie Quinto, Executive Director

Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021

Appendix G. Progress Report Template

G. PROGRESS REPORT TEMPLATE

Reporting Period: *(Insert reporting period)*

Background: A planning partnership of Sonoma County and cities and special districts within the county developed a hazard mitigation plan to reduce risk from hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the planning partnership organized resources, assessed risks from hazards, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, the participating partners maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at: __[website address]__

Summary Overview of the Plan's Progress: The performance period for the hazard mitigation plan became effective on __[date]__, with the final approval of the plan by FEMA. The performance period for this plan will be 5 years, with an anticipated update to the plan to occur before __[date]__. As of this reporting period, the performance period for this plan is considered to be __% complete. The hazard mitigation plan has targeted __[number]__ hazard mitigation actions to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ actions (__%) reported ongoing action toward completion.
- __ out of __ actions (__%) were reported as being complete.
- __ out of __ actions (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the hazard mitigation plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the hazard mitigation plan dynamic and responsive to the needs and capabilities of the planning partners. This report discusses the following:

- Hazard events that have occurred within the last year
- Changes in risk exposure within the planning area
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement

The Plan Maintenance Oversight Committee: It was determined through the plan's development process that a designated committee would oversee maintenance of the plan. At a minimum, the plan maintenance oversight committee is to provide technical review and oversight on the development of the annual progress report. The committee reviewed and approved this progress report at its annual meeting held on __[date]__. For this reporting period, the plan maintenance oversight committee membership is as indicated in Table 1.

Table 1. Plan Maintenance Oversight Committee Members

Name	Title	Department/Agency

Hazard Events within the Planning Area: During the reporting period, there were __ hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ______________________________
- ______________________________

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or rating of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each action. Reviewers of this report should refer to the hazard mitigation plan for more detailed descriptions of each action and the prioritization process.

Table 2. Action Plan Matrix

Action Taken? (Yes or No)	Time Line	Priority	Status[a]	Status (X, O,✓)[b]
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	
			Action #: Action Title—Action Description	

a. Items addressed to determine action status:
Was any element of the action carried out during the reporting period?
If no action was completed, why?
Is the timeline for implementation for the action still appropriate?
If the action was completed, does it need to be changed or removed from the action plan?

b. Completion status legend:
✓ = Project Completed
O = Action ongoing toward completion
X = No progress at this time

New Actions to Include in the Plan: *(List any new actions added to the action plan; see Chapter 21 of the hazard mitigation plan for description of the information to be provided).*

Table 3. New Actions to Add to Action Plan

			Action #: Action Title—Action Description *Hazards Mitigated:*			
			Action #: Action Title—Action Description *Hazards Mitigated:*			
			Action #: Action Title—Action Description *Hazards Mitigated:*			
			Action #: Action Title—Action Description *Hazards Mitigated:*			
			Action #: Action Title—Action Description *Hazards Mitigated:*			

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory, and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the plan maintenance oversight committee, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the planning partner governing bodies and to local media outlets. The report is posted on the hazard mitigation plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here